ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 53 and 58

RIN 2060–AH09

[AD–FRL–5659–2]

Proposed Requirements for Designation of Reference and Equivalent Methods for $PM_{2.5}$ and Ambient Air Quality Surveillance for Particulate Matter

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: The EPA proposes to revise 40 CFR part 58 to establish ambient air quality monitoring requirements for $PM_{2.5}$ (particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers) as measured by a new reference method being proposed in Appendix L to 40 CFR part 50 or by an equivalent method designated in accordance with requirements being proposed in 40 CFR part 53. In addition, this document also proposes certain revisions to existing ambient air quality monitoring requirements for PM_{10} (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers). The changes proposed in this document address among other things, network design and siting, quality assurance and quality control, and monitoring methodology. The document also indicates EPA's intent to explore opportunities to coordinate and integrate the existing visibility monitoring requirements with the ambient air quality monitoring requirements for particulate matter being proposed today to accommodate a better regional haze program and to reduce burdens and achieve multiple monitoring objectives.

DATES: Comments must be submitted on or before February 18, 1997.

ADDRESSES: Comments should be submitted (in duplicate, if possible) to: Air Docket (LE–131), U.S. Environmental Protection Agency, Attn. Docket No. A–96–51, 401 M Street, SW, Washington, DC 20460. The docket may be inspected between 8:00 a.m. and 5:30 p.m. on weekdays. A reasonable fee may be charged for copying.

Public hearing: The EPA will announce in a separate Federal Register document the date, time, and address of the public hearing on this proposed decision.

FOR FURTHER INFORMATION CONTACT: Mr. Neil Frank (MD–14), Monitoring and Quality Assurance Group, Emissions, Monitoring, and Analysis Division, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone (919) 541–5560.

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I. Authority

Sections 110, 301(a), and 319 of the Clean Air Act as amended 42 U.S.C. 7410, 7601(a), 7619.

II. Introduction

A. Proposed Revision to the Particulate Matter NAAQS

Elsewhere in today's Federal Register, EPA announced proposed revisions to the national ambient air quality standards for particulate matter. In that notice, EPA proposes to amend the current suite of PM_{10} standards by adding new $PM_{2.5}$ standards and by revising the form of the current 24-hour PM_{10} standard. Specifically, the EPA proposes to add two new primary $PM_{2.5}$ standards set at 15 $\mu g/m^3$, annual mean, and 50 $\mu g/m^3$, 24-hour average. The proposed new annual $PM_{2.5}$ standard would be met when the 3-year average of the annual arithmetic mean $PM_{2.5}$ concentrations, spatially averaged across an area, is less than or equal to 15 $\mu g/m^3$. The proposed new 24-hour $PM_{2.5}$ standard would be met when the 3-year average of the 98th percentile of 24-hour $PM_{2.5}$ concentrations at each monitor within an area is less than or equal to 50.

The EPA also proposes to retain the current annual PM_{10} standard at the level of 50 $\mu g/m^3$, which would be met when the 3-year average of the annual arithmetic PM_{10} concentrations at each monitor within an area is less than or equal to 50 $\mu g/m^3$. Further, EPA proposes to retain the current 24-hour PM_{10} standard at the level of 150 $\mu g/m^3$, but to revise the form such that the standard would be met when the 3-year average of the 98th percentile of the monitored concentrations at the highest monitor in an area is less than or equal to 150 $\mu g/m^3$.

In the part 50 notice, EPA also proposed to revise the current secondary standards by making them identical to the suite of proposed primary standards. The suite of $PM_{2.5}$ and PM_{10} standards, in conjunction with the establishment of a regional haze program under section 169A of the Clean Air Act (Act), are intended to protect against PM-related welfare effects including soiling and materials damage and visibility impairment.

As discussed in the part 50 notice, the proposed new $PM_{2.5}$ standards are intended to protect against exposures to fine particulate pollution, while the new PM_{10} standards are intended to protect against coarse fraction particles as measured by PM_{10}.

For $PM_{2.5}$, the annual standard is intended to protect against both long- and short-term exposures to fine particle pollution. Under this approach, the $PM_{2.5}$ 24-hour standard would serve as a ''back stop'' to provide additional protection against days with high $PM_{2.5}$ concentrations, localized ''hot spots,'' and risks arising from seasonal emissions that would not be well controlled by a national annual standard.

In specifying that the calculation of the annual arithmetic mean for an area (for purposes of comparison to level of $PM_{2.5}$ annual standard) should be

accomplished by averaging the annual arithmetic means derived from multiple, population-oriented monitoring sites, EPA took into account several factors. As discussed in the part 50 notice, many of the community-based epidemiologic studies examined in this review used spatial averages, when multiple monitoring sites were available, to characterize area-wide PM exposure levels and associated public health risk. Even in those studies that used only one monitoring location, the selected site was chosen to represent community-wide exposures, not the highest value likely to be experienced within the community. Because the annual $PM_{2.5}$ standard would be intended to reduce aggregate population risk from both long- and short-term exposures by lowering the broad distribution of PM concentrations across the community, an annual standard based on spatially averaged concentrations from several population-oriented monitoring sites would better reflect areawide PM exposure levels and associated health risks than would a standard based on concentrations from a single monitor with the highest measured values in the area. The spatial average approach is not appropriate for PM_{10} because the spatial distribution of coarse particles is different and tends to be more localized in its behavior.

Finally, under the policy approach presented in the part 50 notice, the 24-hour $PM_{2.5}$ standard would be intended to supplement a spatially-averaged annual $PM_{2.5}$ standard by providing protection against peak 24-hour concentrations arising from situations that would not be well-controlled by an annual standard. Accordingly, the 24-hour $PM_{2.5}$ standard would be based on the single population-oriented monitoring site within a monitoring planning area with the highest measured values.

In EPA's judgment, an annual $PM_{2.5}$ standard expressed as a spatial average, established in conjunction with a 24-hour standard based on the monitoring site with the highest measured values, would provide the most appropriate target for reducing area-wide population exposure to fine particle pollution and would be most consistent with the underlying epidemiologic data base. On the other hand, EPA is mindful that adoption of spatial averaging for a $PM_{2.5}$ standard would add a degree of complexity to the monitoring siting requirements and to the specification of those areas across which spatial averaging should be permitted. This approach may also require larger monitoring networks in some areas. By proposing a spatial averaging approach, the part 50 notice recognizes that some monitoring planning areas may have to be subdivided into smaller subareas to reflect gradients in particle levels (e.g., upwind suburban sites, central city sites, downwind sites) as well as topographical barriers or other factors that may result in a monitoring planning area having several distinct air quality regimes.

Recognizing the complexities that spatial averaging may introduce into risk management programs and that unforeseen issues may arise from public comment on the requirements presented in this notice, the part 50 notice also requests comment on the alternative of basing the $PM_{2.5}$ annual standard on the population-oriented monitoring site within the monitoring planning area with the highest 3-year average annual mean. The part 50 notice indicates, based on comments received, that EPA may choose either of these two approaches for specifying the form of the annual $PM_{2.5}$ standard at the time of promulgation of any revisions to the PM standards.

In the part 50 notice, EPA also solicits comments on alternative levels of both annual and 24-hour $PM_{2.5}$ primary standards and on revoking the current 24-hour primary PM_{10} standard.

B. Air Quality Monitoring Requirements

Section 110(a)(2)(C) of the Act requires ambient air quality monitoring for purposes of the State implementation plans (SIP's) and for reporting data quality to EPA. Uniform criteria to be followed when measuring air quality and provisions for daily air pollution index reporting are required by section 319 of the Act. To satisfy these requirements, on May 10, 1979 (44 FR 27558), EPA established 40 CFR part 58 which provided detailed requirements for air quality monitoring, data reporting, and surveillance for all of the pollutants for which national ambient air quality standards have been established (criteria pollutants). Provisions were promulgated subsequently for particulate matter (PM_{10}) on July 1, 1987 (52 FR 24740).

The intent of the air quality surveillance requirement being proposed today is to establish a revised particulate matter monitoring network that would produce air quality data for the purpose of comparison to the proposed primary and secondary PM NAAQS and to facilitate implementation of a possible new regional haze program. In developing a new particulate matter monitoring network and associated requirements, consideration has been given to the indicators, forms, and levels of the proposed primary and secondary PM NAAQS. As a result, nationwide monitoring would be performed for two indicators of PM: $PM_{2.5}$ and PM_{10}. To be reflective of the basis for and the specification of the forms of the proposed new annual and 24-hour primary and secondary $PM_{2.5}$ NAAQS, new monitoring network design and siting requirements are being proposed. For purposes of comparison to the proposed $PM_{2.5}$ annual standard, such sites would be population-oriented and be representative of community-wide exposure levels. The siting criteria for monitors to be used for comparison to the proposed 24-hour $PM_{2.5}$ standard would also be population-oriented but reflective of the highest measured values within the community. To ensure PM data of the highest possible quality, new requirements for quality assurance and designation of new $PM_{2.5}$ reference or equivalent samplers are also described.

With respect to NAAQS comparisons and visibility protection in more rural areas, the new network design and siting requirements would encourage the placement of $PM_{2.5}$ monitors outside population centers with two purposes in mind: (1) To provide air quality data necessary to facilitate implementation of the proposed NAAQS, and (2) augmentation of the existing visibility fine particle monitoring network. The coordination of these two monitoring objectives would facilitate implementation of a regional haze program and lead to an integrated monitoring program for fine particles.

The network design and siting requirements for the annual and 24-hour PM_{10} NAAQS would continue to emphasize identification of locations at maximum concentrations. The PM_{10} network itself, however, would be revised because the proposed $PM_{2.5}$ standards would likely be the controlling standards in most situations.

The new network for PM_{10} would be derived from the existing network of State and Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS), and other monitors generically classified as Special Purpose Monitors (SPM's) which include industrial and special study monitors. Population-oriented NAMS will generally be maintained, other key sampling locations in existing nonattainment areas, and in areas whose concentrations are near the levels of the proposed PM_{10} NAAQS will be continued. Currently approved reference or equivalent PM_{10} samplers could continue to be utilized. The revised network would ensure that analysis of national trends in PM_{10} can

be continued, that air surveillance in areas with established PM emission control programs can be maintained, and that the PM_{10} NAAQS will not be jeopardized by additional growth in PM_{10} emissions. PM_{10} sites should be collocated with new $PM_{2.5}$ sites at key population-oriented monitoring stations so that better definition of fine and coarse contributions to PM_{10} can be determined to provide a better understanding of exposure, emission controls, and atmospheric processes. PM_{10} sites not needed for trends or for monitoring in areas with relatively high PM_{10} concentrations would likely be discontinued in a longer-term PM_{10} network. The sampling frequency at all PM_{10} sites would be reduced to a minimum of once in 6 days, which would be sufficient to make comparisons with proposed PM_{10} standards. The combination of fewer PM_{10} sites and the reduction in required sampling frequency would save significant resources that could be redirected to $PM_{2.5}$ monitoring.

The new network for $PM_{2.5}$ would consist of a ''core'' network of population-oriented SLAMS monitors, ''core'' regional background and regional transport SLAMS, a NAMS subset for long-term monitoring, other SLAMS monitors, and supplementary network of SPM's. The core population-oriented sites would be reflective of community-wide exposure and would be required in all of the largest metropolitan areas and must sample everyday. Frequent measurements are important to understand episodic behavior of $PM_{2.5}$, and to establish effective emission control strategies to assure protection of the NAAQS. Many of the new $PM_{2.5}$ sites are expected to be located at existing PM_{10} sites, and would be collocated with some PAMS sites.

Consistency with the proposed new $PM_{2.5}$ NAAQS necessitates the adoption of new concepts for identification and establishment of monitoring stations for the $PM_{2.5}$ ambient air monitoring network as well as use of the data in relation to the proposed $PM_{2.5}$ NAAQS. These concepts include: (1) The addition of specially coded sites whose data would be used to compare to the levels of the annual and 24-hour $PM_{2.5}$ NAAQS, and (2) the inclusion of monitoring planning areas and spatial averaging zones (SAZ) to correspond to the population-oriented, spatial averaging approach. These concepts and associated requirements are discussed in sections 58.15 and sections 2.8.1–2.8.3 of Appendix D below.

Although the major emphasis of the new PM networks is compliance monitoring in support of the NAAQS, the network is also intended to assist in reporting of data to the general public, especially during air pollution episodes and to assist in the SIP planning process. To these ends, additional monitoring and analysis requirements are proposed concerning the location of nephelometers (or other continuous particulate matter measuring devices) at some core monitoring sites and the archiving of filters for possible subsequent analysis for subsets of the $PM_{2.5}$ SLAMS sites. Moreover, collection of meteorological data at core SLAMS sites (including background and regional transport sites) are suggested. The additional requirements should help to further characterize the composition and trends in $PM_{2.5}$ and better understand the sources and processes leading to elevated $PM_{2.5}$ concentrations. Because these proposed revisions do not specifically require the chemical analysis of collected $PM_{2.5}$ or PM_{10} filters, the Administrator would welcome comments on this issue. In particular, comments are solicited on the need for alternative $PM_{2.5}$ monitoring methodologies and additional monitoring requirements which might accompany the part 51 implementation rules to identify the causes of detected $PM_{2.5}$ NAAQS violations and to assist in the development of $PM_{2.5}$ emission control strategies.

While the proposed siting criteria and network designs are appropriate for both the proposed revisions to the primary and secondary NAAQS as a whole, additional consideration must be given to air quality surveillance in more rural/remote areas to characterize fine particle levels in order to protect against broader regional scale visibility impairment. To achieve the appropriate level of air quality surveillance in such areas, EPA believes it is important to coordinate and integrate the background and transport monitoring sites specified in this notice with the existing Interagency Monitoring of Protected Visual Environments (IMPROVE) monitors that are in place in a number of locations around the country to characterize fine particle levels and visibility in mandatory Federal Class I areas (e.g., certain national parks and wilderness areas). The need for coordination and integration of visibility-oriented monitoring sites will increase when EPA proposes rules under section 169A of the Act to supplement the secondary NAAQS in addressing regional haze. More detailed guidance on monitoring and assessment requirements will be provided when those rules are proposed. This will include details on topics such as monitor placement, monitoring methodology, duration of sampling and frequency of sampling. It is anticipated, however, that the existing IMPROVE network, together with sites established under this proposal, would be an integral part of the network for determining reasonable progress under a regional haze program.

In the meantime, EPA recommends that States, in conjunction with EPA and Federal land managers, explore opportunities for expanding and managing $PM_{2.5}$ and visibility monitoring networks in most efficient and effective ways to meet the collective goals of these programs. To facilitate this, EPA has proposed changes in Appendix C below, to allow use of existing or new IMPROVE monitoring sites to meet the requirements for a transport and/or background site for the proposed $PM_{2.5}$ standards. States should consider the feasibility of siting new transport/background and/or visibility monitoring locations at or near mandatory Federal Class I areas currently without an IMPROVE site so that such sites could provide data to characterize both fine particle levels and visibility in or near Class I areas. It is EPA's intent that monitoring conducted for purposes of the PM primary and secondary NAAQS (including background and transport sites), and for visibility protection be undertaken as one coordinated national PM monitoring program, rather than as a number of independent networks.

It is recognized by EPA as well as many outside groups including the Clean Air Act Advisory Committee's Subcommittee on Ozone, Particulate Matter, Regional Haze Implementation Programs and the National Research Council in its 1993 report ''Protecting Visibility in National Parks and Wilderness Areas'' that chemical speciation of PM data would permit development of more effective control strategies to better target those sources of emissions that are causing or contributing to elevated levels of $PM_{2.5}$ and PM_{10}. Speciation of $PM_{2.5}$ data can also be used to develop reliable estimates of seasonal and annual average visibility conditions.

Because of the costs associated with conducting filter analysis on a routine basis, this proposal only requires filters to be archived so they are available for analysis on an as needed basis. The EPA requests comment, however, on the extent to which chemical speciation should be conducted. This would include: (1) Whether specific monitoring sites should be designated for such analyses; (2) the criteria to be

used to select sites for speciated sampling and analysis; (3) the extent and frequency to which speciation should be required by EPA for at least some monitoring stations and (4) the need for monitoring methodologies not described in this proposal which may be needed to facilitate compositional analysis. The EPA recognizes that there is a need for speciation and other specialized monitoring efforts which are not specifically required by this proposed rule. Accordingly, EPA will give these PM monitoring efforts high priority in its section 105 grants program. The Administrator solicits comment on the appropriate portion of the nation's monitoring resources which should be dedicated to speciation and collection of special study data relative to the siting and collection of mass measurements for purposes of comparisons to the NAAQS and visibility assessments at permanent and temporary monitoring stations. The estimated cost for the new PM monitoring program is discussed further in Section IV. R.

Finally, in anticipation of a new regional haze program and associated additional monitoring requirements, EPA also requests comment on ways that the future PM and IMPROVE networks can be coordinated to conserve resources and serve the goals of both the PM and regional haze implementation program.

This proposed rulemaking is taken in conjunction with the proposed revisions to the PM NAAQS published elsewhere in today's Federal Register and pertains to changes in the ambient air monitoring requirements for particulate matter contained primarily in 40 CFR part 58. A new Federal Reference Method for $PM_{2.5}$, and changes to the definition of PM_{10} measurements are proposed in a new Appendix L and revisions to Appendix J respectively in 40 CR part 50. The effective date of these proposed monitoring regulations would be 6 months after the actual promulgation date. The EPA is soliciting comment on all aspects of all of the proposed rules.

III. Proposed Revisions to Part 53

A. Designation of Reference Methods for $PM_{2.5}$

The specifications for reference methods for $PM_{2.5}$ are described in Appendix L to part 50, proposed elsewhere in this issue of the Federal Register. The performance-based specifications for the operational aspects of a reference method sampler allow various sampler manufacturers to design and fabricate different samplers that would meet the specifications. Accordingly, multiple $PM_{2.5}$ reference methods are expected to become available from several manufacturers, as is the case for reference methods for PM_{10} and most gaseous criteria pollutants. Similarly, each reference method for $PM_{2.5}$, based on a particular sampler, would be formally designated as such by the EPA under new provisions added to part 53.

These new provisions, primarily contained in a new subpart E, would require that the applicant submit information and documentation to demonstrate that a candidate reference method sampler meets the design specifications set forth in Appendix L of part 50. The provisions would also require that the applicant carry out specific tests to demonstrate that the sampler meets all performance specifications. The nature of these tests and the requirement that they be carried out by the applicant rather than the EPA is consistent with the current requirements in part 53 for designating reference methods for other criteria pollutants.

Since the critical inlet and particle size separation components of the sampler are specified by design, no wind tunnel or aerodynamic performance tests of these components would be required. But documentation would be required to demonstrate that samplers to be sold as reference methods would be manufactured under an effective quality control system, such as required in an International Organization for Standardization (ISO) [1] 9001-certified facility, or a quality control system otherwise certified to meet similar requirements. Specific tests would be required to verify that the critical $PM_{2.5}$ impact or jet diameter was within the design specifications, and that the surface finish of surfaces required to anodized meets the surface finish specifications. Also, a checklist certifying that reference method samplers are or will be manufactured under an acceptable quality assurance system would have to be completed by an ISO-certified or equivalent auditor and submitted initially and annually.

The performance tests for reference method samplers would focus on testing of the sampler's operational performance parameters, the accuracy of its measurement systems, its field precision, and various other sampler control functions. A comprehensive test procedure is proposed for testing a representative candidate sampler for correct flow rate, flow rate regulation, flow rate measurement accuracy, ambient air temperature and barometric pressure measurement accuracy, filter temperature control and measurement accuracy, and sampling time accuracy. This test procedure would require a temperature-controlled environmental test chamber, a technique to simulate reduced barometric pressure, and facilities to generate simulated solar radiation. Other specific tests are proposed to test the sampler's post-sampling filter temperature control, leak check procedure, flow rate cut off function, and field operational precision. It should be noted that work to test the feasibility of these proposed test procedures has not been completed at this time; therefore, some technical changes to the proposed test procedures may be necessary following the results of that work.

B. Designation of Equivalent Methods for $PM_{2.5}$

In keeping with the EPA's largely performance-based approach for specification of measurement methods for environmental pollutants, provision is also proposed for designating equivalent methods for $PM_{2.5}$. These provisions are contained in proposed additions to subparts A and C and proposed new subparts E and F of part 53. To minimize the number and extent of performance tests to which candidate equivalent methods would be subjected, three classes of equivalent method are proposed to be defined.

The first class (Class I) would include $PM_{2.5}$ methods based on samplers that are very similar to a reference method sampler as specified in appendix L to part 50. Class I would primarily include methods based on samplers whose primary difference from reference method samplers is one or more modifications necessary to provide capability for collection of several sequential samples automatically without intermediate operator service. Samplers capable of collecting multiple sequential samples are important because the sampling schedules proposed in § 58.13 of part 58 call for daily sampling for certain SLAMS. With such a requirement, there is an expected need for samplers that will permit the collection of the required daily samples without the need for an operator to visit the site on a daily basis or for installing multiple samplers at the site. (Since the samplers would need to sample from midnight to midnight, a minimum of two single day samplers would be

[1] The ISO certification ensures compliance to international manufacturing standards from the design and engineering specifications. An ISO certification, or its equivalence for the manufacturing of the reference samplers is consistent with National Technology Transfer and Advancement Act Section 12(d), 15 U.S.C. Section 272 (1996).

required for full daily sampling; however, as a practical matter, additional single day samplers would generally be needed at a daily monitoring site to cover weekends, holidays, and personnel and scheduling logistics.) A sampler capable of automatically collecting five sequential samples would permit twice-weekly servicing of a monitoring site (assuming sample filters can be retrieved and reloaded on the inactive channels without affecting the actively sampling channel).

Since the design of sequential samplers is not specified explicitly, sampler manufacturers would be able to design and develop their own techniques to provide for this capability. Where the sequential sample technique consists of relatively minor or simple modifications of the reference method sampler, the sampler would be classified as a Class I candidate equivalent method. (Sequential samplers would also be possible as Class II or III equivalent methods.)

Class I equivalent method sequential samplers would have to be tested to make sure that the modifications required to provide for sequential sampling do not significantly compromise sampler performance. However, because of their similarity to the reference method sampler, the only additional test requirement for most Class I candidate equivalent methods—in addition to the tests and performance requirements applicable to reference method samplers—would be a test for possible loss of PM in any new or modified components in the sampler inlet upstream of the sample filter. This additional test for Class I samplers is set forth in the proposed new Subpart E, along with the tests for reference method samplers.

Class II equivalent methods would include all other $PM_{2.5}$ methods that are based on a 24-hour integrated filter sample which is subjected to subsequent moisture equilibration and gravimetric mass analysis, but with an associated sampler having substantial deviations from the design or performance specifications for reference method samplers. These samplers may have a different inlet, a different particle size separator, a different volumetric flow rate, a different filter or filter face velocity, or other significant differences. More extensive performance testing would be required for designation of Class II candidate equivalent methods, with various tests required depending on the nature and extent of the differences between the candidate sampler and specified reference method samplers. These tests include a full wind tunnel evaluation, a wind tunnel inlet aspiration test, a static fractionator test, a fractionator loading test, and a volatility test. The tests and their specific applicability to various types of candidate Class II equivalent method samplers are set forth in proposed new subpart F.

Finally, Class III equivalent methods would include any candidate $PM_{2.5}$ methods that could not qualify as Class I or Class II. This class would include any filter-based integrated sampling method having other than a 24-hour $PM_{2.5}$ sample collection interval followed by moisture equilibration and gravimetric mass. More importantly, class III would also include filter-based continuous or semi-continuous methods, such as beta attenuation instruments, harmonic oscillating element instruments, and other complete *in situ* monitor types, as well as non-filter-based methods such as nephelometry or other optical instruments.

The testing requirements for designation of Class III candidate methods would be the most stringent, since quantitative comparability to the reference method would have to be shown under various potential particle size distributions and aerosol composition. However, because of the variety of measurement principles and types of methods possible for Class III candidate equivalent methods, the test requirements would have to be individually selected or specifically designed or adapted for each such type of method. Therefore, the EPA believes that it is not practical to attempt to develop and explicitly describe the test procedures and performance requirements for all of these potential Class III methods *a priori.* Rather, it is proposed that the test procedures and performance requirements applicable to specific Class III candidate methods would be determined by the EPA on a case-by-case basis upon request, in connection with each proposed or anticipated application for a Class III equivalent method determination. In this regard, the EPA is interested in receiving comments pertinent to the nature and extent of tests that would be appropriate and effectual in determining the performance of various types of Class III candidate equivalent methods relative to the performance of reference methods for $PM_{2.5}$.

All classes of candidate equivalent methods would have to be field-tested to determine their comparability to measurements obtained with collocated reference methods. For Classes I and II, these collocated field test requirements are specified explicitly in Subpart C, which is proposed to be revised to include the specific requirements for $PM_{2.5}$ candidate equivalent methods. The proposed requirements for $PM_{2.5}$ methods are generally patterned after the existing requirements for PM_{10} candidate methods.

However, because of the need for greater measurement precision for $PM_{2.5}$, the comparability specifications, summarized in Table C–4, are somewhat more stringent than those previously established for PM_{10}. Also, for Class II candidate equivalent methods—where two different test sites are required—more definitive specifications are proposed for the tests sites in terms of the $PM_{2.5}$ to PM_{10} measurement ratio for the test samples. This is necessary because experience with PM_{10} measurements has indicated that PM measurements made with dissimilar samplers are often considerably affected by differences in the ''character'' of the PM at different monitoring sites, as represented by differences in particle size distribution, composition, density, humidity, and other factors. For purposes of the comparability test, the character of the PM at each test site is represented by the measured $PM_{2.5}$ to PM_{10} ratio, which must be greater than 0.75 for one site and less than 0.40 at the other site. (More definitive tests of PM character at the test site are deemed too difficult or costly to carry out for purposes of the comparability test.) Insuring comparability to reference method measurements at sites having profoundly different character of PM is critically important for Class II (and Class III) candidate equivalent methods. Note, however, that the $PM_{2.5}$ to PM_{10} ratio requirement does not apply to testing of Class I candidate methods, where only one test site is required.

C. Quality Assurance

Accurate measurement of ambient particulate matter concentrations is severely hampered by the impracticality of providing PM concentration standards for field (or even laboratory) testing of ambient samplers or monitors. Therefore, it is necessary to rely on a specific, well-defined reference method, uniformity of reference method devices and procedures, and continual assessment of bias and operating precision. For the purposes of this regulation, $PM_{2.5}$ concentration measurements would be referenced to measurements made with a reference method sampler in accordance with the reference method as specified in Appendix L of part 50 of this chapter. Monitoring for $PM_{2.5}$ requires greater attention to achieving data of high quality, with minimal imprecision and

relative error. These higher quality monitoring data are essential to reduce the chance that $PM_{2.5}$ measurements would potentially cause unjustified health risk to the population, when measurements underestimate true concentrations, or unnecessary control requirements, when measurements overestimate the true concentrations.

To meet a data quality objective of ±15% precision for ambient $PM_{2.5}$ attainment measurements, enhanced quality assurance would be required in all areas relating to sampler performance including sampler manufacturing and sampler operation. This is especially important because a reference method sampler is proposed to be used to audit other field monitors, as described later.

Designated reference and equivalent method samplers and monitors would be required to be manufactured in a manufacturing facility that is either (1) an ISO 9001-registered manufacturing facility, with registration maintained continuously, or (2) a facility that can be demonstrated, on the basis of information submitted to the EPA, to be operated according to an EPA-approved and periodically audited quality system which meets, to the extent appropriate, the same general requirements as for an ISO-registered facility. (This requirement is referred to in this document as an ISO-registered facility, regardless of the procedure taken for EPA approval.)

In addition to the ISO registration (or equivalent) requirement, a quality assurance manufacturing checklist would have to be submitted annually attesting that the appropriate quality assurance procedures are routinely implemented in the manufacturing of samplers sold as reference or equivalent method samplers. This check list would have to be signed by an ISO-certified auditor or by an auditor who, based on information submitted to the EPA, meets the same general requirements as provided for ISO-certified auditors. (Similarly, an auditor approved by EPA through either mechanism is referred to in this document as an ISO-certified auditor.) This requirement allows for the demonstration of consistency in production and sustained uniformity in design and operation. Further, all testing related to an application for a reference or equivalent method determination under part 53 would have to be carried out in accordance with ISO 9001 and ANSI/ASQC E4 standards.

It is believed that these requirements are necessary to insure that all samplers or analyzers sold as reference or equivalent methods are manufactured to the high standard required to achieve the needed data quality. These procedures are in keeping with the developing international standards for manufacturing in this and other industries. However, comments on the appropriateness and impact of these proposed requirements are solicited. While these requirements are currently proposed to apply only to the manufacture of $PM_{2.5}$ monitors, extending these requirements to the manufacture of PM_{10} monitors and possibly other types of SLAMS monitors will likely be considered at a later time.

A new operational requirement would also have to be met by each $PM_{2.5}$ sampler or monitor to retain its designation as a reference or equivalent method. Each user agency operating a SLAMS site would be required to obtain at least 6 collocated measurements (audits) per year with a reference method ''audit'' sampler for each routinely operating $PM_{2.5}$ monitor. The data obtained from these collocated audits would be used to determine a national network integrated operating precision and relative accuracy performance indicator for each designated method. A $PM_{2.5}$ monitoring method that fails to meet the specified limits for this performance indicator would be subject to possible cancellation of its reference or equivalent method designation under the provisions of § 53.11. For more information on this provision, see section 6 of proposed revisions to Appendix A of part 58 and its associated preamble, set forth elsewhere in this Federal Register.

D. Other Changes

A number of other relatively minor technical changes are proposed to Appendix A, some of which affect designation of reference or equivalent methods for other criteria pollutants as well as for $PM_{2.5}$. These changes include new definitions and clarifications of existing definitions in § 53.1; clarifications of the reference and equivalent method designation requirements for methods for all pollutants, including the new classes of equivalent methods for $PM_{2.5}$ and a new table summarizing all the designation requirements; and updating of the name of the EPA laboratory to which applications are to be sent. Additional changes include proposed clarifications of the content of information required in submitted applications regarding the candidate method test data, manufacturing quality assurance system, and product warranty, and the content required in the operation or instruction manual associated with a candidate method sampler or analyzer.

Also, because of the increasing complexity of anticipated candidate methods for all criteria pollutants, an increase in the EPA's time limit for processing applications for reference and equivalent methods, from 75 to 120 days, is proposed. Finally, it is proposed (under § 53.4) that applicants for a $PM_{2.5}$ reference or equivalent method determination be required to provide a sampler or analyzer that is representative of the one associated with the candidate method for inspection and possible testing by the EPA in connection with processing of the application.

IV. Discussion of Proposed Revisions to Part 58

A. Section 58.1—Definitions

The revisions proposed today would revise the definition of the term traceable and add definitions of the terms Consolidated Metropolitan Statistical Area (CMSA), core SLAMS, equivalent methods, Metropolitan Statistical Area (MSA), monitoring planning area (MPA), monitoring plan, $PM_{2.5}$, Primary Metropolitan Statistical Area (PMSA), population-oriented, reference method, SAZ (SAZ), SPM fine monitors, and Annual State Monitoring Report.

B. Section 58.13—Operating Schedule

1. PM_{10} Sampling. The current operating schedule for PM_{10} is based primarily on an analysis of the ratio of measured PM_{10} concentrations to the controlling PM_{10} standard. Depending upon the ratio, the sampling frequency is either every day, every other day, or every sixth day. The proposed operating schedule would reduce the sampling frequency at all PM_{10} sites to once every sixth day.

The Administrator has proposed a new 24-hr PM_{10} standard based on the 98th percentile which offers a more stable statistical form. She has also solicited comment on the need to retain any 24-hour PM_{10} standard. Unlike the current 24-hr PM_{10} standard, the proposed standard, if adopted, would not place emphasis on the most extreme 24-hr concentrations, especially in areas influenced by fugitive dust. Furthermore, more emphasis for control requirements is anticipated to be placed on annual average concentrations and fewer nonattainment areas (i.e. violation areas) are expected to be based on peak daily concentrations. Consequently, 1 in 6 day sampling should be sufficient to support the new PM_{10} NAAQS and a less dense monitoring network would also be needed. Comments are solicited on the appropriate sampling schedules

for PM_{10} sites if the 24-hour NAAQS for PM_{10} is retained.

2. $PM_{2.5}$ Sampling. Core $PM_{2.5}$ SLAMS (including NAMS and Core SLAMS collocated at PAMS sites) would be required to sample every day, unless an exception is approved by EPA during established seasons of low PM pollution during which time a minimum of once in 6 days sampling would be permitted. Non-core SLAMS sites would generally be required to sample a minimum of once every sixth day, although episodic or seasonal sampling could also be possible (e.g., in areas where significant violations of the 24-hour NAAQS are expected or at sites heavily influenced by regional transport or episodic conditions). Special purpose monitors, however, may sample on any sampling schedule.

There is currently very little $PM_{2.5}$ measurement data. New networks must be established as expeditiously as possible to help characterize the nature and extent of $PM_{2.5}$ ambient air quality nationwide. Daily sampling for $PM_{2.5}$ is especially important during the first few years of the new $PM_{2.5}$ monitoring program to allow for the collection of complete sets of data in order to help with identifying temporal patterns and to understand the episodic behavior of fine particles.

Although daily sampling with manual methods is labor intensive due to site visits and filter equilibration and weighing, semi-automatic sequential samplers are anticipated to be approvable as class I equivalent samplers (under the provisions of Part 53) which will simplify the data collection process. The EPA solicits comments on the need to extend the start date for a requirement to perform everyday sampling until the time when Class I equivalent samplers have been approved by the Agency.

In addition, alternative $PM_{2.5}$ operating schedules which combine intermittent sampling with the use of acceptable continuous fine particle samplers are approvable at some core sites. This alternative is intended to give the States additional flexibility in designing their $PM_{2.5}$ monitoring networks and to permit data from continuous instruments to be telemetered. This would facilitate public reporting of fine particle concentrations, allow air pollution alerts to be issued and episodic controls to be implemented (as currently done in woodburning areas for PM_{10}). Furthermore, this would permit monitoring agencies to take advantage of new and improved monitoring technologies that should become available during the first few years following the promulgation. As proposed, applicability of the alternative depends on population size of the monitoring area and $PM_{2.5}$ air quality status.

After the initial 3 years of $PM_{2.5}$ data collection and after characterization of $PM_{2.5}$ levels, determination of violation areas and development of State Implementation Plans), reductions in the frequency of $PM_{2.5}$ sampling may be appropriate. The EPA welcomes comments on the need for continued long-term monitoring with reference or equivalent samplers on an every day schedule at some or all monitoring stations and on the appropriateness of the criteria for allowing alternative schedules.

C. Section 58.14—Special Purpose Monitors

Special purpose monitoring is needed to help identify potential problems, to help define boundaries of problem areas, to better define temporal (e.g., diurnal) patterns, to determine the spatial scale of high concentration areas, and to help characterize the chemical composition of PM (using alternative samplers and supplemental analyzers), especially on high concentration days or during special studies. Special purpose monitors are an important part of the overall PM monitoring program, and sufficient EPA and State resources must be allocated for their use.

Today's revisions propose that special purpose $PM_{2.5}$ and PM_{10} monitors may sample with any measurement method on any sampling schedule. However, the data from SPM's would not be used for attainment/nonattainment designations if the monitoring method is not a reference or equivalent method or does not meet the requirements of Section 2.4 of Appendix C of Part 58. Moreover, in order to encourage the deployment of SPM's, today's revisions propose that nonattainment designations will not be based on data produced at an SPM site with any monitoring method for a period of 3 years following the promulgation date of the NAAQS.

The rationale for this concept is based on the need for to encourage building from ''ground zero'' a monitoring infrastructure. Such an infrastructure is needed because of the complexity of the $PM_{2.5}$ problem and the relative paucity of $PM_{2.5}$ data to determine where problem areas lie, and the lack of information about sources and formation of aerosols in particular areas. The requirements for the NAMS, minimum core SLAMS, and minimum additional SLAMS sites, described in this notice, are designed to provide much of the information needed to merely define the location of problem areas.

There is a need, however, to look beyond this minimal network to create an ''optimal'' network that would gather air quality data over a wider geographic area. The optimal network would consist of SLAMS monitors in addition to the required minimums and also SPM's. There are several reasons for a moratorium on regulatory use of data from the during the first 3 years following promulgation of the NAAQS:

(1) SPM data have historically supplemented the SLAMS network to provide the States with a flexible monitoring program. Although the SPM monitoring does not have to use reference or equivalent monitors, the States tend to use these monitors for data collection. And although SPM data are not required to be submitted to EPA, the States tend to enter all such data into the AIRS data base. Because of the paucity of $PM_{2.5}$ data, we want to encourage both the collection—with reference or equivalent monitors—and the reporting of as much new $PM_{2.5}$ data as possible. This includes SPM data.

(2) There is a general reluctance among State and local governments and businesses to monitor ambient air quality beyond those minimum requirements contained in regulations promulgated by the Environmental Protection Agency (EPA) in the Code of Federal Regulations at Part 58. The reluctance is based in part on the fact that areas have historically been designated to nonattainment where monitoring shows violations of the NAAQS and then classified according to the seriousness of the air pollution problem. Currently, such a nonattainment designation and classification automatically trigger the State implementation attainment planning and demonstration requirements, potential stationary and mobile source emission controls, nonattainment new source review for sources wanting to locate or expand in the new nonattainment area, and possibly additional requirements relating to nonattainment of the NAAQS. Thus, to many affected parties, the current regulatory system results in a disincentive for detecting violations.

(3) The EPA is evaluating a concept involving the identification of areas that have measured or modeled violations and subsequent identification of other areas whose emissions contribute to those violations. The new required $PM_{2.5}$ monitoring network, however, may be insufficient to determine all such violation areas and contributing areas, and therefore additional monitors may be desirable. Ambient air

monitoring will play an important and expanded role in defining violating and contributing areas; with a moratorium on the regulatory use of SPM data, States and businesses would have an additional incentive to monitor for data to more accurately determine the extent of these areas.

(4) During the initial stages of development of a new $PM_{2.5}$ network, there is a greater need for experimental sampling—to move samplers around, to sample for short periods of time, and to utilize different methods. Incomplete data sets may not be fully representative of local air quality. For these and other similar reasons, there is a need for a pilot network that would not be subjected to the same rules as the full SLAMS network.

(5) Finally, collecting data at a number of sites beyond either the minimum or optimal number proposed in these regulations would support modeling studies to better define pollution problems, identification of potential pollution problems for enhanced air management programs, the design and implementation of episodic control plans to encourage quick response actions for voluntary emission reduction measures to lower pollution and thereby possibly avoiding nonattainment or ''bump-ups'', and to measure progress toward attainment by relating air quality to population.

The system of SPM's would at first not be part of the full required or even the ''optimal'' network. To provide the best kind of information, EPA believes that properly sited Federal Reference or Equivalent Methods be used for these SPM efforts in order to collect technically credible data. The EPA also believes that data from those efforts be reported to AIRS so that they are generally available to the public at large and to those who need them for understanding the nature of the problem and for developing solutions and control strategies.

In proposing a 3-year moratorium on the regulatory use of SPM data, EPA is trying to establish an incentive for States to engage in this additional SPM monitoring using properly sited Federal Reference or Equivalent Monitors. The data from these SPM's would supplement the data collected by SLAMS sites. Although the SPM data would be exempt from regulatory use during the 3-year moratorium, they would nevertheless be evaluated by the State during its annual SLAMS network review. A notice of NAAQS violations resulting from PM SPM''s should be reported to EPA, such high concentrations should be evaluated by the State in the design of its overall SLAMS network and considered by EPA in its review and approval of the State''s monitoring plan. Therefore, during the first 3 years, the SPM data would still play an important role in the regulatory process. After the proposed 3-year exemption period, SPM locations should be considered as potential SLAMS in the State's development and subsequent EPA reviewal process of their monitoring plan network, if the sites record high concentrations which indicate potential violations of the PM NAAQS (for either PM_{10} or $PM_{2.5}$) and have been operating for at least 6 months.

The EPA could have taken a different approach to this problem and not propose a moratorium on the regulatory use of data from the SPM sites. States would still be able to deploy SPM monitors in ways to avoid legal consequences if an exceedance of the NAAQS were found. For instance, any State may use non-reference or non-equivalent methods, which do not meet EPA specifications. Any State could site monitors so that they do not meet EPA siting criteria. Such monitoring would avoid the above-described legal entanglements associated with any NAAQS exceedances, because the data collected would not, under current EPA regulations, be valid for use in comparison to the NAAQS. Moreover, any State could simply not submit the SPM data to EPA.

The approach described in the above paragraph, however, does have major disadvantages. For instance, an approach that uses unacceptable monitors or siting would result in data that—even if close to being representative of the area or what a properly sited acceptable monitor would measure, would still be clouded with questions regarding its accuracy or precision, which would limit their value in the kinds of analyses mentioned above. In the case of data simply not submitted to EPA, data would not be available to either other States that would be working on development of a solution to the PM-fine problem, or, more important, to the public at large so that they could be aware if there really are problems detected by the monitor.

In light of these concerns, EPA's proposal is an attempt to take a more straightforward approach, which will encourage collection of additional data that is technically credible and publicly available, and therefore address the Act's mandate for EPA to take the lead in this matter, as found in section 103(c).

D. Section 58.15—$PM_{2.5}$ NAAQS Eligible Monitors

This new section is proposed to define the $PM_{2.5}$ monitors eligible for use in determining compliance with the $PM_{2.5}$ annual and 24-hour NAAQS. The EPA proposes that States identify on EPA's AIRS monitoring site file, all $PM_{2.5}$ sites eligible for both annual NAAQS comparisons and 24-hour comparisons and those only eligible for 24-hour (daily) comparisons. The former sites are intended to be population oriented spatial averaging sites and the latter are intended to represent population-oriented ''hot spot'' locations. The reasons for the different types of monitors are discussed in the preamble to 40 CFR part 50.

E. Section 58.20—Air Quality Surveillance: Plan Content

The revisions proposed today would require States to submit a PM monitoring plan to the Regional Administrator within 6 months of the effective date promulgation. The monitoring plan would describe the PM monitoring strategy based on the use of SLAMS (including NAMS and PAMS) and SPM's for PM_{10} and $PM_{2.5}$; describe the phase-in of $PM_{2.5}$ monitors and changes in the existing PM_{10} monitoring program; describe monitoring objectives and scales of representativeness to facilitate subsequent interpretation of data; define sampling schedules; denote sites intended for comparison to the PM NAAQS; and define the monitoring planning areas (MPA's) and SAZ's (SAZ's) within the State. It should also reference the revised quality assurance plan which is required by Appendix A to Part 58. In regard to the use of air quality data for making comparisons to the NAAQS and other SIP related purposes, the monitoring plan shall also describe the SPM's whose data the State intends to use for SIP purposes. The monitoring plan must also provide for an annual review for termination, relocations, or establishment of new SLAMS or core SLAMS.

F. Section 58.23—Monitoring Network Completion

Under the revisions proposed today, the PM networks would be expected to be completed within 3 years of the effective date of promulgation. While new $PM_{2.5}$ networks are developed, existing PM_{10} networks should be considered for reductions consistent with the goals stated in the background section earlier. For $PM_{2.5}$, a 3-year phase-in would be used. The proposed schedule for deployment of new required $PM_{2.5}$ monitors is described

here. During the first year, a minimum of one monitoring planning area per State would be required to have core $PM_{2.5}$ SLAMS. This area would be selected by the State according to the likelihood of observing high $PM_{2.5}$ concentrations and according to the size of the affected population. In addition, one $PM_{2.5}$ site would be collocated at one site in each of the PAMS areas. During the second year, all other core population-oriented $PM_{2.5}$ SLAMS, and all core background and transport sites, must be fully operational. During the third year, any additional required $PM_{2.5}$ (non-core) SLAMS must be fully deployed and all NAMS sites must be selected from core SLAMS and proposed to EPA for approval.

G. Section 58.25—System Modification

No changes to the regulatory language are proposed to § 58.25; however, under the revisions proposed today, the annual system modifications review must include changes to $PM_{2.5}$ site designations (e.g., NAAQS comparison sites), the number or boundaries of monitoring planning areas and/or SAZ's.

H. Section 58.26—Annual State Monitoring Report

Under the current regulations, States are required to submit an annual SLAMS data summary report. Under today's proposed revisions, this report shall be expanded to include additional information. First, the new State Monitoring report shall describe the proposed changes to the State's Monitoring Plan, as defined in § 58.20. It shall include a new brief narrative report to describe the findings of the annual SLAMS network review, reflecting within year and proposed changes to the State air quality surveillance system, and to provide information on PM SPM's and other PM sites described in the monitoring plan regardless of whether data from the stations are submitted to EPA (including number of monitoring stations; general locations; monitoring objective; scale of measurement; and appropriate concentration statistics to characterize PM air quality such as number of measurements, averaging time, and maximum, minimum, and average concentration). The latter is needed for EPA to ensure that a proper mix of permanent and temporary monitoring locations are used, that populated areas throughout the nation are monitored, and to provide needed flexibility in the State monitoring program. The content of this brief report shall be in accordance with EPA guidance, and will be available at the time of promulgation of the final Part 58 rule.

Next, States would be required to describe the proposed changes to existing PM networks. Proposed changes to the existing networks may include modifications to the number, size, or boundaries of Monitoring Planning Areas or SAZ's, number and location of PM SLAMS; number or location of core $PM_{2.5}$ SLAMS; alternative sampling frequencies proposed for $PM_{2.5}$ SLAMS (including core $PM_{2.5}$ SLAMS and $PM_{2.5}$ NAMS); core $PM_{2.5}$ SLAMS to be designated $PM_{2.5}$ NAMS; and PM SLAMS to be designated PM NAMS. SLAMS with NAAQS violations should be considered to become new or replacement core sites, and SPM's with NAAQS violations could become part of the SLAMS network. The proposed changes should be developed in close consultation with the appropriate EPA Regional Office and submitted to the appropriate Regional Office for approval. The portion of the plan pertaining to NAMS would be submitted to the Administrator (through the appropriate Regional Office).

Finally, as a continuation of current regulations, the States shall be required to submit the Annual SLAMS summary report and to certify to the Administrator that the SLAMS data submitted are accurate and in conformance with applicable Part 58 requirements. Under the revisions proposed today, States would also be required to submit annual summaries of SPM data to the Regional Administrator for sites included in their Monitoring Plan and to certify that such data are similarly accurate and likewise in conformance with applicable Part 58 requirements or other requirements approved by the Regional Administrator, if these data are intended to be used for SIP purposes.

During the first 3 years following promulgation, the monitoring plan and any modifications of it must be submitted to EPA by July 1 (starting on the year following promulgation) or by alternate annual date to be negotiated between the State and Regional Administrator, with review and approval/disapproval by the Regional Administrator within 45 days. After the initial 3-year period or once a SAZ has been determined to be violating any $PM_{2.5}$ NAAQS, then changes to a monitoring planning area will require public review and notification to ensure that the appropriate monitoring locations and site types are included. Specific comment on or suggestions for alternate procedures that are not unduly time consuming or burdensome to allow public review and comment on changes in MPA's, SAZ's, or other elements of a monitoring plan developed by a State or local air pollution control agency are especially welcome.

I. Section 58.30—NAMS Network Establishment

The revision proposed today would designate 6 months after the effective date of promulgation as the date by which the NAMS network portion (to be derived from core $PM_{2.5}$ SLAMS) of each State's SLAMS network must be fully described and documented in a submittal to the Administrator (through the appropriate EPA Regional Office). At this time, a State's NAMS PM_{10} network must be reaffirmed if no changes are made to the existing network and if changed must also be fully described and documented in a submittal to the Administrator (through the appropriate EPA Regional Office).

J. Section 58.31—NAMS Network Description

Today's proposed revision would require that the NAMS network description also include for $PM_{2.5}$ the monitoring planning area, SAZ, and the site code designation to identify which site will be used to determine violation of the appropriate NAAQS (annual or 24-hour).

K. Section 58.34—NAMS Network Completion

The revision proposed today would designate 3 years after the effective date of promulgation as the date by which the State must have all $PM_{2.5}$ NAMS in operation, and 1 year after the effective date of promulgation as the date by which the State must have made all changes to the existing PM_{10} NAMS.

L. Section 58.35—NAMS Data Submittal

This section defines the data submittal requirements for NAMS and SLAMS. Consistent with current requirements, only the total mass derived from PM_{10} and $PM_{2.5}$ SLAMS would be required to be submitted to EPA. However, EPA encourages reporting all data from monitors proposed in the State monitoring plan. These optional data would include data from SPM's and compositional data from all monitors.

M. Appendix A—Quality Assurance Requirements for SLAMS

Meeting the more stringent data quality objectives for ambient $PM_{2.5}$ monitoring will require considerably enhanced quality assurance in the areas of sampler operation, filter handling, data quality assessment, and other

operator-related aspects of the $PM_{2.5}$ measurement process.

Most operational quality control aspects are specified in Appendix A in general terms. For $PM_{2.5}$, however, explicit, more stringent, requirements are proposed for sample filter treatment—including the moisture equilibration protocol, weighing procedures, temperature limits for collected samples, and time limits for prompt analysis of samples. These requirements, which are specified in the reference method set forth in proposed new Appendix L to part 50, will help to control measurement precision. Additional or supplemental detailed quality assurance procedures and guidance for all operator-related aspects of the $PM_{2.5}$ monitoring process will be developed and published as a new Section 2.12 of the EPA's, Quality Assurance Handbook for Air Pollution Measurement Systems series to assist monitoring personnel in maintaining high standards of data quality.

Procedures for continually assessing the operational quality of the SLAMS monitoring data are specified explicitly in Appendix A of part 58. Perhaps the most significant new data quality assessment requirement proposed for $PM_{2.5}$ monitoring is the requirement that each routinely operating $PM_{2.5}$ ''compliance'' monitor must be ''audited'' at least 6 times per year. A compliance monitor is a monitor at a site which is included in the PM monitoring plan and whose data is intended for comparison to the NAAQS as described in Appendix D. This is the first time a requirement has been proposed to assess the relative accuracy of the mass concentration measured by a SLAMS PM monitor.

Each of these 6 ''audits'' would be performed by the monitoring agency and would consist of concurrent operation of a collocated reference method audit sampler along with the routinely operated compliance sampler or monitor. The data from these collocated audits would be pooled by the EPA to assess the performance of $PM_{2.5}$ monitoring methods on a national basis and for each reporting organization. These data would also be used in a screening test of the performance of individual monitors at each monitoring location. Six has been determined to be the minimum number of audit data points needed to yield a reasonable assessment of individual monitor operational performance on an annual basis. This number is analagous to the data requirements for the precision and accuracy assessments for PM_{10}, $PM_{2.5}$ and other pollutants described in Section 5.

The integrated operating precision and relative accuracy, evaluated annually, would have to meet a limit of ±15 percent. A monitoring method that fails this requirement nationally would be placed in a probationary status pending resolution of the inadequate performance or possible cancellation of its reference or equivalent method designation under the provisions of § 53.11 of part 53 of this chapter. While this action would not result in immediate cancellation of the designation, it would require the method applicant (e.g., the manufacturer) to correct the method performance problems or to submit alternative evidence or arguments (possibly in collaboration with other affected entities) that the method's designation should not be canceled.

Reporting organizations whose monitoring data failed to meet this requirement (or are significantly worse than the national norm) would be notified that its quality assurance plan or procedures need improvement. Similarly, monitoring data from individual sites that fail the screening test would require remedial action or replacement of the monitoring method. Note, however, that failure of either of these tests or the national test would not automatically cause the associated monitoring data to be invalid.

Comments are solicited on these method operating performance audits and particularly on the potential use of the audit data by EPA to: (1) Determine a national network operating precision and accuracy performance indicator for each type of designated method, (2) determine the operational performance of methods used by reporting organizations relative to the national norm, and (3) consider cancellation of the reference or equivalent method designation of methods failing to meet the ±15 percent operational performance specification.

Other data assessment requirements proposed in Appendix A for $PM_{2.5}$ monitoring networks are patterned after the current requirements for PM_{10} networks and are intended to supplement the audit procedure. $PM_{2.5}$ network monitors would be subject to precision and accuracy assessments for both manual and automated methods, using procedures similar or identical to the current procedures required for PM_{10} monitoring networks. Results of these field tests performed by the monitoring agencies (along with the results of the field audits) would be sent to the EPA, which then would carry out the specified calculations. These calculated statistics would become part of the annual assessment of the quality of the monitoring data.

For automated methods, the additional assessment of the precision would consist of a one-point precision check performed at least once every 2 weeks on each automated analyzer used to measure $PM_{2.5}$. This precision check would be made by checking the operational flow rate of the analyzer. A standard precision flow rate check procedure similar to that currently used for PM_{10} network assessments is proposed. Also proposed is an alternative procedure where, under certain specific conditions, it would be 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. (This alternative procedure would also be made applicable to PM_{10} methods.)

The additional accuracy assessment procedure proposed for $PM_{2.5}$ automated methods is also similar to that used for PM_{10} networks, although each $PM_{2.5}$ analyzer would have to be audited quarterly rather than annually, as is the current requirement for PM_{10} analyzers. The assessment would be performed on the analyzer's operational flow rate using a flow rate transfer standard, with the accuracy calculated from the percent difference between the actual flow rate and the corresponding flow rate indicated by the analyzer.

For manual methods, an additional precision assessment would be calculated from the data collected from collocated samplers, as is currently required for manual PM_{10} methods. The number of collocated samplers within each $PM_{2.5}$ network is proposed to be based upon the total number of samplers within the reporting organization's network. For 1 to 10 total sites, 1 site would be selected for collocation; for 11 to 20 total sites, 2 sites would be selected for collocation; and if a reporting organization has over 20 total sites, then 3 sites would be selected for collocation. As for PM_{10}, one sampler of the collocated pair would be designated as the primary sampler whose samples would be used to report air quality for the site, and the other would be designated as the duplicate sampler. The percent differences in measured concentration between the two collocated samplers would be used to calculate this additional network precision.

The accuracy of the flow rate system of manual methods for $PM_{2.5}$ would be determined, as for automated methods, by auditing each sampler each calendar quarter. Using a flow rate transfer standard, each sampler would be audited at its normal operating flow

rate. The percent differences between these flow rates would be used to calculate an additional indicator of accuracy.

Although the new quality assurance requirements for $PM_{2.5}$ would result in an increase in the quality of the PM monitoring data, the additional QA/QC checks would entail additional cost to the monitoring agency. Some of the new QA/QC assessment requirements may somewhat overlap the similar information provided by other checks, such as the periodic flow rate checks and the use of collocated samplers in monitoring networks. Consequently, the EPA solicits comments on the need to maintain all of these QA requirements and also on the adequacy of the proposed QA data assessments to ensure the defined quality for $PM_{2.5}$ measurements.

Table A–1, which summarizes the minimum data quality assessment requirements, would be updated to include the new requirements for $PM_{2.5}$ methods, and other minor, mostly editorial changes are proposed to Appendix A to update and clarify the language and specific requirements.

A change to section 2.5 of Appendix A is also being proposed to provide for technical system audits to be performed by EPA at least every three years rather than every year. This change to a less frequent system audit schedule recognizes the fact that for many well established agencies, an extensive system audit and rigorous inspection may not be necessary every year. The determination of the extent and frequency of system audits at an even lower frequency than the proposed three year interval is being left to the discretion of the appropriate Regional Office, based on an evaluation of the Agency's data quality measures. This change would afford both the EPA and the air monitoring agencies flexibility to manage their air monitoring resources to better address the most critical data quality issues.

N. Appendix C—Monitoring Methodology

Section 2.2 of Appendix C is proposed to be amended to allow the use of PM_{10} monitors as surrogates for $PM_{2.5}$ monitors for purposes of demonstrating compliance with the NAAQS. However, following the measurement of a PM_{10} concentration higher than the 24-hour $PM_{2.5}$ standard or an annual average concentration higher than the annual average $PM_{2.5}$ standard, the PM_{10} monitor would have to be replaced with a $PM_{2.5}$ monitor. In addition, for NAMS that are converted to $PM_{2.5}$ monitoring from PM_{10} monitoring, the PM_{10} monitoring must continue concurrently with the PM_{10} monitoring for 1 year following the beginning of the $PM_{2.5}$ monitoring.

Appendix C would also be amended to add a new section 2.4 containing provisions that would allow the use at a SLAMS of a $PM_{2.5}$ method that had not been designated as a reference or equivalent method under part 53. Such a method would be allowed to be used at a particular SLAMS site to make comparisons to the NAAQS if it met the basic requirements of the test for comparability to a reference method sampler for $PM_{2.5}$, as specified in Subpart C of part 53 of this chapter, in each of the four seasons of the year at the site at which it is intended to be used. A method that meets this test would then be further subjected to the operating precision and accuracy requirements specified in section 6 of Appendix A of this part, at twice the normal evaluation interval (6 audits in 6 months instead of 6 audits in 12 months). A method that meets these requirements would not become an equivalent method, but the method could be used at that particular SLAMS site for any regulatory purpose. The method would be assigned a special method code, and monitoring data obtained with the method would be accepted into AIRS as if they had been obtained with a reference or equivalent method. This provision could thus allow the use of non-conventional $PM_{2.5}$ methods, such as optical or open path measurement methods, which would be difficult to test under the equivalent method test procedures proposed for part 53.

In addition, Appendix C would also be amended to add two new sections. A proposed new section 2.5 would clarify that correlated acceptable continuous (CAC) methods for $PM_{2.5}$ approved for use in a SLAMS under proposed new provisions in § 58.13(f) would not become de facto equivalent methods. This applies to methods that have not been designated equivalent and do not satisfy the requirement of Section 2.4 described above. The new section would further clarify that the monitoring data obtained with CAC methods would be restricted to use for the purposes of § 58.13(f) and would not be used for making comparisons to the NAAQS. Proposed new section 2.9 would define so-called ''IMPROVE'' samplers for fine particulate matter and clarify that IMPROVE samplers, although not designated as equivalent methods, could be used in SLAMS for monitoring regional background concentrations of fine particulate matter.

Finally, minor changes are proposed to section 2.7.1 to update the address to which requests for approval for the use of methods under the various provisions of Appendix C should be sent, and section 5 to add additional references.

O. Appendix D

The revisions to Appendix D proposed today would revise Sections 1, 2, 2.8, 3, 3.7, and 5 to incorporate changes made necessary by the proposed new $PM_{2.5}$ NAAQS. Section 1 is revised to add criteria for core $PM_{2.5}$ stations. Two additional SLAMS monitoring objectives are added: the first is to determine the extent of regional pollutant transport among populated areas, which may originate from distant pollutant sources; the second is in support of secondary NAAQS, to determine the welfare-related impacts in more rural and remote areas (such as visibility impairment and effects on vegetation). Section 2 is revised to include information that would be useful in designing regulatory networks. Section 2.8 and 3.7 are revised to apply to $PM_{2.5}$ as well as PM_{10}. Section 2.8.1 is added to discuss monitoring planning areas and SAZ's. Section 2.8.2 is added to address the $PM_{2.5}$ monitoring sites and other requirements to be discussed in the State PM monitoring plan. Finally, section 2.8.3 is added to describe the selection of monitoring locations and SAZ's within the monitoring planning area. A series of diagrams are used to illustrate the basic principles.

The $PM_{2.5}$ NAMS shall be selected from the core $PM_{2.5}$ SLAMS. This network will focus on population-oriented surveillance and is intended to provide a national trends network to study the impact of $PM_{2.5}$ emission sources including regional transport. A new Table 5, which lists the goals for the number of $PM_{2.5}$ NAMS by EPA Region, is added to Section 3.7. Table 5 in Section 5 is redesignated as Table 6 and revised to include $PM_{2.5}$.

In Section 2.8.1, in particular, MPA's and SAZ's are introduced to conform to the population-oriented, spatial averaging approach taken in the proposed new $PM_{2.5}$ NAAQS under 40 CFR Part 50. This approach is more directly related to the epidemiological studies used as the basis for the proposed revisions to the particulate matter NAAQS. This proposal recognizes that the use of MPA's and SAZ's introduces greater complexity into the network design process and the assessment of violations of the NAAQS. Thus, the Administrator would specifically welcome comments on the

network design approach described in Section 2.8.1 through Section 2.8.3.

Previous requirements for number of monitors in this appendix have been related to the urbanized area populations. The boundaries for the urbanized populations to do not follow political or geographical boundaries. Hence, it is difficult at times to determine the component populations, emissions, or location of monitoring sites. A new concept is being introduced with this proposal to change from urbanized area population to MSA/PMSA populations for PM_{10} and $PM_{2.5}$. This will make it easier to track monitors for the above reasons, and to more accurately relate measured concentrations to population exposures.

1. NAAQS Comparison Sites and New Site Codes

Through its monitoring plan, which is reviewed and approved by the Regional Administrator, a State would select the population-oriented [2] sites eligible for NAAQS comparisons which are included in each monitoring planning area and its SAZ's. Comparisons with the annual primary $PM_{2.5}$ NAAQS would be based on population oriented SLAMS sites as well as other sites representative of area-wide concentrations in SAZ's. Comparisons to the 24-hour primary $PM_{2.5}$ NAAQS would be based on these sites as well as all other sites which are population-oriented. To encourage $PM_{2.5}$ monitoring initially, for the first 3 years after effective date of promulgation a moratorium is proposed on using data from all eligible SPM's to determine violations of the NAAQS. After this time, any operating SPM site which records a violation of the NAAQS would become eligible for NAAQS comparisons, should be included in the State monitoring plan, and should be considered during the State's review and development of their monitoring network.

Figure 1 in Appendix D shows a conceptual Venn diagram that illustrates which $PM_{2.5}$ sites in a MPA would be eligible for comparison to the 24-hour and annual $PM_{2.5}$ NAAQS. To be eligible for NAAQS comparisons, sites must meet all three of the following requirements: (1) Are NAMS/SLAMS or other population oriented sites, (2) are included in the monitoring plan, and (3) meet the requirements of 58.13 and Appendices A, C, and E. Sites that meet the additional requirement of generally representing areawide concentrations in the SAZ are also eligible for comparison to the annual $PM_{2.5}$ NAAQS using the spatial averaging procedure specified in Part 50 Appendix K. Such sites are designated ''B''. All core monitoring sites and NAMS sites, which are a subset of the core sites, are B sites as are many other SLAMS and some non-SLAMS sites. Other population-oriented sites which are more representative of localized hot spots are only eligible for comparison on a site-by-site basis to the 24-hour $PM_{2.5}$ NAAQS and are designated ''D''. These may include population-oriented industrial monitors which meet the applicable Part 58 requirements and are also included in the PM monitoring plan. The figure shows that all $PM_{2.5}$ SLAMS sites are designated ''B'' or ''D''. Sites not designated as ''B'' or ''D'' sites would be designated as ''O'' sites. These codes would become new pollutant specific codes on the AIRS monitoring site file. In addition, core SLAMS $PM_{2.5}$ sites will receive a new AIRS site type code. These data reporting changes will be described more fully in future AIRS guidance.

A network design issue that relates to the spatial averaging form of the annual standard is the selection of the first (and/or only) site in a prospective SAZ. Because the intent of the spatial average form of the $PM_{2.5}$ NAAQS is to estimate community, area-wide air pollution, the emphasis on the first selected SLAMS sites (including core SLAMS) would be ''typical population exposure.''

2. Monitoring Planning Areas and SAZ's

In order to acquire population-oriented, spatially averaged monitoring data that correspond more closely to the data that are the basis for the proposed $PM_{2.5}$ NAAQS, the concepts of monitoring planning areas and SAZ's are used in Section 2.8.1. As part of its monitoring plan, a State will propose monitoring planning areas and also propose non-overlapping SAZ's for each monitoring planning area. The number of monitoring planning areas is determined by the State. This may be one area to cover a small State like Rhode Island or be as many as 25 to correspond to existing air pollution control districts in a State like California. Information to be considered includes topography, PM emissions, number and type of significant PM sources as well as population density and distribution. Monitoring planning areas are required to include all metropolitan statistical areas (MSA's) and Primary Metropolitan Statistical areas (PMSA's) with population greater than 500,000, and generally recommended to include MSA's/PMSA's with population greater than 250,000 and high pollution (defined as producing measurements greater than or equal to 0.8 times the level of the $PM_{2.5}$ NAAQS) as well as other areas determined to be likely to have high concentration of $PM_{2.5}$. In addition, optional MPA's may include other designated parts of a State. An MPA should not include different areas separated by topographical barriers. Each MPA can have one or more SAZ's representing the area. The SAZ define the area within which all eligible monitoring data (from ''B'' sites) will be averaged for comparisons with the annual $PM_{2.5}$ NAAQS. The MPA's and SAZ's would be reviewed and approved annually by the Regional Administrator. Until the monitoring plan is approved, EPA intends to have the SLAMS and sites eligible for NAAQS comparisons default to the SLAMS previously approved. Sites which have discontinued monitoring would continue to be used for comparisons to the NAAQS until their monitoring type status changes.

Multiple zones within an MPA are most appropriate for large metropolitan areas, large geographical monitoring regions and areas in which concentrated source regions are in low population portions of an MPA. All MPA's and SAZ's must be defined on the basis of some existing delineated mapping data such as county boundaries, zip codes, census blocks or groups of census blocks. This will assist in the proper characterization of the spatial representativeness of air monitoring sites and facilitate better presentations of air monitoring data on national, regional, and local maps.

All areas in the ambient air may become a SAZ based on considerations of population density, pollution concentration gradients and or the physical size of the area. Generally, a SAZ should characterize an area of relatively homogeneous air quality (i.e., the annual average concentration of the individual monitoring locations within the area should be within ±20 percent of the spatial average) and be affected by the same major source categories of particulate matter. In MSA's, the SAZ's must completely cover the entire MPA. In other MPA's, the SAZ's might not completely cover the entire MPA. For example, small networks consisting of say one or two monitoring sites may not adequately characterize the air quality in a large geographic area or in large areas of relatively low population or pollution density. In another situation,

[2] As currently used in Part 58, population-oriented monitoring or sites applies to residential areas, commercial areas, recreational areas, industrial areas where workers from more than one company are located, and other areas where a substantial number of people may spend a significant fraction of their day.

population centers and pollution regions represented by monitoring sites may be geographically disjoint. In these cases, the spatial representativeness of the monitoring site should be considered in defining the SAZ boundaries. Until more monitoring sites are established, the monitored air quality in areas outside of SAZ's is not known. Although ideally all areas of a State should be included in a SAZ, monitoring density may be insufficient to completely characterize a specific MPA and more monitors would be needed. Nonetheless, in some circumstances a SAZ can be represented by a single monitoring location and this may be sufficient to properly characterize an MPA. The SAZ's should generally include a minimum population of 250,000 and not more than 2 million. Deviations from this criteria should be based on the area's physical size and population density.

The Administrator recognizes that the designation of SAZ's within Monitoring Planning Areas introduces a certain degree of complexity into the monitoring network planning and data usage process. Comments are therefore solicited on the use of a simpler approach to satisfy the requirements for spatial averaging which are proposed in Part 50. In particular, comments are solicited on a approach wherein there is only one SAZ in each MPA which has the same boundaries as the MPA.

3. Core Monitoring Sites

To provide a minimal $PM_{2.5}$ network in all high population areas for protection of the annual and 24-hour PM NAAQS, each required monitoring planning area must have at least two core monitors. The new core monitoring locations would be an important part of the basic PM-fine SLAMS regulatory network. These sites are intended to primarily reflect community-wide air pollution, which would reflect monitoring locations in residential areas or where people spend a substantial part of the day take. In addition to the population-oriented monitoring sites, core monitors would also be established for background and transport monitoring. States should work cooperatively in establishing their State networks in order to maximize the value of monitoring data to best understand the regional behavior of $PM_{2.5}$.

To permit interface with measurements of ozone precursors which are also contributors to $PM_{2.5}$, an additional core monitor collocated at a PAMS site is required in those MSA's where both PAMS and $PM_{2.5}$ monitoring are required. The core monitor to be collocated at a PAMS site is considered part of the MPA $PM_{2.5}$ SLAMS network and is not considered as a part of the PAMS network as described in Section 4 of Appendix D.

The new core population-oriented PM-fine network is conceptually similar to the existing NAMS for other pollutants, but would allow for some year to year changes in site location to ensure that the typical areas of high pollution, high population areas are always monitored. Core sites will be the key sampling locations designated for initial monitoring, and a subset would be selected for longer-term monitoring. The latter would become the NAMS.

The core sites will also produce the most complete data in the PM-fine network. Daily sampling would be required, except during low pollution seasons or other periods as exempted by EPA. As such, a subset of these sites should be considered as candidate locations for adding state-of-the-art research monitoring devices whose data might need to be considered in future reviews of the PM NAAQS. This will ensure continuity and comparability of past, present and future PM data bases.

Finally, because the core sites would produce the most data, many would be the most likely locations for determining violations of a short-term NAAQS. The core locations would become critical for judging future attainment in an area that has been determined to violate the NAAQS, again putting emphasis on areas with the largest population impact. Complete data at background and transport core sites will also provide the needed data base to better understand the source-receptor relationships and assist the implementation program.

Each SAZ in a required MPA must have at least one core monitor; the SAZ's in optional MPA's should have at least one core monitor; and it is also suggested that SAZ's should have at least one core site for every four SLAMS. Exemptions are allowed for required core stations in MSA's with population greater than 500,000, if measured or modeled concentrations of $PM_{2.5}$ are less than 80 percent of the NAAQS for $PM_{2.5}$. Specific comments on the required and suggested number of core monitoring locations are requested.

4. Examples of MPA's, SAZ's and NAAQS Eligible Monitors

Some examples may better illustrate how the concepts of monitoring planning areas and SAZ's may be realized in practice. The San Joaquin Valley air basin in California could be an MPA. If emission sources are distributed throughout this region, then the entire MPA could also be the SAZ. For large counties, such as California's San Bernardino County, which have non-uniform emission sources and population density, there could be at least two SAZ's, such as an eastern SAZ and a western SAZ which is part of the South Coast Air Basin. For an MSA, such as the Philadelphia MSA, or MSA/MPA which crosses State boundaries, separate SAZ's are suggested for each State portion, with substantial population (e.g. greater than 250,000). For the Philadelphia PA–NJ MSA, this could mean at least separate zones for the Philadelphia, PA and NJ portions. In this manner, each State would be responsible for the networks in its SAZ portion of the MPA. (Each of these SAZ's must have at least one core monitor for a total of two for the MPA). Furthermore, for MSA's and large geographic areas with concentrated source regions or industrial areas, such as Philadelphia, separate SAZ's are suggested for the residential/city center and the industrial area to better characterize the gradients in $PM_{2.5}$ concentrations. Downtown street canyons may be appropriate SAZ's if they also include residential areas, such as is the case in mid-town Manhattan, NY or if they include commercial areas which have higher $PM_{2.5}$ concentrations within the MPA and where significant numbers of people work during the day. Comments are solicited on criteria for defining SAZ's.

A series of figures is presented to illustrate the concept of MPA's and SAZ's. A hypothetical MPA representing an Eastern urban area is given in Figure 2 of appendix D and illustrates how monitors can be located in relation to population and areas of poor quality. Figure 3 in Appendix D shows the same MPA as Figure 2, but includes three SAZ's: an industrial zone, a downtown central business district, and residential areas. Figure 4 in Appendix D shows the same MPA illustrated in Figures 2 and 3. However, sites are denoted by whether they are eligible for comparison with the 24-hour $PM_{2.5}$ NAAQS or both the 24-hour and the annual $PM_{2.5}$ NAAQS. Figure 5 in Appendix D shows potential SAZ's in a hypothetical Western State. Figure 6 in Appendix D illustrates State coverage by SAZ's both within and outside MPA's. More detailed guidance for network design for $PM_{2.5}$ using the concepts of core monitoring stations, MPA's, and SAZ's will be available shortly in an EPA guidance document which is in preparation.

5. Substitute PM Samplers

Appendix C (Section 2.2) to Part 58 describes conditions under which TSP samplers may be used as substitutes for PM_{10} samplers and when such TSP samplers must be replaced with PM_{10} samplers. The proposed rule will describe similar language regarding PM_{10} samplers which may be used as substitutes for $PM_{2.5}$ and provide clarification to ensure that only the appropriate TSP or PM_{10} sites are required to be converted to PM_{10} and $PM_{2.5}$, respectively. This provision is intended to be used when PM concentrations are low and substitute samplers can be used to satisfy the minimum number of PM samplers needed for an adequate PM network. This may be most appropriate when sufficient resources to purchase new PM samplers may not exist and existing samplers can be temporarily used to serve a new PM network.

6. NAMS Network Design

In Section 3.7, the PM_{10} design criteria for NAMS, namely monitoring objectives, spatial representativeness, the category ''a'' maximum concentration site, number of sites, etc., remains in effect. In addition, the traditional concept of NAMS as long-term monitoring stations to assess trends and to support national assessments and decisions is reiterated. However, concerning $PM_{2.5}$ network design, a more flexible approach is proposed. First, the $PM_{2.5}$ NAMS will be concentrated in metropolitan areas in keeping with the risk management approach of the proposed new $PM_{2.5}$ NAAQS. Next, a numeric range of prospective $PM_{2.5}$ NAMS by EPA Region are identified. These are based on consideration of a number of factors set by Regions to provide maximum flexibility for State and local agencies, but should represent the range of conditions occurring in the Regions taking into consideration such factors as the total number and types of sources, ambient characteristics of particulate matter, regional transport, geographic area, and affected population. The goals for Regions varies from a low of 10 to 15 for Regions VII, VIII and X to a high of 35 to 50 for Regions IV and V while the total ranges from 205 to 295 with an expected national target of 250. In particular, comments are requested about the general approach of goals by Region and the numbers estimated.

P. Appendix E

Today's revision to Appendix E consists of relatively minor changes to Section 8 which currently provides the sampler siting criteria for PM_{10}. The modifications basically expand the siting requirements to include $PM_{2.5}$ as well as PM_{10} by selectively replacing the term PM_{10} with PM which would be defined as applying to PM_{10} and $PM_{2.5}$. This will permit existing PM_{10} sites to continue to be used and, when appropriate, to serve as platforms for new $PM_{2.5}$ sampling.

Q. Appendix F

A new section has been added for the annual summary statistics for $PM_{2.5}$ in Appendix F. It should be noted that the current procedures for reporting and certifying the air quality data may be changed later, since the AIRS system is undergoing reengineering.

R. Cost Estimates for New PM Networks

The costs associated with the start-up of a $PM_{2.5}$ network and the phase-down of the existing PM_{10} sampling network depend on the 3-year phase-in of the new proposed requirements and the number of PM monitors that the Administrator believes are necessary in a mature network.

TABLE 1. PM–2.5 NETWORK COSTS

[Thousands of dollars]

Year	Number of sites	Number of samplers [1]	Capital cost	Sampling & QA	Filter analysis [2]	Special studies	Total cost
1997	0	0	$4,095	.....	.....	.....	$4,095
1998	216	318	7,908	$4,382	$1,558	$2,600	16,478
1999	714	1,004	6,850	11,514	926	1,300	20,590
2000	1,200	1,490	.....	17,833	926	1,300	20,059

[1] The PM–2.5 Network includes 160 collocated monitors for QA purposes, and 130 collocated monitors to avoid weekend site visits.
[2] Three different types of filter analyses are anticipated (exceedances analyses, screening analyses, and detailed analyses).

TABLE 2.—COST FOR $PM_{2.5}$ FILTER ANALYSES

Type of filter analysis	Estimated cost per sample
Exceedance Analysis:	$200
High $PM_{2.5}$ concentration events are optically analyzed for particle size and composition utilizing electron microscopy.	
Screening Analysis:	
X-Ray Fluorescence (XRF) for elemental composition (crustal material, sulfur, and heavy metals)	50

TABLE 2.—COST FOR $PM_{2.5}$ FILTER ANALYSES—Continued

Type of filter analysis	Estimated cost per sample
Thermo-optical analysis for elemental/organic/total carbon	50
Detailed Analysis:	
Inductively Coupled Argon Plasma (ICAP) Analysis for elemental composition	100
Analysis for speciated organic composition	400
Analysis for sulfate, aerosol acidity	100

Table 3 presents the change in PM_{10} network costs. The costs are shown for a current network of 1,650 sites and the phase down to a future projected network of 600 sites. PM_{10} costs have been calculated for the continued operation on a one in 6-day schedule, and for the relocation or discontinuance of monitoring sites. Table 4 shows the cost of PM monitoring according to sampling frequency and the type of PM monitor. Details of this information can be found in the ''Information Collection Request'' for these proposed requirements.

TABLE3.—PM–10 NETWORK COSTS

[Thousands of dollars]

Year	Number of sites	Number of samplers[1]	Capital cost to remove sites	Operation & maintenance cost	Total cost
1997	1,650	1,810	.....	$15,474	$15,473
1998	1,374	1,544	$110	12,181	12,291
1999	972	1,132	174	8,914	9,088
2000	600	760	161	5,966	6,127

[1] The PM_{10} network includes 160 collocated monitors for QA purposes.

TABLE 4.—COSTS FOR PARTICULATE MONITORING

PM monitor and sampling frequency	One-time capital cost	Annual operation & maintenance cost
PM–10 1-in-6 day sampling schedule.	$14,500	$8,700.
PM–2.5 1-in-6 day sampling schedule.	$9,600 to $16,900.	$11,200.
PM–2.5 every day sampling.	$14,600 to $21,900.	$18,900.
Nephelometer (continuous).	$20,100 to $26,300.	$16,700 to $17,500.

S. Reference

1. Information Collection Request, 40 CFR 58 Ambient Air Quality Surveillance, OMB #2060–0084, EPA ICR #0940.14, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711 (October 23, 1996).

V. Administrative Requirements

A. Regulatory Impact Analysis

Under Executive Order 12866 (58 FR 51735, October 4, 1993), the Agency must determine whether the regulatory action is ''significant'' and therefore subject to Office of Management and Budget (OMB) review and to the requirements of the Executive Order. The Order defines ''significant regulatory action'' as one that is likely to result in a rule that may:

(1) Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or governments or communities;

(2) Create a serious inconsistency or otherwise interfere with an action taken or planned by another Agency;

(3) Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations or recipients thereof; or

(4) Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

It has been determined that this rule is not a ''significant regulatory action'' under the terms of the Executive Order 12866 and is therefore not subject to formal OMB review. However, this rule is being reviewed by OMB under Reporting and Record keeping Requirements (see below).

B. Paperwork Reduction Act

The information collection requirements contained in this proposed rule have been submitted for approval to OMB under the *Paperwork Reduction Act,* 44 U.S.C. 3501 *et seq.* An Information Collection Request document has been prepared by the EPA (ICR No. 0940.14) and a copy may be obtained from Sandy Farmer, Information Policy Branch, EPA, 401 M Street SW, Mail Code 2137, Washington, DC 20460; or by calling (202) 260–2740.

1. Need and Use of the Collection

The main use for the collection of the data is to support the PM NAAQS revisions. The various parameters reported as part of this ICR are necessary to ensure that the information and data collected by State and local agencies to assess the nation's air quality are defensible, of known quality, and meet the EPA's data quality goals of completeness, precision, and accuracy.

The need and authority for this information collection is contained in Section 110(a)(2)(C) of the Act, which requires ambient air quality monitoring for purposes of the SIP and reporting of the data to EPA, and Section 319, which requires the reporting of a daily air pollution index. The legal authority for this requirement is the Ambient Air Quality Surveillance Regulations, 40 CFR 58.20, 58.21, 58.25, 58.26, 58.28, 58.30, 58.31, 58.35, and 58.36.

The EPA's Office of Air Quality Planning and Standards uses ambient air monitoring data for a wide variety of purposes, including making NAAQS attainment/nonattainment decisions; determining the effectiveness of air pollution control programs; evaluating the effects of air pollution levels on public health; tracking the progress of SIP's; providing dispersion modeling support; developing responsible, cost-effective control strategies; reconciling emission inventories; and developing air quality trends. The collection of $PM_{2.5}$ data is necessary to support the $PM_{2.5}$ NAAQS, and the information collected will have practical utility as a data analysis tool.

The State and local agencies with responsibility for reporting ambient air quality data and information as requested by these proposed regulations will submit these data electronically to the U.S. EPA's Aerometric Information Retrieval System, Air Quality Subsystem (AIRS–AQS). Quality assurance/quality control records and monitoring network documentation are also maintained by each State/local agency, in AIRS–AQS electronic format where possible.

2. Reporting and Recordkeeping Burden

The total annual collection and reporting burden associated with this proposal is estimated to be 490,526 hours. Of this total, 484,545 hours are estimated to be for data reporting, or an average of 3,327 hours for the estimated 130 respondents. The remainder of 5,981 hours for recordkeeping burden averages 46 hours for the estimated 130 respondents. The capital O/M costs associated with this proposal are estimated to be $19,714,453. These estimates include time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

The frequency of data reporting for the NAMS and the SLAMS air quality data as well as the associated precision and accuracy data are submitted to EPA according to the schedule defined in 40 CFR part 58. This regulation currently requires that State and local air quality

management agencies report their data within 90 days after the end of the quarter during which the data were collected. The annual SLAMS report is submitted by July 1 of each year for data collected from January 1 through December 31 of the previous year in accordance with 40 CFR 58.26. This certification also implies that all SPM data to be used for regulatory purposes by the affected State or local air quality management agency have been submitted by July 1.

3. Burden

Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purpose of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information.

An Agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations are listed in 40 CFR Part 9 and 48 CFR Chapter 15.

Comments are requested on the Agency's need for this information, the accuracy of the provided burden estimates, and any suggested methods for minimizing respondent burden, including through the use of automated collection techniques. Send comments on the ICR to the Director, OPPE Regulatory Information Division; U.S. Environmental Protection Agency (2137); 401 M St., SW.; Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, 725 17th St., NW., Washington, DC 20503, marked ''Attention: Desk Officer for EPA.'' Include the ICR number in any correspondence. Since OMB is required to make a decision concerning the ICR between 30 and 60 days after December 13, 1996, a comment to OMB is best assured of having its full effect if OMB receives it by January 13, 1997. The final rule will respond to any OMB or public comments on the information collection requirements contained in this proposal.

C. Impact on Small Entities

Pursuant to section 605(b) of the Regulatory Flexibility Act, 5 U.S.C. 605(b), the Administrator certifies that this rule will not have a significant economic impact on a substantial number of small entities. This rulemaking package does not impose any additional requirements on small entities because it applies to governments whose jurisdictions cover more than 200,000 population. Under the Regulatory Flexibility Act, governments are small entities only if they have jurisdictions of less than 50,000 people. In addition, this rule imposes no enforceable duties on small businesses.

D. Unfunded Mandates Reform Act of 1995

Under sections 202, 203 and 205 of the Unfunded Mandates Reform Act of 1995 (''Unfunded Mandates Act''), signed into law on March 22, 1995, the EPA must undertake various actions in association with proposed or final rules that include a Federal mandate that may result in estimated costs of $100 million or more to the private sector, or to State or local governments in the aggregate.

The EPA has determined that this rule does not contain a Federal mandate that may result in expenditures of $100 million or more for State, and local governments, in the aggregate, or the private sector in any one year. Our economic analysis indicates that the total implementation cost will be approximately $88,728,000 in 1996 dollars for the 3 years to phase in the network, or an average of $29,576,000 for the 3-year implementation. The table below shows how this 3-year average was derived for the various cost elements of monitoring. While this table represents the 3-year period 1998–2000, the total cost for $PM_{2.5}$ monitoring include the initial capital costs anticipated in 1997. In addition, this rule imposes no enforceable duties on small businesses.

COST BASED ON 3-YEAR AVERAGE

[Thousands of dollars]

Cost/Element	PM_{10}	$PM_{2.5}$	3 year totals
Network design	$0	$571	$571
Site installation	311	5,013	5,324
Sampling & analysis	2,647	6,758	9,405
Maintenance	1,233	1,928	3,161
Data management	1,245	1,574	2,819
Quality assurance	1,745	3,373	5,118
Supervision	1,988	1,189	3,177
Summary [1]	9,169	20,407	29,576

[1] Totals are rounded.

List of Subjects

40 CFR Part 53

Environmental protection, Administrative practice and procedure, Air pollution control, Reporting and recordkeeping requirements.

40 CFR Part 58

Air pollution control, Intergovernmental relations, Reporting and recordkeeping requirements.

Dated: November 27, 1996.

Carol M. Browner,

Administrator.

For the reasons set forth in the preamble, title 40, chapter I, part 53 and part 58 of the Code of Federal Regulations are proposed to be amended as follows:

PART 53—[AMENDED]

1. The authority citation for part 53 continues to read as follows:

Authority: Sec. 301(a) of the Clean Air Act (42 U.S.C. Sec. 1857g(a)) as amended by sec. 15(c)(2) of Pub. L. 91–604, 84 Stat. 1713, unless otherwise noted.

2. Subpart A is revised to read as follows:

Subpart A—General Provisions

Sec.
53.1 Definitions.
53.2 General requirements for a reference method determination.
53.3 General requirements for an equivalent method determination.
53.4 Applications for reference or equivalent method determinations.
53.5 Processing of applications.
53.6 Right to witness conduct of tests.
53.7 Testing of methods at the initiative of the Administrator.
53.8 Designation of reference and equivalent methods.
53.9 Conditions of designation.
53.10 Appeal from rejection of application.
53.11 Cancellation of reference or equivalent method designation.
53.12 Request for hearing on cancellation.
53.13 Hearings.
53.14 Modification of a reference or equivalent method.
53.15 Trade secrets and confidential or privileged information.
53.16 Supersession of reference methods.

Tables to Subpart A of Part 53

Table A–1—Summary of Applicable Requirements for Reference & Equivalent Methods for Air Monitoring of Criteria Pollutants

Appendix A to Subpart A of Part 53—References

Subpart A—General Provisions

§ 53.1 Definitions.

(a) Terms used but not defined in this part shall have the meaning given them by the Act.

(b) *Act* means the Clean Air Act (42 U.S.C. 1857–1857l), as amended.

(c) *Agency* means the Environmental Protection Agency.

(d) *Administrator* means the Administrator of the Environmental Protection Agency or the Administrator's authorized representative.

(e) *Reference method* means a method of sampling and analyzing the ambient air for an air pollutant that is 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.

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

(g) *Candidate method* means a method of sampling and analyzing the ambient air for an air pollutant for which an application for a reference method determination or an equivalent method determination is submitted in accordance with § 53.4, or a method tested at the initiative of the Administrator in accordance with § 53.7.

(h) *Manual method* means a method for measuring concentrations of an ambient air pollutant in which sample collection, analysis, or measurement, or some combination thereof, is performed manually. A method for PM_{10} or $PM_{2.5}$ which utilizes a sampler that requires manual preparation, loading, and weighing of filter samples is considered a manual method even though the sampler may be capable of automatically collecting a series of sequential samples.

(i) *Automated method* or *analyzer* means a method for measuring concentrations of an ambient air pollutant in which sample collection (if necessary), analysis, and measurement are performed automatically by an instrument.

(j) *Test analyzer* means an analyzer subjected to testing as part of a candidate method in accordance with subparts B, C, D, E, or F of this part, as applicable.

(k) *Applicant* means a person or entity who submits an application for a reference or equivalent method determination under § 53.4, or a person or entity who assumes the rights and obligations of an applicant under § 53.7. Applicant may include a manufacturer, distributer, supplier, or vendor.

(l) *Ultimate purchaser* means the first person who purchases a reference method or an equivalent method for purposes other than resale.

(m) *PM_{10} sampler* or *$PM_{2.5}$ sampler* means a device, associated with a manual method for measuring PM_{10} or $PM_{2.5}$ (respectively), designed to collect PM_{10} or $PM_{2.5}$ (respectively) from an ambient air sample, but lacking the ability to automatically analyze or measure the collected sample to determine the mass concentration of PM_{10} or $PM_{2.5}$ in the sampled air.

(n) *Test sampler* means a PM_{10} sampler or a $PM_{2.5}$ sampler subjected to testing as part of a candidate method in accordance with subparts C, D, E or F of this part.

(o) *Collocated* describes two or more air samplers, analyzers, or other instruments which sample the ambient air that are operated simultaneously while located side by side, separated by a distance that is large enough to preclude the air sampled by any of the devices from being affected by any of the other devices, but small enough so that all devices obtain identical or uniform ambient air samples that are equally representative of the general area in which the group of devices is located.

(p) *Sequential samples* for particulate matter samplers means two or more particulate matter samples for sequential (but not necessarily contiguous) time periods that are collected automatically by the same sampler without the need for intervening operator service.

(q) *Class I equivalent method* means an equivalent method for $PM_{2.5}$ which is based on a sampler that is very similar to the sampler specified for reference methods in Appendix L of part 50 of this chapter, with only minor deviations or modifications, as determined by the EPA. A common example of a Class I $PM_{2.5}$ sampler is a reference method sampler that has been modified to provide automatic collection of sequential samples, as defined in paragraph (p) of this section.

(r) *Class II equivalent method* means an equivalent method for $PM_{2.5}$ that utilizes a $PM_{2.5}$ sampler in which an integrated $PM_{2.5}$ sample is obtained from the atmosphere by filtration and subjected to a subsequent filter equilibration process followed by a gravimetric mass determination, but which is not a Class I equivalent method because of substantial deviations from the design specifications of the sampler specified for reference methods in Appendix L of part 50 of this chapter, as determined by the EPA.

(s) *Class III equivalent method* means an equivalent method for $PM_{2.5}$ that has been determined by the EPA not to be a Class I or Class II equivalent method. This fourth type of $PM_{2.5}$ method includes alternative equivalent method samplers and continuous analyzers, based on designs and measurement principles different from those specified for reference methods (e.g., a means for estimating aerosol mass concentration other than by conventional integrated filtration followed by equilibration and gravimetric analysis). These samplers (or monitors) are those deemed to be substantially different from reference method samplers and may use components and methods other than

those specified for reference method samplers. Class III candidate samplers or analyzers require full equivalency testing and must meet all requirements specified in subpart F of this chapter.

(t) An *ISO-registered facility* shall be defined as a manufacturing facility that is either:

(1) An International Organization for Standardization (ISO) 9001-registered manufacturing facility, with registration maintained continuously; or

(2) A facility that can be demonstrated, on the basis of information submitted to the EPA, to be operated according to an EPA-approved and periodically audited quality system which meets, to the extent appropriate, the same general requirements as an ISO registered facility for the design and manufacture of designated reference and equivalent method samplers and monitors.

(u) An *ISO-certified auditor* shall be defined as an auditor either certified by an ISO accredited registrar or an auditor who, based on information submitted to the EPA, meets the same general requirements as provided for ISO-certified auditors.

§ 53.2 General requirements for a reference method determination.

The following general requirements for a reference method determination are summarized in Table A–1 of this subpart.

(a) *Manual methods.* (1) For measuring SO_2 and lead, Appendices A and G of part 50 of this chapter specify unique manual reference methods for those pollutants. Except as provided in § 53.16, other manual methods for SO_2 and lead will not be considered for reference method determinations under this part.

(2) A reference method for measuring PM_{10} must be a manual method that meets all requirements specified in Appendix J of part 50 of this chapter and must include a PM_{10} sampler that has been shown in accordance with this part to meet all requirements specified in subpart D of this part.

(3) A reference method for measuring $PM_{2.5}$ must be a manual method that meets the requirements specified in Appendix L of part 50 of this chapter and must include a $PM_{2.5}$ sampler that has been shown in accordance with this part to meet the applicable requirements specified in subpart E of this part. Further, reference method samplers must be manufactured in an ISO 9001-registered facility as defined in § 53.1(t) and , as set forth in § 53.51 (subpart E, of this part), and the Product Manufacturing Checklist set forth in subpart E of this part must be completed by an ISO 9001-certified auditor, as defined in § 53.1(u), and submitted to the EPA annually to retain a $PM_{2.5}$ reference method designation. In addition, all designated reference methods for $PM_{2.5}$ must meet requirements for network operating performance determined annually as set forth in section 6 of Appendix A of part 58 of this chapter.

(b) ''Automated methods.'' An automated reference method for measuring CO, O_3, and NO_2 must utilize the measurement principle and calibration procedure specified in the appropriate appendix to part 50 of this chapter and must have been shown in accordance with this part to meet the requirements specified in subpart B of this part.

§ 53.3 General requirements for an equivalent method determination.

(a) *Manual methods.* A manual equivalent method must have been shown in accordance with this part to satisfy the applicable requirements specified in subpart C of this part. In addition, PM_{10} or $PM_{2.5}$ samplers associated with manual equivalent methods for PM_{10} or $PM_{2.5}$ must have been shown in accordance with this part to satisfy the following additional requirements:

(1) A PM_{10} sampler associated with a manual method for PM_{10} must satisfy the requirements of subpart D of this part.

(2) A $PM_{2.5}$ Class I equivalent method sampler must satisfy all requirements of subparts C and E of this part, which include appropriate demonstration that each and every deviation or modification from the reference method sampler specifications does not significantly alter the performance of the sampler.

(3) A $PM_{2.5}$ Class II equivalent method sampler must satisfy the requirements of subparts C, E, and F of this chapter.

(4) Requirements for $PM_{2.5}$ Class III equivalent method samplers are not provided in this part because of the wide range of no-filter-based measurement technologies that could be applied and the likelihood that these requirements will have to be specifically adapted for each such type of technology. Specific requirements will be developed as needed.

(5) All designated equivalent methods for $PM_{2.5}$ must be manufactured in an ISO 9001-registered facility, as defined in § 53.1(t) and as set forth in § 53.51 (subpart E) of this part, and the Product Manufacturing Checklist set forth in Appendix E of this part must be completed by an ISO 9001-certified auditor, as defined in § 53.1(u), and submitted to the EPA annually to retain a $PM_{2.5}$ equivalent method designation.

(6) All designated equivalent methods for $PM_{2.5}$ must also meet annual requirements for network operating performance determined as set forth in section 6 of Appendix A of part 58 of this chapter.

(b) *Automated methods.* (1) Automated equivalent methods for pollutants other than $PM_{2.5}$ or PM_{10} must have been shown in accordance with this part to satisfy the requirements specified in subparts B and C of this part.

(2) Automated equivalent methods for PM_{10} must have been shown in accordance with this part to satisfy the requirements of subparts C and D of this part.

(3) Requirements for $PM_{2.5}$ Class III automated equivalent methods for $PM_{2.5}$ are not provided in this part because of the wide range of non-filter-based measurement technologies that could be applied and the likelihood that these requirements will have to be specifically adapted for each such type of technology. Specific requirements will be developed as needed.

(4) All designated equivalent methods for $PM_{2.5}$ must be manufactured in an ISO 9001-registered facility, as set forth in Appendix E of this part, and the Product Manufacturing Checklist set forth in Appendix E of this part must be completed by an ISO 9001-certified auditor and submitted to the EPA annually to retain a $PM_{2.5}$ equivalent method designation.

(5) All designated equivalent methods for $PM_{2.5}$ must also meet annual requirements for network operating performance determined as set forth in section 6 of Appendix A of part 58 of this chapter.

§ 53.4 Applications for reference or equivalent method determinations.

(a) Applications for reference or equivalent method determinations shall be submitted in duplicate to: Director, National Exposure Research Laboratory, Department E (MD–77B), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

(b) Each application shall be signed by an authorized representative of the applicant, shall be marked in accordance with § 53.15 (if applicable), and shall contain the following:

(1) A clear identification of the candidate method, which will distinguish it from all other methods such that the method may be referred to unambiguously. This identification must consist of a unique series of descriptors such as title, identification

number, analyte, measurement principle, manufacturer, brand, model, etc., as necessary to distinguish the method from all other methods or method variations, both within and outside the applicant's organization.

(2) A detailed description of the candidate method, including but not limited to the following: The measurement principle, manufacturer, name, model number and other forms of identification, a list of the significant components, schematic diagrams, design drawings, and a detailed description of the apparatus and measurement procedures. Drawings and descriptions pertaining to candidate methods or samplers for $PM_{2.5}$ must meet all applicable requirements in Reference 1 of Appendix A to this subpart, using appropriate graphical, nomenclature, and mathematical conventions such as those specified in References 3 and 4 of Appendix A to this subpart.

(3) A copy of a comprehensive operation or instruction manual providing a complete and detailed description of the operational and calibration procedures prescribed for field use of the candidate method and all instruments utilized as part of that method (see § 53.9a).

(i) As a minimum this manual shall include:

(A) Description of the method and associated instruments;

(B) Explanation of all indicators, information displays, and controls;

(C) Complete setup and installation instructions, including any additional materials or supplies required;

(D) Details of all initial or startup checks or acceptance tests and any auxiliary equipment required;

(E) Complete operational instructions;

(F) Calibration procedures and required calibration equipment and standards;

(G) Instructions for verification of correct or proper operation;

(H) Trouble-shooting guidance and suggested corrective actions for abnormal operation;

(I) Required or recommended routine, periodic, and preventative maintenance and maintenance schedules,

(J) Any calculations required to derive final concentration measurements; and

(K) Appropriate references to 40 CFR part 50, Appendix L, Reference 6, and any other pertinent guidelines.

(ii) The manual shall also include adequate warning of potential safety hazards that may result from normal use and/or malfunction of the method and a description of necessary safety precautions. [See § 53.9(b)] However, the previous requirement shall not be interpreted to constitute or imply any warranty of safety of the method by the EPA. For samplers and automated methods, the manual shall include a clear description of all procedures pertaining to installation, operation, preventative maintenance, and troubleshooting and shall also include parts identification diagrams. The manual may be used to satisfy the requirements of paragraphs (b) (1) and (2) of this section to the extent that it includes information necessary to meet those requirements.

(4) A statement that the candidate method has been tested in accordance with the procedures described in subparts B, C, D, E, and/or F of this part, as applicable.

(5) Test data, records, calculations, and test results as specified in subparts B, C, D, E, and/or F of this part, as applicable. Data must be sufficiently detailed to meet appropriate principles described in paragraphs 4 through 6 of Reference 2, Part b, sections 3.3.1 (paragraph 1) and 3.5.1 (paragraphs 2 and 3) and in paragraphs 1 through 3 of Reference 5 (section 4.8, Records) of appendix A of this subpart. Salient requirements from these references include the following:

(i) The applicant shall maintain and include records of all relevant measuring equipment, including the make, type, and serial number or other identification, and most recent calibration with identification of the measurement standard or standards used and their NIST traceability. These records shall demonstrate the measurement capability of each item of measuring equipment used for the application and include a description and justification (if needed) of the measurement setup or configuration in which it was used for the tests. The calibration results shall be recorded and identified in sufficient detail so that the traceability of all measurements can be determined and any measurement could be reproduced under conditions close to the original conditions, if necessary, to resolve any anomalies.

(ii) Test data shall be collected according to the standards of good practice and by qualified personnel. Test anomalies or irregularities shall be documented and explained or justified. The impact and significance of the deviation on test results and conclusions shall be determined. Data collected shall correspond directly to the specified test requirement and be labeled and identified clearly so that results can be verified and evaluated against the test requirement. Calculations or data manipulations must be explained in detail so that they can be verified.

(6) A statement that the method, analyzer, or sampler tested in accordance with this part is representative of the candidate method described in the application.

(c) For candidate automated methods and candidate manual methods for PM_{10} and $PM_{2.5}$, the application shall also contain the following:

(1) A detailed description of the quality system that will be utilized, if the candidate method is designated as a reference or equivalent method, to ensure that all analyzers or samplers offered for sale under that designation will have essentially the same performance characteristics as the analyzer(s) or samplers tested in accordance with this part. In addition, the quality system requirements for candidate methods for $PM_{2.5}$ must be described in sufficient detail, based on the elements described in section 4 of Reference 1 (Quality System Requirements) of appendix A of this subpart. Further clarification is provided in the following sections of Reference 2: Part A (Management Systems), sections 2.2 (Quality System and Description), 2.3 (Personnel Qualification and Training), 2.4 (Procurement of Items and Services), 2.5 (Documents and Records), and 2.7 (Planning); Part B (Collection and Evaluation of Environmental Data), sections 3.1 (Planning and Scoping), 3.2 (Design of Data Collection Operations), and 3.5 (Assessment and Verification of Data Usability); and Part C (Operation of Environmental Technology), sections 4.1 (Planning), 4.2 (Design of Systems), and 4.4 (Operation of Systems) of appendix A of this subpart .

(2) A description of the durability characteristics of such analyzers or samplers [see §53.9(c)]. For methods for $PM_{2.5}$, the warranty program must ensure that the required specifications (see Table A–1 of this subpart) will be met throughout the warranty period and that the applicant accepts responsibility and liability for ensuring this conformance, or resolving any nonconformities, including all necessary components of the system, regardless of the original manufacturer. The warranty program must be described in sufficient detail to meet appropriate provisions of the ANSI/ASQC and ISO 9001 standards (References 1 and 2 in appendix A of this subpart) for controlling conformance and resolving nonconformance, particularly sections 4.12, 4.13, and 4.14 of Reference 1 in appendix A of this subpart.

(i) Section 4.12 in appendix A of this subpart requires the manufacturer to establish and maintain a system of procedures for identifying and maintaining the identification of inspection and test status throughout all phases of manufacturing to ensure that only instruments that have passed the required inspections and tests are released for sale.

(ii) Section 4.13 in appendix A of this subpart requires documented procedures for control of nonconforming product, including review and acceptable alternatives for disposition; section 4.14 requires documented procedures for implementing corrective (4.14.2) and preventive (4.14.3) action to eliminate the causes of actual or potential nonconformities. In particular, section 4.14.3 requires that potential causes of nonconformities be eliminated by using information such as service reports and customer complaints to eliminate potential causes of nonconformities.

(d) For candidate reference or equivalent methods for $PM_{2.5}$, the applicant shall provide to EPA for test purposes one sampler or analyzer that is representative of the sampler or analyzer associated with the candidate method. The sampler or analyzer shall be shipped FOB destination to Department E, (MD–77B), U.S. EPA, 79 T.W. Alexander Drive, Research Triangle Park, NC 27709, scheduled to arrive concurrent with or within 30 days of the arrival of the other application materials. This analyzer or sampler may be subjected to various tests that the EPA determines to be necessary or appropriate under § 53.5(e), and such tests may include special tests not otherwise described in this part. If the instrument submitted under this paragraph malfunctions, becomes inoperative, or fails to perform as represented in the application before the necessary EPA testing is completed, the applicant shall be afforded an opportunity to repair or replace the device at no cost to the EPA. Upon completion of the EPA testing, the analyzer or sampler submitted under this paragraph shall be repacked by the EPA for return shipment to the applicant, using the same packing materials used for shipping the instrument to the EPA unless alternative packing is provided by the applicant. Arrangements for, and the cost of, return shipment shall be the responsibility of the applicant. The EPA does not warrant or assume any liability for the condition of the analyzer or sampler upon return to the applicant.

§ 53.5 Processing of applications.

After receiving an application for a reference or equivalent method determination, the Administrator will publish notice of the application in the Federal Register and, within 120 calendar days after receipt of the application, take one or more of the following actions:

(a) Send notice to the applicant, in accordance with § 53.8, that the candidate method has been determined to be a reference or equivalent method;

(b) Send notice to the applicant that the application has been rejected, including a statement of reasons for rejection;

(c) Send notice to the applicant that additional information must be submitted before a determination can be made and specify the additional information that is needed (in such cases, the 120-day period shall commence upon receipt of the additional information);

(d) Send notice to the applicant that additional test data must be submitted and specify what tests are necessary and how they shall be interpreted (in such cases, the 120-day period shall commence upon receipt of the additional test data);

(e) Send notice to the applicant that the application has been found to be substantially deficient or incomplete and cannot be processed until additional information is submitted to complete the application and specify the general areas of substantial deficiency; or

(f) Send notice to the applicant that additional tests will be conducted by the Administrator, specifying the nature of and reasons for the additional tests and the estimated time required (in such cases, the 120-day period shall commence one calendar day after the additional tests have been completed).

§ 53.6 Right to witness conduct of tests.

(a) Submission of an application for a reference or equivalent method determination shall constitute consent for the Administrator or the Administrator's authorized representative, upon presentation of appropriate credentials, to witness or observe any tests required by this part in connection with the application or in connection with any modification or intended modification of the method by the applicant.

(b) The applicant shall have the right to witness or observe any test conducted by the Administrator in connection with the application or in connection with any modification or intended modification of the method by the applicant.

(c) Any tests by either party that are to be witnessed or observed by the other party shall be conducted at a time and place mutually agreeable to both parties.

§ 53.7 Testing of methods at the initiative of the Administrator.

(a) In the absence of an application for a reference or equivalent method determination, the Administrator may conduct the tests required by this part for such a determination, may compile such other information as may be necessary in the judgment of the Administrator to make such a determination, and on the basis of the tests and information may determine that a method satisfies applicable requirements of this part.

(b) In the absence of an application requesting the Administrator to consider revising an appendix to part 50 of this chapter in accordance with § 53.16, the Administrator may conduct such tests and compile such information as may be necessary in the Administrator's judgment to make a determination under § 53.16(d) and on the basis of the tests and information make such a determination.

(c) If a method tested in accordance with this section is designated as a reference or equivalent method in accordance with § 53.8 or is specified or designated as a reference method in accordance with § 53.16, any person or entity who offers the method for sale as a reference or equivalent method thereafter shall assume the rights and obligations of an applicant for purposes of this part, with the exception of those pertaining to submission and processing of applications.

§ 53.8 Designation of reference and equivalent methods.

(a) A candidate method determined by the Administrator to satisfy the applicable requirements of this part shall be designated as a reference method or equivalent method (as applicable), and a notice of the designation shall be submitted for publication in the Federal Register not later than 15 days after the determination is made.

(b) A notice indicating that the method has been determined to be a reference method or an equivalent method shall be sent to the applicant. This notice shall constitute proof of the determination until a notice of designation is published in accordance with paragraph (a) of this section.

(c) The Administrator will maintain a current list of methods designated as reference or equivalent methods in accordance with this part and will send a copy of the list to any person or group

upon request. A copy of the list will be available for inspection or copying at EPA Regional Offices.

§ 53.9 Conditions of designation.

Designation of a candidate method as a reference method or equivalent method shall be conditioned on the applicant's compliance with the following requirements. Failure to comply with any of the requirements shall constitute a ground for cancellation of the designation in accordance with § 53.11.

(a) Any method offered for sale as a reference or equivalent method shall be accompanied by a copy of the manual referred to in § 53.4(b)(3) when delivered to any ultimate purchaser.

(b) Any method offered for sale as a reference or equivalent method shall generate no unreasonable hazard to operators or to the environment during normal use or when malfunctioning.

(c) Any analyzer, PM_{10} sampler, or $PM_{2.5}$ sampler offered for sale as a reference or equivalent method shall function within the limits of the performance specifications referred to in § 53.20(a), § 53.40(a), § 53.50(a), or § 53.60(a), as applicable, for at least 1 year after delivery and acceptance when maintained and operated in accordance with the manual referred to in § 53.4(b)(3).

(d) Any analyzer, PM_{10} sampler or $PM_{2.5}$ sampler offered for sale as a reference or equivalent method shall bear a prominent, permanently affixed label or sticker indicating that the analyzer or sampler has been designated by EPA as a reference method or as an equivalent method (as applicable) in accordance with this part and displaying any designated method identification number that may be assigned by the EPA.

(e) If an analyzer is offered for sale as a reference or equivalent method and has one or more selectable ranges, the label or sticker required by paragraph (d) of this section shall be placed in close proximity to the range selector and shall indicate clearly which range or ranges have been designated as parts of the reference or equivalent method.

(f) An applicant who offers analyzers, PM_{10} samplers, or $PM_{2.5}$ samplers for sale as reference or equivalent methods shall maintain an accurate and current list of the names and mailing addresses of all ultimate purchasers of such analyzers or samplers. For a period of 7 years after publication of the reference or equivalent method designation applicable to such an analyzer or sampler, the applicant shall notify all ultimate purchasers of the analyzer or $PM_{2.5}$ or PM_{10} sampler within 30 days if the designation has been canceled in accordance with § 53.11 or § 53.16 or if adjustment of the analyzer or sampler is necessary under § 53.11(b).

(g) If an applicant modifies an analyzer, PM_{10} sampler, or $PM_{2.5}$ sampler that has been designated as a reference or equivalent method, the applicant shall not sell the modified analyzer or sampler as a reference or equivalent method nor attach a label or sticker to the modified analyzer or sampler under paragraph (d) or (e) of this section until the applicant has received notice under § 53.14(c) that the existing designation or a new designation will apply to the modified analyzer, PM_{10} sampler, or $PM_{2.5}$ sampler or has applied for and received notice under § 53.8(b) of a new reference or equivalent method determination for the modified analyzer or sampler.

(h) An applicant who has offered $PM_{2.5}$ samplers or analyzers for sale as part of a reference or equivalent method may continue to do so only so long as the reference or equivalent method meets the annual requirements for network operating performance determined as set forth in section 6 of Appendix A of part 58 of this chapter. In the event that the annual network operating performance does not meet those requirements, the EPA shall, within 90 days after the end of the calendar year, notify the applicant of the unacceptable network performance assessment and issue a preliminary finding and notification of possible cancellation of the reference or equivalent method designation under § 53.11. (Net performance is generally assessed for each calendar year, although when the number of samples for a specific method is not great enough to determine precision with adequate confidence, more than 1 calendar year of data may be combined.)

(i) An applicant who has offered $PM_{2.5}$ samplers or analyzers for sale as part of a reference or equivalent method may continue to do so only so long as the facility in which the samplers or analyzers are manufactured continues to be an ISO-registered facility, as set forth in subpart E of this part. In the event that the ISO registration for the facility is withdrawn, suspended, or otherwise becomes inapplicable, either permanently or for some specified time interval, such that the facility is no longer an ISO-registered facility, the applicant shall notify EPA within 30 days of the date the facility becomes other than an ISO-registered facility, and upon such notification, the EPA shall issue a preliminary finding and notification of possible cancellation of the reference or equivalent method designation under § 53.11.

(j) An applicant who has offered $PM_{2.5}$ samplers or analyzers for sale as part of a reference or equivalent method may continue to do so only so long as updates of the Product Manufacturing Checklist set forth in subpart E of this part are submitted annually. In the event that an annual Checklist update is not received by the EPA within 12 months of the date of the last such submitted Checklist or Checklist update, the EPA shall notify the applicant within 30 days that the Checklist update has not been received and shall, within 30 days from the issuance of such notification, issue a preliminary finding and notification of possible cancellation of the reference or equivalent method designation under § 53.11.

§ 53.10 Appeal from rejection of application.

Any applicant whose application for a reference or equivalent method determination has been rejected may appeal the Administrator's decision by taking one or more of the following actions:

(a) The applicant may submit new or additional information in support of the application.

(b) The applicant may request that the Administrator reconsider the data and information already submitted.

(c) The applicant may request that any test conducted by the Administrator that was a material factor in the decision to reject the application be repeated.

§ 53.11 Cancellation of reference or equivalent method designation.

(a) *Preliminary finding.* If the Administrator makes a preliminary finding on the basis of any available information that a representative sample of a method designated as a reference or equivalent method and offered for sale as such does not fully satisfy the requirements of this part or that there is any violation of the requirements set forth in § 53.9, the Administrator may initiate proceedings to cancel the designation in accordance with the following procedures.

(b) *Notification and opportunity to demonstrate or achieve compliance.*

(1) After making a preliminary finding in accordance with paragraph (a) of this section, the Administrator will send notice of the preliminary finding to the applicant, together with a statement of the facts and reasons on which the preliminary finding is based, and will publish notice of the preliminary finding in the Federal Register.

(2) The applicant will be afforded an opportunity to demonstrate or to

achieve compliance with the requirements of this part within 60 days after publication of notice in accordance with paragraph (b)(1) of this section or within such further period as the Administrator may allow, by demonstrating to the satisfaction of the Administrator that the method in question satisfies the requirements of this part, by commencing a program to make any adjustments that are necessary to bring the method into compliance, or by taking such action as may be necessary to cure any violation of the requirements of § 53.9. If adjustments are necessary to bring the method into compliance, all such adjustments shall be made within a reasonable time as determined by the Administrator. If the applicant demonstrates or achieves compliance in accordance with this paragraph (b)(2), the Administrator will publish notice of such demonstration or achievement in the Federal Register.

(c) *Request for hearing.* Within 60 days after publication of a notice in accordance with paragraph (b)(1) of this section, the applicant or any interested person may request a hearing as provided in § 53.12.

(d) *Notice of cancellation.* If, at the end of the period referred to in paragraph (b)(2) of this section, the Administrator determines that the reference or equivalent method designation should be canceled, a notice of cancellation will be published in the Federal Register and the designation will be deleted from the list maintained under § 53.8(c). If a hearing has been requested and granted in accordance with § 53.12, action under this paragraph (d) will be taken only after completion of proceedings (including any administrative review) conducted in accordance with § 53.13 and only if the decision of the Administrator reached in such proceedings is that the designation in question should be canceled.

§ 53.12 Request for hearing on cancellation.

Within 60 days after publication of a notice in accordance with § 53.11(b)(1), the applicant or any interested person may request a hearing on the Administrator's action. If, after reviewing the request and supporting data, the Administrator finds that the request raises a substantial issue of fact, a hearing will be granted in accordance with § 53.13 with respect to such issue. The request shall be in writing, signed by an authorized representative of the applicant or interested person, and shall include a statement specifying:

(a) Any objections to the Administrator's action; and

(b) Data or other information in support of such objections.

§ 53.13 Hearings.

(a)(1) After granting a request for a hearing under § 53.12, the Administrator will designate a presiding officer for the hearing.

(2) If a time and place for the hearing have not been fixed by the Administrator, the hearing will be held as soon as practicable at a time and place fixed by the presiding officer, except that the hearing shall in no case be held sooner than 30 days after publication of a notice of hearing in the Federal Register.

(3) For purposes of the hearing, the parties shall include the Environmental Protection Agency, the applicant or interested person(s) who requested the hearing, and any person permitted to intervene in accordance with paragraph (c) of this section.

(4) The Deputy General Counsel or the Deputy General Counsel's representative will represent the Environmental Protection Agency in any hearing under this section.

(5) Each party other than the Environmental Protection Agency may be represented by counsel or by any other duly authorized representative.

(b)(1) Upon appointment, the presiding officer will establish a hearing file. The file shall contain copies of the notices issued by the Administrator pursuant to § 53.11(b)(1), together with any accompanying material, the request for a hearing and supporting data submitted therewith, the notice of hearing published in accordance with paragraph (a)(2) of this section, and correspondence and other material data relevant to the hearing.

(2) The hearing file shall be available for inspection by the parties or their representatives at the office of the presiding officer, except to the extent that it contains information identified in accordance with § 53.15.

(c) The presiding officer may permit any interested person to intervene in the hearing upon such a showing of interest as the presiding officer may require; provided that permission to intervene may be denied in the interest of expediting the hearing where it appears that the interests of the person seeking to intervene will be adequately represented by another party (or by other parties), including the Environmental Protection Agency.

(d)(1) The presiding officer, upon the request of any party or at the officer's discretion, may arrange for a prehearing conference at a time and place specified by the officer to consider the following:

(i) Simplification of the issues.

(ii) Stipulations, admissions of fact, and the introduction of documents.

(iii) Limitation of the number of expert witnesses.

(iv) Possibility of agreement on disposing of all or any of the issues in dispute.

(v) Such other matters as may aid in the disposition of the hearing, including such additional tests as may be agreed upon by the parties.

(2) The results of the conference shall be reduced to writing by the presiding officer and made part of the record.

(e)(1) Hearings shall be conducted by the presiding officer in an informal but orderly and expeditious manner. The parties may offer oral or written evidence, subject to exclusion by the presiding officer of irrelevant, immaterial, or repetitious evidence.

(2) Witnesses shall be placed under oath.

(3) Any witness may be examined or cross-examined by the presiding officer, the parties, or their representatives. The presiding officer may, at his discretion, limit cross-examination to relevant and material issues.

(4) Hearings shall be reported verbatim. Copies of transcripts of proceedings may be purchased from the reporter.

(5) All written statements, charts, tabulations, and data offered in evidence at the hearing shall, upon a showing satisfactory to the presiding officer of their authenticity, relevancy, and materiality, be received in evidence and shall constitute part of the record.

(6) Oral argument shall be permitted. The presiding officer may limit oral presentations to relevant and material issues and designate the amount of time allowed for oral argument.

(f)(1) The presiding officer shall make an initial decision which shall include written findings and conclusions and the reasons therefor on all the material issues of fact, law, or discretion presented on the record. The findings, conclusions, and written decision shall be provided to the parties and made part of the record. The initial decision shall become the decision of the Administrator without further proceedings unless there is an appeal to, or review on motion of, the Administrator within 30 calendar days after the initial decision is filed.

(2) On appeal from or review of the initial decision, the Administrator will have all the powers consistent with making the initial decision, including the discretion to require or allow briefs, oral argument, the taking of additional evidence or the remanding to the presiding officer for additional proceedings. The decision by the

Administrator will include written findings and conclusions and the reasons or basis therefor on all the material issues of fact, law, or discretion presented on the appeal or considered in the review.

§ 53.14 Modification of a reference or equivalent method.

(a) An applicant who offers a method for sale as a reference or equivalent method shall report to the Administrator prior to implementation any intended modification of the method, including but not limited to modifications of design or construction or of operational and maintenance procedures specified in the operation manual [see § 53.9(g)]. The report shall be signed by an authorized representative of the applicant, marked in accordance with § 53.15 (if applicable), and addressed as specified in § 53.4(a).

(b) A report submitted under paragraph (a) of this section shall include:

(1) A description, in such detail as may be appropriate, of the intended modification;

(2) A brief statement of the applicant's belief that the modification will, will not, or may affect the performance characteristics of the method;

(3) A brief statement of the probable effect if the applicant believes the modification will or may affect the performance characteristics of the method; and

(4) Such further information, including test data, as may be necessary to explain and support any statement required by paragraphs (b)(2) and (b)(3) of this section.

(c) Within 30 calendar days after receiving a report under paragraph (a) of this section, the Administrator will take one or more of the following actions:

(1) Notify the applicant that the designation will continue to apply to the method if the modification is implemented.

(2) Send notice to the applicant that a new designation will apply to the method (as modified) if the modification is implemented, submit notice of the determination for publication in the Federal Register, and revise or supplement the list referred to in § 53.8(c) to reflect the determination.

(3) Send notice to the applicant that the designation will not apply to the method (as modified) if the modification is implemented and submit notice of the determination for publication in the Federal Register;

(4) Send notice to the applicant that additional information must be submitted before a determination can be made and specify the additional information that is needed (in such cases, the 30-day period shall commence upon receipt of the additional information);

(5) Send notice to the applicant that additional tests are necessary and specify what tests are necessary and how they shall be interpreted (in such cases, the 30-day period shall commence upon receipt of the additional test data); or

(6) Send notice to the applicant that additional tests will be conducted by the Administrator and specify the reasons for and the nature of the additional tests (in such cases, the 30-day period shall commence one calendar day after the additional tests are completed).

(d) An applicant who has received a notice under paragraph (c)(3) of this section may appeal the Administrator's action as follows:

(1) The applicant may submit new or additional information pertinent to the intended modification.

(2) The applicant may request the Administrator to reconsider data and information already submitted.

(3) The applicant may request that the Administrator repeat any test conducted that was a material factor in the Administrator's determination. A representative of the applicant may be present during the performance of any such retest.

§ 53.15 Trade secrets and confidential or privileged information.

Any information submitted under this part that is claimed to be a trade secret or confidential or privileged information shall be marked or otherwise clearly identified as such in the submittal. Information so identified will be treated in accordance with part 2 of this chapter (concerning public information).

§ 53.16 Supersession of reference methods.

(a) This section prescribes procedures and criteria applicable to requests that the Administrator specify a new reference method, or a new measurement principle and calibration procedure on which reference methods shall be based, by revision of the appropriate appendix to 50 part of this chapter. Such action will ordinarily be taken only if the Administrator determines that a candidate method or a variation thereof is substantially superior to the existing reference method(s).

(b) In exercising discretion under this section, the Administrator will consider:

(1) The benefits, in terms of the requirements and purposes of the Act, that would result from specifying a new reference method or a new measurement principle and calibration procedure;

(2) The potential economic consequences of such action for State and local control agencies; and

(3) Any disruption of State and local air quality monitoring programs that might result from such action.

(c) An applicant who wishes the Administrator to consider revising an appendix to part 50 of this chapter on the ground that the applicant's candidate method is substantially superior to the existing reference method(s) shall submit an application for a reference or equivalent method determination in accordance with § 53.4 and shall indicate therein that such consideration is desired. The application shall include, in addition to the information required by § 53.4, data and any other information supporting the applicant's claim that the candidate method is substantially superior to the existing reference method(s).

(d) After receiving an application under paragraph (c) of this section, the Administrator will publish notice of its receipt in the Federal Register and, within 120 calendar days after receipt of the application, take one of the following actions:

(1) Determine that it is appropriate to propose a revision of the appendix to part 50 of this chapter in question and send notice of the determination to the applicant;

(2) Determine that it is inappropriate to propose a revision of the appendix to part 50 of this chapter in question, determine whether the candidate method is a reference or equivalent method, and send notice of the determinations, including a statement of reasons for the determination not to propose a revision, to the applicant;

(3) Send notice to the applicant that additional information must be submitted before a determination can be made and specify the additional information that is needed (in such cases, the 120-day period shall commence upon receipt of the additional information);

(4) Send notice to the applicant that additional tests are necessary, specifying what tests are necessary and how they shall be interpreted (in such cases, the 120-day period shall commence upon receipt of the additional test data); or

(5) Send notice to the applicant that additional tests will be conducted by the Administrator, specifying the nature of and reasons for the additional tests and the estimated time required (in such cases, the 120-day period shall

commence one calendar day after the additional tests have been completed).

(e)(1)(i) After making a determination under paragraph (d)(1) of this section, the Administrator will publish a notice of proposed rulemaking in the Federal Register. The notice will indicate that the Administrator proposes:

(A) To revise the appendix to part 50 of this chapter in question;

(B) Where the appendix specifies a measurement principle and calibration procedure, to cancel reference method designations based on the appendix; and

(C) To cancel equivalent method designations based on the existing reference method(s).

(ii) The notice will include the terms or substance of the proposed revision, will indicate what period(s) of time the Administrator proposes to allow for replacement of existing methods under section 2.3 of Appendix C to part 58 of this chapter, and will solicit public comments on the proposal with particular reference to the considerations set forth in paragraphs (a) and (b) of this section.

(2) If, after consideration of comments received, the Administrator determines that the appendix to part 50 in question should be revised, the Administrator will by publication in the Federal Register promulgate the proposed revision, with such modifications as may be appropriate in view of comments received; where the appendix to part 50 (prior to revision) specifies a measurement principle and calibration procedure, cancel reference method designations based on the appendix; cancel equivalent method designations based on the existing reference method(s); and specify the period(s) that will be allowed for replacement of existing methods under section 2.3 of Appendix C to part 58 of this chapter, with such modifications from the proposed period(s) as may be appropriate in view of comments received. Canceled designations will be deleted from the list maintained under §53.8(c). The requirements and procedures for cancellation set forth in §53.11 shall be inapplicable to cancellation of reference or equivalent method designations under this section.

(3) If the appendix to part 50 of this chapter in question is revised to specify a new measurement principle and calibration procedure on which the applicant's candidate method is based, the Administrator will take appropriate action under §53.5 to determine whether the candidate method is a reference method.

(4) Upon taking action under paragraph (e)(2) of this section, the Administrator will send notice of the action to all applicants for whose methods reference and equivalent method designations are canceled by such action.

(f) An applicant who has received notice of a determination under paragraph (d)(2) of this section may appeal the determination by taking one or more of the following actions:

(1) The applicant may submit new or additional information in support of the application.

(2) The applicant may request that the Administrator reconsider the data and information already submitted.

(3) The applicant may request that any test conducted by the Administrator that was a material factor in making the determination be repeated.

Tables to Subpart A of Part 53

TABLE A–1 TO SUBPART A—SUMMARY OF APPLICABLE REQUIREMENTS FOR REFERENCE AND EQUIVALENT METHODS FOR AIR MONITORING OF CRITERIA POLLUTANTS

Pollutant	Ref. or equivalent	Manual or automated	Applicable part 50 appendix	Applicable subparts of part 53					
				A	B	C	D	E	F
SO_2	Reference	Manual	A						
	Equivalent	Manual		✔		✔			
		Automated		✔	✔	✔			
CO	Reference	Automated	C	✔	✔				
	Equivalent	Manual		✔		✔			
		Automated		✔	✔	✔			
O_3	Reference	Automated	D	✔	✔				
	Equivalent	Manual		✔		✔			
		Automated		✔	✔	✔			
NO_2	Reference	Automated	F	✔	✔				
	Equivalent	Manual		✔		✔			
		Automated		✔	✔	✔			
Pb	Reference	Manual	G						
	Equivalent	Manual		✔		✔			
PM_{10}	Reference	Manual	J	✔			✔		
	Equivalent	Manual		✔		✔	✔		
		Automated		✔		✔	✔		
$PM_{2.5}$	Reference	Manual	L	✔				✔	
	Equivalent Class I	Manual	L	✔		✔		✔	
	Equivalent Class II	Manual	L	✔		✔		✔	✔
	Equivalent Class III	Manual or Automated		✔		✔[1]		✔[1]	✔[1]

[1] Because of the wide variety of potential devices possible, the specific requirements applicable to a Class III candidate equivalent method for $PM_{2.5}$ are not specified explicitly in this part but, instead, shall be determined on a case-by-case basis for each such candidiate method.

Appendix A to Subpart A of Part 53—References

1. American National Standard—Quality Systems-Model for Quality Assurance in Design, Development, Production, Installation, and Servicing, ANSI/ISO/ASQC Q9001–1994. Available from American Society for Quality Control, 611 East Wisconsin Avenue, Milwaukee, WI 53202.
2. American National Standard—Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs, ANSI/ASQC E4—1994. Available from American Society for Quality Control, 611 East Wisconsin Avenue, Milwaukee, WI 53202.
3. Dimensioning and Tolerancing, ASME Y14.5M–1994. Available from the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.
4. Mathematical Definition of Dimensioning and Tolerancing Principles, ASME Y14.5.1M–1994. Available from the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.
5. ISO 10012, Quality assurance requirements for measuring equipment—Part 1: Meteorological confirmation system for measuring equipment):1992(E). Available from American Society for Quality Control, 611 East Wisconsin Avenue, Milwaukee, WI 53202.
6. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Specific Methods (Interim Edition), Section 2.12. EPA/600/R–94/038b, April 1994. Available from CERI, ORD Publications, U.S. Environmental Protection Agency, 26 West Martin Luther King Drive, Cincinnati, Ohio 45268. [Note: Section 2.12 of Volume II is currently under development and will not be available from the CERI address until it is published as an addition to EPA/600/R–94/038b. Prepublication draft copies of Section 2.12 will be available from Department E (MD–77B), U. S. EPA, Research Triangle Park, NC 27711 or from the contact identified at the beginning of this proposed rule.]

3. Subpart C is revised to read as follows:

Subpart C—Procedures for Determining Comparability Between Candidate Methods and Reference Methods

Sec.
53.30 General provisions.
53.31 Test conditions.
53.32 Test procedures for methods for SO_2, CO, O_3, and NO_2.
53.33 Test procedure for methods for lead.
53.34 Test procedure for methods for PM_{10} and $PM_{2.5}$

Tables to Subpart C of Part 53

Table C–1—Test Concentration Ranges, Number of Measurements Required, and Maximum Discrepancy Specification
Table C–2—Sequence of Test Measurements
Table C–3—Test Specifications for Lead Methods
Table C–4—Specifications for PM_{10} and $PM_{2.5}$ Methods

Figures to Subpart C

Figure C–1—Suggested Format for Reporting Test Results

Appendix A to Subpart C to Part 53—References

Subpart C—Procedures for Determining Comparability Between Candidate Methods and Reference Methods

§ 53.30 General provisions.

(a) *Determination of comparability.* The test procedures prescribed in this Subpart shall be used to determine if a candidate method is comparable to a reference method when both methods measure pollutant concentrations in ambient air.

(1) Comparability is shown for SO_2, CO, $O_3$3, and NO_2 methods when the differences between:

(i) Measurements made by a candidate manual method or by a test analyzer representative of a candidate automated method; and

(ii) Measurements made simultaneously by a reference method, are less than or equal to the values specified in the last column of Table C–1 of this subpart.

(2) Comparability is shown for lead methods when the differences between:

(i) Measurements made by a candidate method, and

(ii) Measurements made by the reference method on simultaneously collected lead samples (or the same sample, if applicable), are less than or equal to the value specified in Table C–3 of this subpart.

(3) Comparability is shown for PM_{10} and $PM_{2.5}$ methods when the relationship between:

(i) Measurements made by a candidate method; and

(ii) Measurements made by a reference method on simultaneously collected samples (or the same sample, if applicable) at each of two test sites, is such that the linear regression parameters (slope, intercept, and correlation coefficient) describing the relationship meet the values specified in Table C–4 of this subpart.

(b) *Selection of test sites.* (1) *All methods.* Each test site shall be in a predominately urban area which can be shown to have at least moderate concentrations of various pollutants. The site shall be clearly identified and shall be justified as an appropriate test site with suitable supporting evidence such as maps, population density data, vehicular traffic data, emission inventories, pollutant measurements from previous years, concurrent pollutant measurements, and meteorological data. If approval of a proposed test site is desired prior to conducting the tests, a written request for approval of the test site or sites must be submitted prior to conducting the tests and must include the supporting and justification information required. The Administrator may exercise discretion in selecting a different site (or sites) for any additional tests the Administrator decides to conduct.

(2) *Methods for SO_2, CO, O_3, and NO_2.* All test measurements are to be made at the same test site. If necessary, the concentration of pollutant in the sampled ambient air may be augmented with artificially generated pollutant to facilitate measurements in the specified ranges. [See paragraph (d)(2) of this section.]

(3) *Methods for lead.* Test measurements may be made at any number of test sites. Augmentation of pollutant concentrations is not permitted, hence an appropriate test site or sites must be selected to provide lead concentrations in the specified range.

(4) *Methods for PM_{10}.* Test measurements must be made, or derived from particulate samples collected, at not less than two test sites, each of which must be located in a geographical area characterized by ambient particulate matter that is significantly different in nature and composition from that at the other test site(s). Augmentation of pollutant concentrations is not permitted, hence appropriate test sites must be selected to provide PM10 concentrations in the specified range. The tests at the two sites may be conducted in different calendar seasons, if appropriate, to provide PM_{10} concentrations in the specified ranges.

(5) *Methods for $PM_{2.5}$.* Augmentation of pollutant concentrations is not permitted, hence appropriate test sites must be selected to provide $PM_{2.5}$ concentrations and $PM_{2.5}/PM_{10}$ ratios (if applicable) in the specified ranges.

(i) Where only one test site is required, as specified in Table C–4 of this subpart, the site need only meet the $PM_{2.5}$ ambient concentration levels required by § 53.34(c)(3).

(ii) Where two sites are required, as specified in Table C–4 of this subpart, each site must be selected to provide the ambient concentration levels required by § 53.34(c)(3). In addition, one site

must be selected such that all acceptable test sample sets, as defined in § 53.34(c)(3), have a $PM_{2.5}/PM_{10}$ ratio of more than 0.75; the other site must be selected such that all acceptable test sample sets, as defined in § 53.34(c)(3), have a $PM_{2.5}/PM_{10}$ ratio of less than 0.40. At least two reference method PM_{10} samplers shall be collocated with the candidate and reference method $PM_{2.5}$ samplers and operated simultaneously with the other samplers at each test site to measure concurrent ambient concentrations of PM_{10} to determine the $PM_{2.5}/PM_{10}$ ratio for each sample set. The $PM_{2.5}/PM_{10}$ ratio for each sample set shall be the average of the $PM_{2.5}$ concentration, as determined in § 53.34(c)(1), divided by the average PM_{10} concentration, as measured by the PM_{10} samplers. The tests at the two sites may be conducted in different calendar seasons, if appropriate, to provide $PM_{2.5}$ concentrations and $PM_{2.5}/PM_{10}$ ratios in the specified ranges.

(c) *Test atmosphere.* Ambient air sampled at an appropriate test site or sites shall be used for these tests. Simultaneous concentration measurements shall be made in each of the concentration ranges specified in Table C–1, C–3, or C–4 of this subpart, as appropriate.

(d) *Sample collection.*

(1) *All methods.* All test concentration measurements or samples shall be taken in such a way that both the candidate method and the reference method receive air samples that are homogenous or as nearly identical as practical.

(2) *Methods for SO_2*, CO, O_3, and NO_2. Ambient air shall be sampled from a common intake and distribution manifold designed to deliver homogenous air samples to both methods. Precautions shall be taken in the design and construction of this manifold to minimize the removal of particulates and trace gases, and to insure that identical samples reach the two methods. If necessary, the concentration of pollutant in the sampled ambient air may be augmented with artificially generated pollutant. However, at all times the air sample measured by the candidate and reference methods under test shall consist of not less than 80 percent ambient air by volume. Schematic drawings, physical illustrations, descriptions, and complete details of the manifold system and the augmentation system (if used) shall be submitted.

(3) *Methods for lead, PM_{10}* and $PM_{2.5}$. The ambient air intake points of all the candidate and reference method collocated samplers for lead, PM_{10} or $PM_{2.5}$ shall be positioned at the same height above the ground level, and between 2 and 5 meters apart. The samplers shall be oriented in a manner that will minimize spatial and wind directional effects on sample collection.

(4) *PM_{10} methods employing the same sampling procedure as the reference method but a different analytical method.* Candidate methods for PM_{10} which employ a sampler and sample collection procedure that are identical to the sampler and sample collection procedure specified in the reference method, but use a different analytical procedure, may be tested by analyzing common samples. The common samples shall be collected according to the sample collection procedure specified by the reference method and shall be analyzed in accordance with the analytical procedures of both the candidate method and the reference method.

(e) *Submission of test data and other information.* All recorder charts, calibration data, records, test results, procedural descriptions and details, and other documentation obtained from (or pertinent to) these tests shall be identified, dated, signed by the analyst performing the test, and submitted. For candidate methods for $PM_{2.5}$, all submitted information must meet the requirements of the ANSI/ASQC E4, sections 3.3.1, paragraphs 1 and 2 (Reference 1) of Appendix A of this Subpart.

§ 53.31 Test conditions.

(a) *All methods.* All test measurements made or test samples collected by means of a sample manifold as specified in § 53.30(d)(2) shall be at a room temperature between 20° and 30°C, and at a line voltage between 105 and 125 volts. All methods shall be calibrated as specified in paragraph (c) of this section prior to initiation of the tests.

(b) *Samplers and automated methods.* (1) Setup and start-up of the test analyzer, test sampler(s), and reference method (if applicable) shall be in strict accordance with the applicable operation manual(s). If the test analyzer does not have an integral strip chart or digital data recorder, connect the analyzer output to a suitable strip chart or digital data recorder. This recorder shall have a chart width of at least 25 centimeters, a response time of 1 second or less, a deadband of not more than 0.25 percent of full scale, and capability of either reading measurements at least 5 percent below zero or offsetting the zero by at least 5 percent. Digital data shall be recorded at appropriate time intervals such that trend plots similar to a strip chart recording may be constructed with a similar or suitable level of detail.

(2) Other data acquisition components may be used along with the chart recorder during the conduct of these tests. Use of the chart recorder is intended only to facilitate visual evaluation of data submitted.

(3) Allow adequate warmup or stabilization time as indicated in the applicable operation manual(s) before beginning the tests.

(c) *Calibration.* The reference method shall be calibrated according to the appropriate appendix to part 50 of this chapter (if it is a manual method) or according to the applicable operation manual(s) (if it is an automated method). A candidate manual method (or portion thereof) shall be calibrated, according to the applicable operation manual(s), if such calibration is a part of the method.

(d) *Range.* Except as provided in paragraph (d)(2) of this section, each method shall be operated in the range specified for the reference method in the appropriate appendix to part 50 of this chapter (for manual reference methods), or specified in Table B–1 of subpart B of this part (for automated reference methods).

(e) *Operation of automated methods.* (1) Once the test analyzer has been set up and calibrated and tests started, manual adjustment or normal periodic maintenance is permitted only every 3 days. Automatic adjustments which the test analyzer performs by itself are permitted at any time. At 3-day intervals only adjustments and periodic maintenance as specified in the manual referred to in § 53.4(b)(3) are permitted. The submitted records shall show clearly when manual adjustments were made and describe the operations performed.

(2) All test measurements shall be made with the same test analyzer; use of multiple test analyzers is not permitted. The test analyzer shall be operated continuously during the entire series of test measurements.

(3) If a test analyzer should malfunction during any of these tests, the entire set of measurements shall be repeated, and a detailed explanation of the malfunction, remedial action taken, and whether recalibration was necessary (along with all pertinent records and charts) shall be submitted.

§ 53.32 Test procedures for methods for SO_2, CO, O_3, and NO_2.

(a) Conduct the first set of simultaneous measurements with the candidate and reference methods:

(1) Table C–1 of this subpart specifies the type (1- or 24-hour) and number of

measurements to be made in each of the three test concentration ranges.

(2) The pollutant concentration must fall within the specified range as measured by the reference method.

(3) The measurements shall be made in the sequence specified in Table C–2 of this subpart, except for the 1-hour SO_2 measurements, which are all in the high range.

(b) For each pair of measurements, determine the difference (discrepancy) between the candidate method measurement and reference method measurement. A discrepancy which exceeds the discrepancy specified in Table C–1 of this subpart constitutes a failure. (See Figure C–1 of this subpart for a suggested format for reporting the test results.)

(c) The results of the first set of measurements shall be interpreted as follows:

(1) *Zero (0) failures.* The candidate method passes the test for comparability.

(2) *Three (3) or more failures.* The candidate method fails the test for comparability.

(3) *One (1) or two (2) failures.* Conduct a second set of simultaneous measurements as specified in Table C–1 of this subpart. The results of the combined total of first-set and second-set measurements shall be interpreted as follows:

(i) *One (1) or two (2) failures.* The candidate method passes the test for comparability.

(ii) *Three (3) or more failures.* The candidate method fails the test for comparability.

(4) For sulfur dioxide, the 1-hour and 24-hour measurements shall be interpreted separately, and the candidate method must pass the tests for both 1- and 24-hour measurements to pass the test for comparability.

(d) A 1-hour measurement consists of the integral of the instantaneous concentration over a 60-minute continuous period divided by the time period. Integration of the instantaneous concentration may be performed by any appropriate means such as chemical, electronic, mechanical, visual judgment, or by calculating the mean of not less than 12 equally spaced instantaneous readings. Appropriate allowances or corrections shall be made in cases where significant errors could occur due to characteristic lag time or rise/fall time differences between the candidate and reference methods. Details of the means of integration and any corrections shall be submitted.

(e) A 24-hour measurement consists of the integral of the instantaneous concentration over a 24-hour continuous period divided by the time period. This integration may be performed by any appropriate means such as chemical, electronic, mechanical, or by calculating the mean of twenty-four (24) sequential 1-hour measurements.

(f) For oxidant and carbon monoxide, no more than six (6) 1-hour measurements shall be made per day. For sulfur dioxide, no more than four (4) 1-hour measurements or one (1) 24-hour measurement shall be made per day. One-hour measurements may be made concurrently with 24-hour measurements if appropriate.

(g) For applicable methods, control or calibration checks may be performed once per day without adjusting the test analyzer or method. These checks may be used as a basis for a linear interpolation-type correction to be applied to the measurements to correct for drift. If such a correction is used, it shall be applied to all measurements made with the method, and the correction procedure shall become a part of the method.

§ 53.33 Test procedure for methods for lead.

(a) *Sample collection.* Collect simultaneous 24-hour samples (filters) of lead at the test site or sites with both the reference and candidate methods until at least 10 filter pairs have been obtained. If the conditions of § 53.30(d)(4) apply, collect at least 10 common samples (filters) in accordance with § 53.30(d)(4) and divide each to form the filter pairs.

(b) *Audit samples.* Three audit samples must be obtained from the Quality Assurance Branch (MD–77B), Air Measurements Research Division, National Exposure Research Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. The audit samples are ¾ × 8-inch glass fiber strips containing known amounts of lead at the following nominal levels: 100 µg/strip; 300 µg/strip; 750 µg/strip. The true amount of lead in total µg/strip will be provided with each audit sample.

(c) *Filter analysis.*

(1) For both the reference method and the audit samples, analyze each filter extract 3 times in accordance with the reference method analytical procedure. The analysis of replicates should not be performed sequentially (i.e., a single sample should not be analyzed three times in sequence). Calculate the indicated lead concentrations for the reference method samples in µg/m³ for each analysis of each filter. Calculate the indicated total lead amount for the audit samples in µg/strip for each analysis of each strip. Label these test results as R_{1A}, R_{1B}, R_{1C}, R_{2A}, R_{2B}, * * *, Q_{1A}, Q_{1B}, Q_{1C}, * * *., where R denotes results from the reference method samples; Q denotes results from the audit samples; 1, 2, 3 indicates filter number and A, B, C indicates the first, second, and third analysis of each filter, respectively.

(2) For the candidate method samples, analyze each sample filter or filter extract three times and calculate, in accordance with the candidate method, the indicated lead concentration in µg/m³ for each analysis of each filter. Label these test results as C_{1A}, C_{1B}, C_{2C}, * * *, where C denotes results from the candidate method. (For candidate methods which provide a direct measurement of lead concentrates without a separable procedure, $C_{1A}=C_{1B}=C_{1C}$, $C_{2A}=C_{2B}=C_{2C}$, etc.)

$$R_{i\,ave} = \frac{R_{iA} + R_{iB} + R_{iC}}{3} \quad (1)$$

(d) For the reference method, calculate the average lead concentration for each filter by averaging the concentrations calculated from the three analyses: where I is the filter number.

(e) Disregard all filter pairs for which the lead concentration as determined in the previous paragraph (d) of this section by the average of the three reference method determinations, falls outside the range of 0.5 to 4.0 µg/m³. All remaining filter pairs must be subjected to both of the following tests for precision and comparability. At least five filter pairs must be within the 0.5 to 4.0 µg/m³ range for the tests to be valid.

(f) *Test for precision.* (1) Calculate the precision (P) of the analysis (in percent) for each filter and for each method, as the maximum minus the minimum divided by the average of the three concentration values, as follows:

$$P_{Ri} = \frac{R_{i\,max} - R_{i\,min}}{R_{i\,ave}} \times 100\% \quad (2)$$

or

$$P_{Ci} = \frac{C_{i\,max} - C_{i\,min}}{C_{i\,ave}} \times 100\% \quad (3)$$

where I indicates the filter number.

(2) If any reference method precision value (P_{Ri}) exceeds 15 percent, the precision of the reference method analytical procedure is out of control. Corrective action must be taken to determine the source(s) of imprecision and the reference method determinations must be repeated

according to paragraph (c) of this section, or the entire test procedure (starting with paragraph (a) of this section) must be repeated.

(3) If any candidate method precision value (P_{Ci}) exceeds 15 percent, the candidate method fails the precision test.

(4) The candidate method passes this test if all precision values (i.e., all P_{Ri}'s and all P_{Ci}'s) are less than 15 percent.

(g) *Test for accuracy.*

(1) (i) For the audit samples calculate the average lead concentration for each strip by averaging the concentrations calculated from the three analyses:

$$Q_{i\,ave} = \frac{Q_{iA} + Q_{iB} + Q_{iC}}{3} \quad (4)$$

where i is audit sample number.

(ii) Calculate the percent difference (D_q) between the indicated lead concentration for each audit sample and the true lead concentration (T_q) as follows:

$$D_{qi} = \frac{Q_{i\,ave} - T_{qi}}{T_{qi}} \times 100\% \quad (5)$$

(2) If any difference value (D_{qi}) exceeds ±5 percent the accuracy of the reference method analytical procedure is out of control. Corrective action must be taken to determine the source of the error(s) (e.g., calibration standard discrepancies, extraction problems, etc.) and the reference method and audit sample determinations must be repeated according to paragraph (c) of this section or the entire test procedure (starting with paragraph (a) of this section) must be repeated.

(h) *Test for comparability.*

(1) For each filter pair, calculate all nine possible percent differences (D) between the reference and candidate methods, using all nine possible combinations of the three determinations (A, B, and C) for each method, as:

$$D_{in} = \frac{C_{ij} - R_{ik}}{R_{ik}} \times 100\% \quad (6)$$

where i is the filter number, and n numbers from 1 to 9 for the nine possible difference combinations for the three determinations for each method (j= A, B, C, candidate; k= A, B, C, reference).

(2) If none of the percent differences (D) exceed ±20 percent, the candidate method passes the test for comparability.

(3) If one or more of the percent differences (D) exceed ±20 percent, the candidate method fails the test for comparability.

(i) The candidate method must pass both the precision test and the comparability test to qualify for designation as an equivalent method.

§ 53.34 Test procedure for methods for PM_{10} and $PM_{2.5}$.

(a) *Collocated measurements.* Set up three reference method samplers collocated with three candidate method samplers or analyzers at each of the number of test sites specified in Table C–4 of this subpart. At each site, obtain as many sets of simultaneous PM_{10} or $PM_{2.5}$ measurements as necessary (see 53.34(c)(3)), each set consisting of three reference method and three candidate method measurements, all obtained simultaneously. For $PM_{2.5}$ Class II candidate methods, at least two collocated PM_{10} reference method samplers are also required to obtain $PM_{2.5}/PM_{10}$ ratios for each sample set. Candidate PM_{10} method measurements shall be 24-hour integrated measurements; $PM_{2.5}$ measurements may be either 24- or 48-hour integrated measurements. All collocated measurements in a sample set must cover the same 24- or 48-hour time period. For samplers, retrieve the samples promptly after sample collection and analyze each sample according to the reference method or candidate method, as appropriate, and determine the PM_{10} or $PM_{2.5}$ concentration in μg/m³. If the conditions of § 53.30(d)(4) apply, collect sample sets only with the three reference method samplers. Guidance for quality assurance procedures for $PM_{2.5}$ methods is found in section 2.12 of the Quality Assurance Handbook.

(b) *Sequential samplers.* For sequential samplers, the sampler shall be configured for the maximum number of sequential samples and shall be set for automatic collection of all samples sequentially such that the test samples are collected equally, to the extent possible, among all available sequential channels or utilizing the full available sequential capability. At least 2 valid samples, one each above and below the applicable concentration limit specified in paragraph (c)(3) of this section, shall be obtained from each sequential channel in the maximum-channel configuration of the sampler.

(c) *Test for comparability.* (1) For each of the measurement sets, calculate the average PM_{10} or $PM_{2.5}$ concentration obtained with the reference method samplers:

$$\bar{R}_j = \frac{\sum_{i=1}^{3} R_{i,j}}{3} \quad (7)$$

where R denotes results from the reference method, I is the sampler number, and j is the set.

(2)(i) For each of the measurement sets, calculate the precision of the reference method PM_{10} or $PM_{2.5}$ measurements as:

$$P_j = \sqrt{\frac{\sum_{i=1}^{3} R_{i,j}^2 - \frac{1}{3}\left(\sum_{i=1}^{3} R_{i,j}\right)^2}{2}} \quad (8)$$

if $\bar{R}_j$ is below:

80 μg/m³ for PM_{10} methods;

40 μg/m³ for 24-hour $PM_{2.5}$ at single test sites for Class I candidate methods;

40 μg/m³ for 24-hour $PM_{2.5}$ at sites having $PM_{2.5}/PM_{10}$ ratios >0.75;

30 μg/m³ for 48-hour $PM_{2.5}$ at single test sites for Class I candidate methods;

30 μg/m³ for 48-hour $PM_{2.5}$ at sites having $PM_{2.5}/PM_{10}$ ratios >0.75;

30 μg/m³ for 24-hour $PM_{2.5}$ at sites having $PM_{2.5}/PM_{10}$ ratios <0.40; and

20 μg/m³ for 48-hour $PM_{2.5}$ at sites having $PM_{2.5}/PM_{10}$ ratios >0.75.

(ii) Otherwise, calculate the precision of the reference method PM_{10} or $PM_{2.5}$ measurements as:

$$RP_j = \frac{1}{\overline{R}_j}\sqrt{\frac{\sum_{i=1}^{3} R_{i,j}^2 - \frac{1}{3}\left(\sum_{i=1}^{3} R_{i,j}\right)^2}{2}} \times 100\% \qquad (9)$$

(3) If R_j falls outside the acceptable concentration range specified in Table C–4 of this subpart for any set, or if P_j or RP_j, as applicable, exceeds the value specified in Table C–4 of this subpart for any set, that set of measurements shall be discarded. For each site, Table C–4 of this subpart specifies the minimum number of sample sets required for various conditions, and § 53.30(b)(5) specifies the $PM_{2.5}/PM_{10}$ ratio requirements applicable to Class II candidate equivalent methods. Additional measurement sets shall be collected and analyzed, as necessary, to provide a minimum of 10 acceptable measurement sets for each test site. If more than 10 measurement sets are collected that meet the above criteria, all such measurement sets shall be used to demonstrate comparability.

(4) For each of the acceptable measurement sets, calculate the average PM_{10} or $PM_{2.5}$ concentration obtained with the candidate method samplers:

$$\overline{C}_j = \frac{\sum_{i=1}^{3} C_{i,j}}{3} \qquad (10)$$

where C denotes results from the candidate method, I is the sampler number, and j is the set.

(5) For each site, plot the average PM_{10} or $PM_{2.5}$ measurements obtained with the candidate method (C_j) against the corresponding average PM_{10} or $PM_{2.5}$ measurements obtained with the reference method (R_j). For each site, calculate and record the linear regression slope and intercept, and the correlation coefficient.

(6) If the linear regression parameters calculated above meet the values specified in Table C–4 of this subpart for all test sites, the candidate method passes the test for comparability.

Tables to Subpart C of Part 53

TABLE C–1.—TEST CONCENTRATION RANGES, NUMBER OF MEASUREMENTS REQUIRED, AND MAXIMUM DISCREPANCY SPECIFICATION

Pollutant	Concentration range parts per million	Simultaneous measurements required				Maximum discrepancy specification, parts per million
		1–hr		24–hr		
		First set	Second set	First set	Second set	
Oxidants	Low 0.06 to 0.10	5	6			0.02
	Med 0.15 to 0.25	5	6			.03
	High 0.35 to 0.45	4	6			.04
	Total	14	18			
Carbon monoxide	Low 7 to 11	5	6			1.5
	Med 20 to 30	5	6			2.0
	High 35 to 45	4	6			3.0
	Total	14	18			
Sulfur dioxide	Low 0.02 to 0.05			3	3	0.02
	Med 0.10 to 0.15			2	3	.03
	High 0.30 to 0.50	7	8	2	2	.04
	Total	7	8	7	8	
Nitrogen dioxide	Low 0.02 to 0.08			3	3	0.02
	Med 0.10 to 0.20			2	3	.03
	High 0.25 to 0.35			2	2	.03
	Total			7	8	

TABLE C–2.—SEQUENCE OF TEST MEASUREMENTS

Measurement	Concentration range	
	First set	Second set
1	Low	Medum.
2	High	High.
3	Medium	Low.
4	High	High.
5	Low	Medium.
6	Medium	Low.
7	Low	Medium.
8	Medium	Low.
9	High	High.

TABLE C–2.—SEQUENCE OF TEST MEASUREMENTS—Continued

Measurement	Concentration range	
	First set	Second set
10	Medium	Low.
11	High	Medium.
12	Low	High.
13	Medium	Medium.
14	Low	High.
15		Low.
16		Medium.
17		Low.
18		High.

TABLE C–3.—TEST SPECIFICATIONS FOR LEAD METHODS

Concentration range, μg/m³	0.5–4.0
Minimum number of 24-hr measurements	5
Maximum analytical precision, percent	5
Maximum analytical accuracy, percent	±5
Maximum difference, percent of reference method	±20

TABLE C–4.—TEST SPECIFICATIONS FOR PM_{10} AND $PM_{2.5}$ METHODS

Specification	PM_{10}	$PM_{2.5}$	
		Class I	Class II
Acceptable concentration range (R_j), μg/m³	30–300	10–200	10–200
Minimum number of test sites	2	1	2
Number of candidate method samplers per site	3	3	3
Number of reference method samplers per site	3	3	3
Minimum number of acceptable sample sets per site for PM_{10}:			
R_j < 80 μg/m³	3		
R_j > 80 μg/m³	3		
Total	10		
Minimum number of acceptable sample sets per site for $PM_{2.5}$:			
Single test site for Class I candidate equivalent methods:			
R_j < 40 μg/m³ for 24-hr or R_j < 30 μg/m³ for 48-hr samples		3[a]	
R_j > 40 μg/m³ for 24-hr or R_j > 30 μg/m³ for 48-hr samples		3[a]	
Sites at which the $PM_{2.5}/PM_{10}$ ratio must be > 0.75:			
R_j < 40 μg/m³ for 24-hr or R_j < 30 μg/m³ for 48-hr samples			3[a]
R_j > 40 μg/m³ for 24-hr or R_j > 30 μg/m³ for 48-hr samples			3[a]
Sites at which the $PM_{2.5}/PM_{10}$ ratio must be < 0.40:			
R_j < 30 μg/m³ for 24-hr or R_j < 20 μg/m³ for 48-hr samples			3[a]
R_j > 30 μg/m³ for 24-hr or R_j > 20 μg/m³ for 48-hr samples			3[a]
Total, each site		10[a]	10[a]
Precision of replicate reference method measurements, P_j or RP_j	5 μg/m³ or 7%	2 μg/m³ or 5%	2 μg/m³ or 5%
Slope of regression relationship	1±0.1	1±0.05	1±0.05
Intercept of regression relationship, μg/m³	0±5	0±1	0±1
Correlation of reference method and candidate method measurements	≥0.97	≥0.97	≥0.97

[a] For sequential samplers, at least 2 samples, one above and one below the applicable concentration limit shall be obtained from each sequential channel in the maximum sequential configuration of the sampler. Therefore, the number of samples in each category, and possibly the total number of samples, will be dependent on the number of sequential channels available.

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FIGURES TO SUBPART C OF PART 53

Figure C–1.—Suggested Format for Reporting Test Results

Candidate Method _____

Reference Method _____

Applicant _____ Pollutant _____

☐ First Set ☐ Second Set ☐ Type ☐ 1 hour ☐ 24 hour

CONCENTRATION RANGE		DATE	TIME	CONCENTRATION, ppm		DIFFERENCE	TABLE C-1 SPEC.	PASS OR FAIL
				CANDIDATE	REFERENCE			
LOW _____ ppm to _____ ppm	1							
	2							
	3							
	4							
	5							
	6							
MEDIUM _____ ppm to _____ ppm	1							
	2							
	3							
	4							
	5							
	6							
HIGH _____ ppm to _____ ppm	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							

TOTAL FAILURES: ☐

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Appendix A to Subpart C of Part 53—References

1. American National Standard—Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs, ANSI/ASQC E4–1994. Available from American Society for Quality Control, 611 East Wisconsin Avenue, Milwaukee, WI 53202.

4. Subpart E is added to read as follows:

Subpart E—Procedures for Testing Physical (Design) and Performance Characteristics of Reference Methods and Class I Equivalent Methods for $PM_{2.5}$

Sec.

53.50 General provisions.
53.51 Requirements to show compliance with design specifications.
53.52 Comprehensive procedure to test sampler performance under various environmental conditions (environmental chamber tests).
53.53 Post-sampling filter temperature control test.
53.54 Leak check test.
53.55 Flow rate cut-off test.
53.56 Operational field precision test.
53.57 Aerosol transport test for Class I sequential samplers.

Tables to Subpart E of Part 53

Table E–1—Test conditions for § 53.52 comprehensive 24-hour tests
Table E–2—Summary of test requirements for reference and Class I equivalent methods for $PM_{2.5}$

Figures to Subpart E of Part 53

Figure E–1—Designation Check List
Figure E–2—Product Manufacturing Check List
Figure E–3—Suggested test configuration for simulating reduced barometric pressure for comprehensive test procedure (§ 53.52)

Appendix to Subpart E of Part 53—References

Subpart E—Procedures for Testing Physical (Design) and Performance Characteristics of Reference Methods and Class I Equivalent Methods for $PM_{2.5}$

§ 53.50 General provisions.

(a) This subpart sets forth the specific tests that must be carried out and the test results, evidence, documentation, and other materials that must be provided to EPA to demonstrate that a $PM_{2.5}$ sampler associated with a candidate reference method or Class I equivalent method meets all design and performance specifications set forth in Appendix L of part 50 of this chapter as well as additional requirements specified in this subpart E. Some of these tests may also be applicable to portions of a Class II or III equivalent method sampler, as determined under subpart F of this part.

(b) Samplers associated with candidate reference methods for $PM_{2.5}$ shall be subject to the provisions, specifications, and test procedures prescribed in §§ 53.51 through 53.56. Samplers associated with candidate Class I equivalent method for $PM_{2.5}$ shall be subject to the provisions, specifications, and test procedures prescribed in all sections of this Subpart. Samplers associated with candidate Class II or Class III equivalent method for $PM_{2.5}$ shall be subject to the provisions, specifications, and test procedures prescribed in all applicable sections of this Subpart, as specified in subpart F of this part.

(c) Section 53.51 pertains to test results and documentation required to demonstrate compliance of a candidate method sampler with the design specifications set forth in Appendix L of part 50 of this chapter. Test procedures prescribed in §§ 53.52 through 53.56 pertain to performance tests required to demonstrate compliance of a candidate method sampler with the performance specifications set forth in Appendix L of part 50 of this chapter, as well as additional requirements specified in this subpart E. These latter test procedures shall be used to test the performance of candidate samplers against the performance specifications and requirements specified in each procedure and summarized in Table E–1 of this subpart.

(d) Test procedures prescribed in § 53.57 do not apply to candidate reference method samplers. These procedures apply primarily to candidate class I equivalent method samplers for $PM_{2.5}$ that have a sample air flow path configuration upstream of the sample filter that is modified from that specified for the reference method sampler—as set forth in Drawings L–18 and L–24 of Appendix L to part 50 of this chapter to provide for sequential sample capability. The additional tests determine the adequacy of aerosol transport through any altered components or supplemental devices that are used in a candidate sampler upstream of the filter to achieve the sequential sample capability. These tests may also apply, with appropriate adaptation, if necessary, to candidate samplers having minor deviations from the specified reference method sampler for purposes other than sequential operation. In addition to the other test procedures in this subpart, these test procedures shall be used to further test the performance of such equivalent method samplers against the performance specifications given in Table E–2 of this subpart.

(e) Tests of a candidate sampler for sample flow rate capacity and regulation, flow rate control, flow rate measurement accuracy, ambient temperature and pressure measurement accuracy, filter temperature control during sampling, and correct determination of elapsed sample time, average volumetric flow rate, and flow rate variation are all combined into a comprehensive test procedure (§ 53.52) that is carried out over four 24-hour test periods under multiple test conditions. Other performance parameters are tested individually with specific test procedures (§§ 53.53—53.57).

(f) A 10-day field test of measurement precision is required for both reference and equivalent method samplers. This test requires collocated operation of 3 candidate method samplers at a field test site. For candidate equivalent method samplers, this test may be combined and carried out concurrently with the test for comparability to the reference method specified under § 53.34, which requires collocated operation of three reference method samplers and three candidate equivalent method samplers.

(g) All tests and collection of test data shall be in accordance with the requirements of Reference 1, section 4.10.5 (ISO 9001) and Reference 2, Part B, section 3.3.1, paragraphs 1 and 2 and Part C, section 4.6 (ANSI/ASQC E4) in appendix A of this subpart. All test data and other documentation obtained specifically from or pertinent to these tests shall be identified, dated, signed by the analyst performing the test, and submitted to EPA in accordance with subpart A of this part.

§ 53.51 Requirements to show compliance with design specifications.

For the purposes of this document the definitions of ISO registered facility and ISO-certified auditor are found in § 53.1(t) and (u). An exception to this reliance by EPA on ISO affiliate audits is the requirement of the submission of the operation or instruction manual associated with the candidate method to EPA prior to designation. This manual is required under § 53.4(b)(3). The EPA has determined that acceptable technical judgment for review of this manual may not be assured by ISO affiliates, and approval of this manual will therefore be accomplished by the EPA.

(a) *Overview.* (1) In the absence of performance standards for some features of the FRM sampler system, and of the EPA resources to directly review and ensure manufacturer performance in producing samplers according to the EPA design specifications in 40 CFR part 50, Appendix L, EPA considers it necessary to require manufacturers to meet two kinds of requirements to ensure their compliance with the design specifications of 40 CFR part 50, Appendix L.

(2) The subsequent paragraphs of this section specify certain documentation that must be submitted and tests that are required to demonstrate that instruments associated with a designated reference or equivalent method for $PM_{2.5}$ are properly manufactured to meet all applicable design specifications and have been properly tested according to all applicable test requirements for such designation. Documentation is required to show that instruments and components are manufactured or assembled in an ISO–9001-registered (or equivalent) facility under a quality system that meets ISO–9001

requirements for manufacturing quality control and testing.

(3) In addition, specific tests are required to verify that two critical features of reference method samplers—impactor jet diameter and the surface finish of surfaces specified to be anodized—meet the specifications of 40 CFR part 50, Appendix L. A checklist is required to provide certification by an ISO-certified auditor that all performance and other required tests have been properly and appropriately conducted. Following designation of the method, another checklist is required, initially and annually, to provide an ISO-qualified (or equivalent) auditor's certification that an adequate and appropriate quality system is being implemented in the instrument manufacturing process.

(b) *ISO Registration of manufacturing facility.* (1) The applicant must submit documentation verifying that the samplers associated with the candidate method will be manufactured in an ISO 9001-registered facility (as defined in § 53.1(u)) and that the manufacturing facility is maintained in compliance with all applicable ISO 9001 requirements (Reference 1 in appendix A of this subpart). The documentation shall indicate the date of the original ISO 9001 registration for the facility and shall include a copy of the most recent certification of continued ISO 9001 facility registration. If the manufacturer does not wish to initiate or complete ISO 9001 registration for the manufacturing facility, documentation must be included in the application to EPA describing an alternative method to demonstrate that the facility meets the same general requirements as required for ISO registration. In this case, the applicant must provide documentation in the application to demonstrate, by required ISO-certified auditor's inspections, that a quality system is in place which is adequate to document and monitor that the sampler system components all conform to the design, performance and other requirements specified in Appendix L of part 50 of this chapter.

(2) *Phase-in period.* For a period of 1 year following the effective date of this subpart, a candidate reference or equivalent method for $PM_{2.5}$ that utilizes a sampler manufactured in a facility that is not ISO 9001-registered or otherwise approved by the EPA under paragraph (b)(1) of this section may be conditionally designated as a reference or equivalent method under this part. Such conditional designation will be considered on the basis of evidence submitted in association with the candidate method application showing that appropriate efforts are currently underway to seek ISO 9001 registration or alternative approval of the facility's quality system under paragraph (b)(1) of this section within the next 12 months. Such conditional designation shall expire 1 year after the date of the Federal Register notice of the conditional designation unless documentation verifying successful ISO 9001 registration for the facility or other EPA-acceptable quality system review and approval process of the production that will manufacture the samplers is submitted at least 30 days prior to the expiration date.

(c) *Sampler Manufacturing Quality Control.* The manufacturer must ensure that all components used in the manufacture of $PM_{2.5}$ samplers to be sold as reference or equivalent methods and that are specified by design in Appendix L of part 50 of this chapter are fabricated or manufactured exactly as specified. If the manufacturer's QC records show that its QC and QA system of standard process control inspections (of a set number and frequency of testing that is less than 100%) complies with the applicable QA provisions of section 4 of Reference 4 in Appendix A of this subpart and prevents nonconformances, 100% testing shall not be required until that conclusion is disproved by customer return or other independent manufacturer or customer test records. If problems are uncovered, inspection to verify conformance to the drawings, specifications, and tolerances shall be performed. See also paragraph (e) of this section (final assembly and inspection requirements).

(d) *Specific tests and supporting documentation required to verify conformance to critical component specifications.* (1) *Verification of $PM_{2.5}$* impactor jet diameter. The diameter of the jet of each impactor manufactured for a $PM_{2.5}$ sampler under the impactor design specifications set forth in Appendix L of part 50 of this chapter shall be verified against the tolerance specified on the drawing, using standard, NIST-traceable plug gages. This test shall be a final check of the jet diameter following all fabrication operations, and a record shall be kept of this final check. Submit evidence that this procedure is incorporated in the ISO 9001-certified manufacturing procedure, that the test is or will be routinely implemented, and that an appropriate procedure is in place for the disposition of units that fail this tolerance test.

(2) *Verification of surface finish.* The anodization process used to treat surfaces specified to be anodized shall be verified by testing treated specimen surfaces for weight and corrosion resistance to ensure that the coating obtained conforms to the coating specification. The specimen surfaces shall be finished in accordance with military standard specification 8625F, Type II, Class I (Reference 4) in the same way the sampler surfaces are finished, and tested, prior to sealing, as specified in Section 4.5.2 of Reference 4 in Appendix A of this subpart.

(e) *Final assembly and inspection requirements.* Each sampler shall be tested after manufacture and before delivery to the final user. Each manufacturer shall document its post-manufacturing test procedures. As a minimum, each test shall consist of the following: Tests of the overall integrity of the sampler, including leak tests; calibration or verification of the calibration of the flow measurement device, barometric pressure sensors, and temperature sensors; and operation of the sampler with a filter in place over a period of at least 48 hours. The results of each test shall be suitably documented and shall be subject to review by an ISO 9001 auditor.

(f) *Manufacturer's audit checklists.* Manufacturers shall require ISO 9001 auditors to sign and date a statement indicating that the auditor is aware of the appropriate manufacturing specifications contained in Appendix L of part 50 of this chapter and the test or verification requirements in this subpart. Manufacturers shall also require ISO 9001 auditors to complete the checklists, shown in Figures E–1 and E–2 of this subpart, which describe the manufacturer's ability to meet the requirements of the standard for both designation testing and product

manufacture. Refer to Reference 5 for additional guidance on the scope and detail required for the checklist evaluations.

(1) *Designation testing checklist.* The completed statement and checklist as shown in Figure E–1 of this subpart shall be submitted with the application for reference or equivalent method determination.

(2) *Product manufacturing checklist.* Manufacturers shall require ISO 9001 auditors to complete the attached Production Checklist, which evaluates the manufacturer on its ability to meet the requirements of the standard in maintaining quality control in the production of reference or equivalent devices. The completed statement and checklist shall be submitted with the application for reference or equivalent method determination. As set forth in subpart A of this part, this checklist must be completed and submitted annually to retain a reference or equivalent method designation for a $PM_{2.5}$ method.

(3) If the conditions of paragraph (b)(2) of this section apply, a candidate reference or equivalent method for $PM_{2.5}$ may be conditionally designated as a reference or equivalent method under this part 53 without the submission of the checklists described in paragraphs (f) (1) and (2) of this section. Such conditional designation shall expire 1 year after the date of the Federal Register notice of the conditional designation unless the checklists are submitted at least 30 days prior to the expiration date.

§ 53.52 Comprehensive procedure to test sampler performance under various environmental conditions (environmental chamber tests).

(a) *Overview.* This test procedure is a combined procedure to test the following performance parameters:

(1) Sample flow rate, flow rate regulation, and flow rate measurement accuracy;

(2) Ambient air temperature and barometric pressure measurement accuracy;

(3) Filter temperature control during sampling; and

(4) Elapsed sampling time accuracy.

The performance parameters tested under this procedure, the corresponding minimum performance specifications, and the applicable test conditions are summarized in Table E–2 of this subpart. Each performance parameter tested, as described or determined in the test procedure, must meet or exceed the performance specification given in Table E–2 of this subpart. The candidate sampler must meet all specifications for the associated $PM_{2.5}$ method to be considered for designation as a reference or equivalent method.

(b) *Technical definition.* Sample flow rate means the quantitative volumetric flow rate of the air stream caused by the sampler to enter the sampler inlet and pass through the sample filter, measured in actual volume units at the temperature and pressure of the air as it enters the inlet.

(c) *Required test equipment.*

(1) Environmental chamber or other temperature-controlled environment or environments, capable of obtaining and maintaining the various temperatures between −20 °C to +40 °C as required for the test with an accuracy of ±2 °C. The test environment(s) must be capable of maintaining temperature within the specified limits continuously with the additional heat load of the operating test sampler in the environment. [Henceforth, where the test procedures specify a test or environmental ''chamber,'' an alternative temperature-controlled environmental area or areas may be substituted, provided the required test temperatures and all other test requirements are met. See paragraph (f)(1) of this section]

(2) Variable voltage ac power transformer, range 100 to 130 Vac, with sufficient VA capacity to operate the test sampler continuously under the test conditions.

(3) Flow rate meter, suitable for measuring the actual volumetric sampler flow rate at the sampler downtube in either an open system or in a closed system operating below atmospheric pressure, range 10 to 25 actual L/min, 2 percent certified accuracy, NIST-traceable, over a temperature range of −30 °C to +50 °C and pressure range of 600 to 800 mm Hg, with continuous (analog) recording capability or digital recording at intervals of not more than 5 minutes. Mass flow meter type recommended; however, note that temperature and pressure corrections are generally required to convert measured mass flow rate to actual volumetric flow rate.

(4) Ambient air temperature recorder, range −30°C to +50°C, certified accurate to within 0.5 °C with a radiation error of 0.2 °C or less under a solar radiation intensity of 1000 watts/m², as described in Reference 6 in appendix A of this subpart.

(5) Barometric pressure meter, range 600 to 800 mm Hg, certified accurate to 2 mm Hg.

(6) Miniature temperature sensor, capable of being installed in the sampler without introducing air leakage and capable of measuring the sample air temperature within 1 cm of the center of the filter, downstream of the filter, certified accurate to within 0.5 °C, NIST traceable, with continuous (analog) recording capability or digital recording at intervals of not more than 5 minutes.

(7) Means for creating or simulating the effect of a reduced barometric pressure on the test sampler during sampler operation, capable of simulating barometric pressures ranging from 730 to 600 mm Hg. A suggested, closed-system technique for a hypothetical sampler is illustrated in Figure E–3 of this subpart, but the configuration shown may have to be modified or adapted to accommodate the specific design of the actual candidate method sampler. The sampler-specific technique or apparatus proposed by the applicant for simulating barometric pressure for purposes of this test may be submitted for pre-approval of concept prior to conducting the test. Alternatively, a hypobarometric chamber or other test environment with capability of maintaining barometric pressures ranging from local actual barometric pressure to 600 mm Hg, as well as the temperature capability specified in paragraph (c)(1) of this section, shall be used.

(8) Means, such as a solar-spectrum lamp or lamps, for generating or simulating thermal radiation in approximate spectral content and intensity equivalent to solar insolation of 1000 watts/m² (1.43 langleys/min) inside the environmental chamber.

(9) AC rms voltmeter, accurate to 0.5 volts.

(10) Means for creating an additional pressure drop of 55 mm Hg in the sampler to simulate a heavily loaded filter, such as an orifice or flow restrictive plate installed in the filter holder or a valve or other flow restrictor temporarily installed in the flow path near the filter.

(11) Time measurement system, accurate to within 10 seconds per day.

(12) Radiometer, to measure the intensity of the simulated solar radiation in the test environment, range 0—1500/m².

(d) *Calibration of test measurement instruments.* Submit documentation showing evidence of recent calibration, calibration accuracy, and NIST-traceability (if required) of all measurement instruments used in the tests. The accuracy of flow meters shall be verified at the highest and lowest pressures and temperatures used in the tests and shall be checked at zero and one or more non-zero flow rates within 7 days of test use. Where an instrument's measurements are to be recorded with an analog recording

device, the accuracy of the entire instrument-recorder system shall be calibrated or verified.

(e) *Test setup.* (1) The test sampler shall be set up for testing in the temperature-controlled chamber. Setup of the sampler shall be performed as described in the sampler's operation or instruction manual referred to in § 53.4(b)(3). The sampler shall be installed upright and set up in its normal configuration for collecting $PM_{2.5}$ samples, except that the sample air inlet shall be removed to permit measurement of the sampler flow rate.

(2) The certified flow rate meter shall be connected to the test sampler so as to accurately measure the sampler flow rate at the entrance to the sampler (*i.e.*, the flow rate that would enter the sampler inlet if the inlet had not been removed).

(3) The sampler shall be provided with ac line power from the variable voltage ac power transformer, which shall be initially set to a nominal voltage of 115 volts ac (rms).

(4) The miniature temperature sensor shall be installed in the test sampler such that it accurately measures the air temperature 1 cm from the center of the filter on the downstream side of the filter. The sensor shall be installed in a way such that no external or internal leakage is created by the sensor installation.

(5) If a closed-system means for simulating reduced barometric pressure in the sampler, as suggested in paragraph (c)(7) of this section, is to be used in lieu of a hypobarometric chamber, the necessary apparatus shall be installed on the test sampler as appropriate, in such a way that the certified flow rate meter will still accurately measure the sampler flow rate. Also, the barometric pressure meter shall be installed to accurately measure the simulated or actual reduced barometric pressure to which the sampler is subjected during the test.

(6) The solar radiant energy source shall be installed in the test chamber such that the entire test sampler is irradiated in a manner similar to the way it would be irradiated by solar radiation if it were located outdoors in an open area on a sunny day, with the radiation arriving at an angle of between 30 and 45 degrees from vertical and such that the intensity of the radiation received by all sampler surfaces that receive direct radiation is not less than 1000 watts/cm^2, measured in a plane perpendicular to the incident radiation. The incident radiation shall be oriented with respect to the sampler such that the area of the sampler's ambient temperature sensor (or temperature shield) receives direct radiation as it would or could during normal outdoor installation. Also, the sensor must not be shielded from the radiation by a sampler part in a way that would not occur at other normal insolation angles or directions.

(7) The ambient air temperature recorder shall be installed in the test chamber such that it will accurately measure the temperature of the air in the chamber without being unduly affected by the chamber's air temperature control system or by the radiant energy from the solar radiation source that may be present inside the test chamber.

(f) *Procedure.* (1) The test sampler shall be tested during operation over four (4) 24-hour sample collection periods (Test numbers 1—4) under the conditions specified in Table E–1 of this subpart. The test chamber temperature shall be held at the specified initial temperature for the first 8 hours of each test period, during which various performance parameters are measured. During hours 9 through 21 of each test period, the chamber temperature is transitioned from the initial to the final specified temperature; the temperature profile is unspecified during this period, provided that the final specified temperature is achieved before the start of hour 22 of each test period. The specified final temperature shall be maintained during hours 22 through 24 of each test period.

(2) Prepare the test sampler for normal sample collection operation as directed in the sampler's operation or instructional manual. If the sampler has multiple (sequential) sample capability, this capability may be used for the four 24-hour tests, if desired. Convenient start and stop times for a 24±0.1 hour test period shall be set in the test sampler to effect automatic sampler operation for each test period. Test periods are not required to start at midnight; each test period may start at any time of day.

(3) Carry out a leak test of the sampler as described in the sampler's operation manual. The leak test must be properly passed before other tests are carried out.

(4) At the beginning of each test period, the solar insolation source, as described in paragraph (c)(8) of this section, shall be off, and the sampler shall be subject to barometric pressure of not less than 730 mm Hg.

(5) During each 24-hour test period, continuously record the test chamber air temperature, the filter temperature, and the sampler flow rate, as measured by the test equipment [paragraph (c) of this section], either via a continuous analog recording or digital recording at intervals of not more than 5 minutes. Note and record the actual start and stop times for the sample period. The sampler power line voltage shall be measured and recorded during hours 1 and 24 of the test period and following completion of the specific performance parameter tests during the initial 8-hour portion of the test period.

(6) The following tests shall be carried out at some time during hours 1–8 of each 24-hour test period. The time at which the test data for each test are obtained (either time of day or elapsed time since the start of the 24-hour test period, whichever system is used to record flow rate and chamber temperature, to the closest 1 minute) shall be recorded along with the test data. If analog recording is used, the time of each test shall be identified or annotated directly on the strip chart record.

(i) Determine and record the sampler flow rate, in actual volumetric units, indicated by the sampler, and the corresponding flow rate measured by the flow rate test meter specified in paragraph (c)(3) of this section.

(ii) Determine and record the ambient (chamber) temperature indicated by the sampler and the corresponding ambient (chamber) temperature measured by the ambient temperature recorder specified in paragraph (c)(4) of this section.

(iii) Determine and record the ambient (chamber) barometric pressure indicated by the sampler and the corresponding ambient (chamber) barometric pressure measured by the barometric pressure meter specified in paragraph (c)(5) of this section.

(iv) Activate the solar radiation source; after at least 2 hours (120 minutes) of sampler operation following the start of simulated insolation exposure, repeat tests in paragraphs (f)(6) (i) and (ii) of this section under continuation of the insolation exposure.

(v) Activate the solar radiation source; after at least 2 hours (120 minutes) of sampler operation following the start of simulated solar insolation exposure, subject the sampler to a barometric pressure (actual or simulated) of ≤600 mm Hg (absolute) while continuing the insolation exposure. After at least 1 hour (60 minutes) of sampler operation at this barometric pressure, repeat tests in paragraphs (f)(6) (i), (ii), and (iii) of this section under continuation of the reduced barometric pressure and insolation exposure.

(vi) Activate the solar radiation source; after at least 2 hours (120 minutes) of sampler operation following the start of insolation exposure, subject the sampler to a barometric pressure (actual or simulated) of ≤600 mm Hg

while continuing the insolation exposure. After at least 1 hour (60 minutes) of sampler operation at this barometric pressure, provide an additional filter pressure drop of 55 mm Hg, as specified in paragraph (c)(10) of this section and repeat tests in paragraphs (f)(6)(i), and (iii) of this section under continuation of the reduced barometric pressure, increased pressure drop, and insolation exposure. One or more of the power interruptions required in paragraph (f) (6)(vii) of this section may be used, if appropriate, to make necessary adjustments to the sampler to effect the additional filter pressure drop.

(vii) Interrupt the ac line electrical power to the sampler for periods of 20 seconds, 40 seconds, 2 minutes, 7 minutes, and 20 minutes, with not less than 5 minutes of electrical power, at the voltage specified for the test, between each power interruption. Record the hour and minute of each power interruption.

(7) After completing the special tests under paragraph (f)(6) of this section, the remainder of the 24-hour test period may be completed with the test sampler subjected to any barometric pressure within the range specified in Table E–2 of this subpart, with or without the additional filter pressure drop, and with the solar radiation either off or on.

(g) *Test Results.* All requirements in this procedure must be passed in full for each of the four 24-hour tests; no provision is made for additional trials to compensate for failed tests. For each of the four 24-hour test periods, validate the test conditions and determine the test results as follows:

(1) *Chamber temperature control.* Examine the continuous record of the chamber temperature obtained in test procedure paragraph (f)(5) of this section and verify that the temperature met the requirements specified in Table E–1 of this subpart at all times during the test. If not, the entire 24-hour test is not valid and must be repeated.

(2) *Power line voltage.* Verify that each of the three power line voltage measurements obtained in test procedure in paragraph (f)(5) of this section met the line voltage requirements specified in Table E–1 of this subpart. If not, the entire 24-hour test is not valid and must be repeated.

(3) *Sample flow rate.* (i) From the continuous record of the test sampler flow rate obtained from the flow rate meter in test procedure paragraph (f)(5) of this section, determine the average or instantaneous sampler flow rate, or average flow rate, at intervals of not more than 5 minutes for the entire 24-hour sample period. Calculate the percent difference between the sampler interval flow rate, in actual liters per minute (L/min), and 16.67 L/min, for each interval in test procedures in paragraphs (f)(6)(i), (6)(iv), (6)(v), and (6)(vi) of this section, as follows:

$$\%\ \text{Difference} = \frac{F_i - 16.67}{16.67} \times 100\% \quad (1)$$

Where F_i is the measured sampler flow rate for interval I, in actual L/min.

(ii) All calculated sampler flow rate percent differences must meet the sample flow rate specification listed in Table E–2 of this subpart.

(4) *Sample flow rate regulation.* (i) Using the sampler interval flow rates obtained in paragraph (g)(3) of this section, calculate the average sampler flow rate in actual liters per minute for the 24-hour period, excluding periods of electrical power interruption, as,

$$\overline{F}_{ave} = \frac{\sum_{i=1}^{n} F_i}{n} \quad (2)$$

where

F_{ave} = average sampler flow rate over the 24-hour test period,

F_i = sampler flow rate for interval I

n = number of flow intervals over the 24-hour period, excluding intervals of no flow rate during power interruptions.

(ii) For each interval over the 24-hour period, calculate the difference between the interval sampler flow rate and the average sampler flow rate. The difference between the interval sampler flow rate and the average sampler flow rate must meet the flow rate regulation specification listed in Table E–2 of this subpart for all intervals during the 24-hour test period, excluding periods of electrical power interruption.

(5) *Sample flow rate coefficient of variation.* (i) Using the sampler interval flow rates determined in paragraph (g)(3) of this section, calculate the sampler flow rate coefficient of variation, CV_{flow} as:

$$CV_{flow} = \frac{1}{F_{ave}} \times \sqrt{\frac{\sum_{i=1}^{n} F_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} F_i\right)^2}{n-1}} \times 100\% \quad (3)$$

Where

CV_{flow} = coefficient of variation of sampler flow rate, and F_{ave}, F_i, I, and n are as defined previously.

(ii) The CV_{flow} calculated must meet the sampler flow rate coefficient of variation specification listed in Table E–2 of this subpart for each test. Also the coefficient of variation reported by the sampler at the end of the sample period must agree with CV_{flow} calculated here within 0.5%.

(6) *Flow rate measurement accuracy.* (i)(A) Calculate the percent difference between the sampler flow rate, in actual liters per minute (L/min), indicated by the sampler, and the sampler flow rate measured with the flow rate test meter [paragraph (c)(3) of this section] in test procedures in paragraphs (f) (6)(i), (6)(iv), (6)(v), and (6)(vi) of this section, for each set of measurements as:

$$\%\ \text{Difference} = \frac{F_{si} - F_i}{F_i} \times 100\% \quad (4)$$

Where

F_{si} = sampler flow rate indicated by the sampler, in actual L/min., for measurement set I.

(B) All calculated sampler flow rate percent differences must meet the flow

rate measurement accuracy specification listed in Table E–2 of this subpart.

(ii)(A) Obtain the value for the average sampler volumetric flow rate reported by the sampler at the end of the sample period and calculate the percent difference between the reported average sampler flow rate and the average flow rate determined in paragraph (f)(4) of this section as:

$$\% \text{ Difference} = \frac{F_{s,ave} - F_{ave}}{F_{ave}} \times 100\% \qquad (5)$$

Where

$F_{s,ave}$ = average sampler flow rate reported by the sampler.

(B) This calculated percent difference must also meet the flow rate measurement accuracy specification listed in Table E–2 of this subpart.

(7) *Ambient temperature measurement accuracy.* (i) Calculate the difference between the ambient air temperature indicated by the sampler and the ambient (chamber) air temperature measured with the ambient air temperature recorder, paragraph (c)(4) of this section, in test procedures paragraphs (f) (6)(ii), (6)(iv), and (6)(v) of this section, as:

$$T_{difference} = T_s - T_m \qquad (6)$$

Where

T_s = ambient air temperature indicated by the sampler, °C; and

T_m = ambient air temperature measured by the test temperature instrument, °C.

(ii) All calculated temperature differences must meet the ambient air temperature measurement accuracy specification listed in Table E–2 of this subpart.

(8) *Ambient barometric pressure measurement accuracy.* (i) Calculate the difference between the ambient barometric pressure indicated by the sampler and the ambient barometric pressure measured with the ambient barometric pressure meter, paragraph (c)(5) of this section, in test procedures in paragraphs (f)(6)(iii), (6)(v), and (6)(vi) of this section, as:

$$P_{difference} = P_s - P_m \qquad (7)$$

Where

P_s=ambient barometric pressure indicated by the sampler, mm Hg; and

P_m=ambient barometric pressure measured by the test barometric pressure meter, mm Hg.

(ii) All calculated differences for barometric pressure must meet the ambient barometric pressure measurement accuracy specification listed in Table E–2 of this subpart.

(9)(i) Filter temperature control (sampling). From the continuous record of the test sampler filter temperature obtained from the filter temperature sensor, paragraphs (c)(6) and (e)(4) of this section, in test procedure in paragraph (f)(5) of this section, determine the measured instantaneous or average filter temperature at intervals of not more than 5 minutes for the entire 24-hour sample period. From the continuous record of the ambient air temperature obtained from the ambient (chamber) air temperature recorder, paragraph (c)(4) of this section, in test procedure paragraph (f)(5) of this section, determine the measured instantaneous or average ambient (chamber) air temperature at intervals of not more than 5 minutes for the entire 24-hour sample period. For each interval over the 24-hour period (excluding intervals during power interruptions), calculate the difference, in °C, between the measured interval filter temperature and the measured interval ambient temperature for the corresponding interval, as:

$$T_{filter,\ difference} = T_{filter} - T_{ambient} \qquad (8)$$

(ii) The difference between the interval filter temperature and the interval average ambient temperature for all intervals must meet the filter temperature control specification listed in Table E–2 of this subpart, excluding periods of electrical power interruption.

(10) Elapsed sample time accuracy. Calculate the sample time for the 24-hour sample period as the difference between the sample end time and the sample start time, as recorded in paragraph (f)(5) of this section, less the total time duration of all power interruptions. The difference between the actual sampler time calculated and the sample time reported by the sampler at the end of the sample period must meet the elapsed sample time accuracy specification listed in Table E–2 of this subpart.

(11) Record of power interruptions. Verify that the sampler provides a visual display of the correct year, month, day-of-month, hour, and minute, within ±2 minutes, of the start of each power interruption of more than 60 seconds.

§ 53.53 Post-sampling filter temperature control test.

(a) *Overview.* This procedure provides for testing the temperature control of the sample filter during the post-sampling (non-sampling) mode following sample collection. The test conditions and performance specifications are summarized in Table E–2 of this subpart. This performance parameter, when tested or determined as described in this test procedure, must meet or exceed the performance specification given in Table E–2 of this subpart for the associated $PM_{2.5}$ method to be considered for designation as a reference or equivalent method.

(b) *Technical Definition.* Post-sampling temperature control is the ability of a sampler to maintain the temperature of the particulate matter sample filter within the specified deviation from ambient temperature during the period between the end of active sample collection of the $PM_{2.5}$ sample by the sampler until the filter is retrieved from the sampler for laboratory analysis.

(c) *Required test equipment.* (1) Environmental chamber or other

temperature-controlled environment or environments, capable of obtaining and maintaining the various temperatures between −20 °C to +40 °C as required for the test with an accuracy of ±2 °C. The test environment(s) must be capable of maintaining temperature within the specified limits continuously with the additional heat load of the operating test sampler in the environment. [Henceforth, where the test procedures specify a test or environmental ''chamber,'' an alternative temperature-controlled environmental area or areas may be substituted, provided the required test temperatures and all other test requirements are met. See § 53.52(f)(1)].

(2) Variable voltage ac power transformer, range 100 to 130 Vac, with sufficient VA capacity to operate the sampler continuously under test conditions.

(3) Ambient air temperature recorder, range −30°C to +50°C, certified accurate to within 0.5 °C with a radiation error of 0.2 °C or less under a solar radiation intensity of 1000 watts/m², as described in Reference 6 in Appendix A of this subpart.

(4) Miniature temperature sensor, capable of being installed in the sampler without introducing air leakage and capable of measuring the sample air temperature within 1 cm of the center of the filter, downstream of the filter, certified accurate to within 0.5°C, NIST traceable, with continuous (analog) recording capability or digital recording at intervals of not more than 5 minutes.

(5) Means, such as a solar-spectrum lamp or lamps, for generating or simulating thermal radiation in approximate spectral content and intensity equivalent to solar insolation of 1000 watts/m², inside the environmental chamber.

(6) AC rms voltmeter, accurate to 0.5 volts.

(7) Time measurement system, accurate to 10 seconds per day.

(d) *Calibration of test measurement instruments.* Submit documentation showing evidence of recent calibration, calibration accuracy, and NIST-traceability (if required) of all measurement instruments used for the tests. Where an instrument's measurements are to be recorded with an analog recording device, the accuracy of the entire instrument-recorder system shall be calibrated or verified.

(e) *Test Setup.* (1) The test sampler shall be set up for testing in the temperature-controlled chamber. Setup of the sampler shall be performed as described in the sampler's operation or instruction manual referred to in § 53.4 (b)(3). The sampler shall be installed upright and set up in its normal configuration for collecting $PM_{2.5}$ samples with a filter installed, except that the sample air inlet may be removed, if desired.

(2) The sampler shall be provided ac line power from the variable voltage ac power transformer, which shall be set to provide power to the sampler at a voltage of 105 ±1 volts ac (rms) during this test.

(3) The miniature temperature sensor shall be installed in the test sampler such that it accurately measures the temperature of the air 1 cm from the center of the filter on the downstream side of the filter.

(4) The solar radiant energy source shall be installed in the test chamber such that the entire test sampler is irradiated in a manner similar to the way it would be irradiated by solar radiation if it were located outdoors in an open area on a sunny day, with the radiation arriving at an angle of between 30 and 45 degrees from vertical and such that the intensity of the radiation received by all sampler surfaces that receive direct radiation is not less than 1000 watts/m² (measured in a plane perpendicular to the incident radiation). The incident radiation shall be oriented with respect to the sampler such that the area of the sampler's ambient temperature sensor (or temperature sensor shield) receives direct radiation as it would or could during normal outdoor installation. Also, the sensor must not be shielded from the radiation by a sampler part in a way that would not occur at other normal insolation angles or directions.

(5) The ambient air temperature recorder shall be installed in the test chamber such that it will accurately measure the temperature of the air in the chamber without being unduly affected by the chamber's air temperature control system or by the radiant energy from the solar radiation that may be present inside the test chamber.

(f) *Procedure.* (1) The test sampler shall be tested during operation in the post-sample collection operational mode (operation of the sampler during the period from the end of active sample collection of the $PM_{2.5}$ sample by the sampler until the filter is retrieved from the sampler for laboratory analysis) over seven (7) hours, following one of the 24-hour tests described in § 53.52. The test chamber temperature shall be initially set to ≤−20 °C, raised to ≥40 °C, held at ≥40 °C for one hour, then reduced to ≤−20 °C during the test.

(2) Prepare the sampler for the test by allowing the sampler to operate for a normal 24-hour sample collection period, as directed in the sampler's operation or instruction manual. If the sampler has multiple (sequential) sample capability, any of the sequential channels may be used for the test; however, if the sampler has multiple filter holders, each filter holder must be tested for temperature control. Convenient start and stop times for a 24 ± 0.1 hour sample collection period shall be set in the sampler to effect automatic sampler operation for each test period. The active sample collection period may start at any time of day and is not required to start at midnight. One or more of the test periods associated with test procedure set forth in § 53.52 may be used for this test preparation.

(3) At the beginning of the 7-hour test period, the solar insolation source, as described in paragraphs (c)(4) and (e)(4) of this section, shall be on, the ambient (chamber) temperature shall be set to ≤−20 °C, and the sampler power line voltage shall be set to 105 ±1 volts ac (rms).

(4) During the 7-hour test period, continuously record the test chamber air temperature and the filter temperature, as measured by the test equipment in paragraph (c) of this section, either via a continuous analog recording or digital recording at intervals of not more than 5 minutes. Note and record the actual start and stop times for the sample period. The sampler power line voltage shall be measured during hours 1 and 7 of the test and at any other time during the test period when there is a possibility that the voltage may have changed.

(5) During the first 3 hours of the test, the chamber air temperature shall be increased such that the chamber air temperature is ≥40 °C 3 hours after the beginning of the test. The chamber air temperature shall be maintained at ≥40 °C for one hour (until 4 hours after the beginning of the test), then decreased over the next 3 hours of the test such that the chamber air temperature is ≤−20 °C at the end of the test (7 hours after the beginning of the test. The chamber air temperature profile during the first and last three hours of the test is unspecified, provided the initial, central hour, and final temperatures are as specified in paragraph (f)(1) of this section.

(g) *Test Results*—(1) *Filter temperature control (post-sampling).* From the continuous record of the test sampler filter temperature obtained from the filter temperature sensor, paragraphs (c)(3) and (e)(3) of this section, determine the measured instantaneous or average filter temperature at intervals of not more than 5 minutes for the entire 7-hour test

period. From the continuous record of the ambient air temperature obtained from the ambient (chamber) air temperature recorder, paragraphs (c)(4) and (e)(5) of this section, determine the measured instantaneous or average ambient (chamber) air temperature at the same intervals used for filter temperature for the entire 7-hour sample period. For each interval over the 7-hour period, calculate the difference, in °C, between the measured interval filter temperature and the measured interval ambient temperature for the corresponding interval, as:

$$T_{filter,\ difference} = T_{filter} - T_{ambient} \qquad (9)$$

(2) The difference between the interval filter temperature and the interval average ambient temperature for each and all intervals must meet the filter temperature control specification listed in Table E–2 of this subpart, excluding periods of electrical power interruption, if any.

§ 53.54 Leak check test.

(a) *Overview.* Under section 7.4.6 of Appendix L of part 50 of this chapter, the sampler is required to include a facility—including components, instruments, operator controls, a written procedure, and other capabilities as necessary—to allow the operator to carry out a leak test of the sampler at a field monitoring site without additional equipment. This procedure is intended to test the adequacy and effectiveness of the sampler's leak check facility. Because of the variety of potential sampler configurations and leak check procedures possible, some adaptation of this procedure may be necessary to accommodate the specific sampler under test.

(b) *Technical definitions.* (1) External leakage includes the total flow rate of external ambient air which enters the sampler other than through the sampler inlet and which passes through any one or more of the impactor, filter, or flow rate measurement components.

(2) Internal leakage is the total sample air flow rate that passes through the filter holder assembly without passing through the sample filter.

(c) *Required test equipment.*

(1) Flow rate measurement device, range 70 to 130 mL/min, 2 percent certified accuracy, NIST-traceable.

(2) Flow control device, capable of providing a controlled, simulated leak flow rate of 100 mL/min.

(3) Flow rate measurement adaptor (Drawing L–27, Appendix L of part 50 of this chapter) or equivalent adaptor to facilitate measurement of sampler flow rate.

(4) A disk, such as a sample filter that is heavily loaded or a flow-impervious membrane containing one or more pinholes, which can be installed into the sampler's filter cassette (either with or without a normal sample filter) and which blocks the normal flow rate through the filter cassette but which, instead, provides a simulated leak flow rate through the disk of not more than 100 mL/min under the conditions specified for the leak check in the sampler's leak check procedure.

(d) *Calibration of test measurement instruments.* Submit documentation showing evidence of recent calibration, calibration accuracy, and NIST-traceability (if required) of all measurement instruments used in the tests. The accuracy of flow meters shall be verified at the highest and lowest pressures and temperatures used in the tests and shall be checked at zero and one or more non-zero flow rates within 7 days of test use.

(e) *Test setup.* (1) The test sampler shall be set up for testing as described in the sampler's operation or instruction manual referred to in § 53.4(b)(3). The sampler shall be installed upright and set up in its normal configuration for collecting $PM_{2.5}$ samples, except that the sample air inlet shall be removed and a device such as a flow rate measurement adaptor shall be installed on the sampler's downtube.

(2) The flow rate control device shall be set up to provide a constant, controlled flow rate of 100 mL/min into the sampler downtube under the conditions specified for the leak check in the sampler's leak check procedure.

(3) The flow rate measurement device shall be set up to measure the controlled flow rate of 100 mL/min into the sampler downtube under the conditions specified for the leak check in the sampler's leak check procedure.

(f) *Procedure.* (1) Install a sample filter in the test sampler and ensure that the sampler has no internal or external leaks.

(2) Carry out both the external and internal leak check procedure as described in the sampler's operation/instruction manual and verify that both leak checks indicate no significant leaks in the test sampler.

(3) Arrange the flow control device, flow rate measurement device, and other apparatus as necessary to provide a simulated leak flow rate of 100 mL/min into the test sampler through the downtube during the specified external leak check procedure. Carry out the external leak check procedure as described in the sampler's operation/instruction manual but with the simulated leak of 100 mL/min.

(4) Install the disk that simulates a filter-bypass leak in the filter cassette and carry out the internal leak check procedure as described in the sampler's operation/instruction manual.

(g) *Test results.* The requirements for successful passage of this test are:

(1) That the leak check procedure indicates no significant external or internal leaks in the test sampler when no simulated leaks are introduced.

(2) That the external leak check procedure properly identifies the simulated external leak of 100 mL/min.

(3) That the internal leak check procedure properly identifies the simulated internal leak of 100 mL/min.

§ 53.55 Flow rate cut-off test.

(a) *Overview.* This test is intended to verify that the sampler carries out the required automatic sample flow rate cut-off function properly.

(b) *Technical definition.* The flow rate-cut off function requires the sampler to automatically stop sample flow and terminate the current sample collection if the sample flow rate becomes less than the minimum flow rate specified in Table E–2 of this subpart (10 percent below the nominal sample flow rate) for more than 60 seconds during a sample collection period.

(c) *Required test equipment.* (1) Flow rate meter, suitable for measuring the sampler flow rate at the sampler inlet in a closed system below atmospheric pressure, range 10 to 25 actual L/min, 2 percent certified accuracy, NIST-traceable, with continuous (analog) recording capability or digital recording at intervals of not more than 5 seconds. Mass flow meter type recommended; however, note that temperature and pressure corrections are generally required to convert measured mass flow rate to actual volumetric flow rate.

(2) Valve or other means to restrict or reduce the sample flow rate.

(d) *Calibration of test measurement instruments.* Submit documentation showing evidence of recent calibration, calibration accuracy, and NIST-traceability of the flow rate meter used for this test. The accuracy of the flow meter shall be verified at the highest

and lowest pressures used in the tests and shall be checked at zero and one or more non-zero flow rates within 7 days of test use. Where an instrument's measurements are to be recorded with an analog recording device, the accuracy of the entire instrument-recorder system shall be calibrated or verified.

(e) *Test setup.* (1) The test sampler shall be set up for testing at any temperature and barometric pressure within the specified ranges. Setup of the sampler shall be performed as described in the sampler's operation or instruction manual referred to in § 53.4(b)(3). The sampler shall be installed upright and set up in its normal configuration for collecting $PM_{2.5}$ samples, except that the sample air inlet shall be removed to permit measurement of the sampler flow rate by the certified flow rate meter.

(2) The flow rate meter shall be connected so as to measure the sampler flow rate at the entrance to the sampler (*i.e.* the flow rate that would enter the sampler inlet if the inlet had not been removed).

(3) The valve or means for reducing sampler flow rate shall be installed such that the sampler flow rate can be manually restricted during the test.

(f) *Procedure.* (1) Prepare the sampler for normal sample collection operation as directed in the sampler's operation or instruction manual. Set the sampler to automatically start a normal 24-hour sampler collection period at a convenient time.

(2) Continuously record the sampler flow rate and the time during the sample period, with at least 5-minute resolution during the normal operation of the sampler and at least 5-second resolution during the time period when the sampler flow rate is manually reduced.

(3) After at least 1 hour of normal sampler operation at a sample flow rate within the specified flow rate range specified in Table E–2 of this subpart, manually restrict the sampler flow rate such that the sampler flow rate is decreased slowly over several minutes to a flow rate less than the flow rate cut off value specified in Table E–2 of this subpart. Maintain this flow rate for at least 2.0 minutes or until the sampler stops the sample flow automatically.

(g) *Test Results.* (1) Inspect the continuous record of the sampler flow rate and determine the time at which the sampler flow rate decreases to a value less than the cut-off value specified in Table E–2 of this subpart. To pass this test, the sampler must automatically stop the sampler flow at least 30 seconds but not more than 50 seconds after the time at which the sampler flow rate was determined to have decreased to a value less than the value specified in Table E–2 of this subpart.

(2) Verify that the elapsed sample time and average flow rate reported by the sampler for this test sample period are accurate within 2 percent. The sampler must provide the same information to the operator as is required following a normal sample collection period, and the information reported in this test must accurately reflect the substantially shortened sample collection period caused by the automatic sample flow cut off.

(3) Verify that the sampler's required ''Flow-out-of-spec'' and the ''Incorrect sample period'' flag indicators are set at the end of the test.

§ 53.56 Operational field precision test.

(a) *Overview.* This test is intended to determine the operational precision of the candidate sampler during a minimum of 10 days of field operation, using three collocated test samplers. Measurements of $PM_{2.5}$ are made with all of the samplers and then compared to determine replicate precision. This procedure is applicable to both reference and equivalent methods. In the case of equivalent methods, this test may be combined and conducted concurrently with the comparability test for equivalent methods (subpart C of this part), using three reference method samplers collocated with three candidate equivalent method samplers and meeting the applicable site and other requirements of subpart C of this part.

(b) *Technical definition.* Field precision means the standard deviation or relative standard deviation of a set of measurements obtained concurrently with three or more collocated samplers in actual ambient air field operation.

(c) *Test site.* Any outdoor test site having $PM_{2.5}$ concentrations that are reasonably uniform over the test area and that meet the minimum level requirement of § 53.56(g) is acceptable for this test.

(d) *Required facilities and equipment.* An appropriate test site and suitable electrical power to accommodate three test samplers.

(e) *Test setup.* (1) Three identical test samplers shall be installed at the test site in their normal configuration for collecting $PM_{2.5}$ samples in accordance with the instructions in the associated manual referred to in § 53.4(b)(3) and in accordance with applicable supplemental guidance provided in Reference 3 in Appendix A of this subpart. The test sampler inlet openings shall be located at the same height above ground and between 2 and 4 meters apart horizontally. The samplers shall be arranged or oriented in a manner that will minimize spatial and wind directional effects on sample collection of one sampler on the other samplers.

(2) Each test sampler shall be leak checked, calibrated, and set up for normal operation in accordance with the instruction manual and with any applicable supplemental guidance provided in Reference 3 in Appendix A of this supbart.

(f) *Test procedure.* (1) Install a specified filter in each sampler and otherwise prepare each sampler for normal sample collection. Set identical sample collection start and stop times for each sampler.

(2) Collect either a 24-hour or a 48-hour atmospheric $PM_{2.5}$ sample simultaneously with each of the three test samplers.

(3) Determine the measured $PM_{2.5}$ mass concentration for each sample in accordance with the procedures prescribed for the candidate method in the associated manual referred to in § 53.4(b)(3) and in accordance with supplemental guidance in Reference 3 in Appendix A of this subpart.

(4) Repeat this procedure to obtain a total of 10 sets of 24-hour or 48-hour $PM_{2.5}$ measurements over 10 test periods.

(g) *Calculations.* (1) Record the $PM_{2.5}$ concentration for each test sampler for each test day as $C_{i,j}$, where I is the sampler number (I=1,2,3) and j is the test day (j=1,2, . . . 10).

(2) For each test day, calculate and record the average of the three measured $PM_{2.5}$ concentrations as $\bar{C}_j$ where j is the test day:

$$\bar{C}_j = \frac{1}{3} \times \sum_{i=1}^{3} C_{i,j} \qquad (10)$$

If $\bar{C}_j < 10\ \mu g/m^3$ for any test day, data from that test day are unacceptable and an additional sample collection set must be performed to replace the unacceptable data.

(3) Calculate and record the precision for each of the 10 test days as:

$$P_j = \sqrt{\frac{\sum_{i=1}^{3} C_{i,j}^2 - \frac{1}{3}\left(\sum_{i=1}^{3} C_{i,j}\right)^2}{2}} \qquad (11)$$

if $\bar{C}_j$ is below 40 μg/m³ for 24-hour measurements or below 30 μg/m³ for 48-hour measurements; or

$$RP_j = 100\% \times \frac{1}{\bar{C}_j}\sqrt{\frac{\sum_{i=1}^{3} C_{i,j}^2 - \frac{1}{3}\left(\sum_{i=1}^{3} C_{i,j}\right)^2}{2}} \qquad (12)$$

if $\bar{C}_j$ is above 40 μg/m³ for 24-hour measurements or above 30 μg/m³ for 48-hour measurements.

(h) *Test results.* The candidate method passes the precision test if all 10 P_j or RP_j values meet the specifications in Table E–2 of this subpart.

§ 53.57 Aerosol transport test for class I sequential samplers

(a) *Overview.* This test is intended to verify adequate aerosol transport through any air flow splitting components that may be used in a Class I candidate equivalent method sampler to achieve sequential sampling capability. This test is applicable to all Class I candidate samplers in which the aerosol flow path (the flow of air upstream of filtration) differs from that specified for reference method samplers as set forth in Drawings L–18 and L–24 of Appendix L to part 50 of this chapter. This test does not apply to candidate Class I equivalent method samplers in which each channel consists of a separate inlet, impactor, and filter holder of the exact same internal geometry as specified for the reference method sampler. The test requirements and performance specifications for this test are summarized in Table E–1 of this subpart.

(b) *Technical Definitions.* (1) Aerosol transport is the percentage of the laboratory challenge aerosol which penetrates to the active sample filter of the candidate Class I sampler.

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

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

(4) A channel is a flow path that the aerosol make take, only one of which may be active at a time.

(5) An added component is any physical part of the sampler which is different from that specified for the reference method sampler and which allows or causes the aerosol to be routed to a different channel.

(c) *Required facilities and test equipment.* (1) Aerosol generation system, as specified in § 53.64(c)(1).

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

(3) Particle size verification equipment, as specified in § 53.64(c)(3).

(4) Fluorometer, as specified in § 53.64(c)(4).

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

(d) *Calibration of test measurement instruments.* Submit documentation showing evidence of recent calibration, calibration accuracy, and NIST-traceability (if required) of all measurement instruments used for the tests. Where an instrument's measurements are to be recorded with an analog recording device, the accuracy of the entire instrument-recorder system shall be calibrated or verified.

(e) *Test setup.* (1) The candidate sampler, with its inlet and impactor(s) removed, shall be installed in the particle delivery system so that the test aerosol is introduced at the top of the downtube that connects to the exit adaptor of the inlet. If the candidate sampler has a separate impactor for each channel, then for this test the filter holder assemblies must be connected to the physical location on the sampler where the impactors would normally connect.

(2) Filters that are appropriate for use with fluorometric methods (e.g., glass fiber) shall be used for particle collection for these tests.

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

(2) Generate aerosol composed of oleic acid with a uranine fluorometric tag of 4 μm ±0.25 μm using a vibrating orifice aerosol generator according to procedures specified in § 53.61(g). Check for the presence of satellites and adjust the generator to minimize their production. Calculate the aerodynamic particle size using the operating parameters of the vibrating orifice aerosol generator and record. The calculated aerodynamic diameter must be within 0.25 μm of 4 μm.

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

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

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

(6) Determine the quantity of material collected on the no-flow filter(s) using a calibrated fluorometer. Record the mass of fluorometric material on each no-flow filter as $M_{no\text{-}flow(ij)}$ where I = active channel number and j = no-flow filter number.

(7) Wash the surfaces of the added component(s) which contact the aerosol flow with 0.01N NaOH and determine the quantity of material collected using a calibrated fluorometer. Record the mass of fluorometric material collected in the wash as $M_{wash(I)}$, where I = replicate number.

(8) Calculate and record the aerosol transport as:

$$T_{(i)} = \frac{M_{active(i)}}{M_{active(i)} + M_{wash(i)} + \sum M_{no\ flow(ij)}} \times 100\% \qquad (13)$$

where I = active channel number and j = no-flow filter number.

(9) Repeat paragraphs (f) (1) through (6) of this section for each channel, making each channel in turn the exclusive active channel.

(g) *Evaluation of test results.* The candidate Class I sampler passes the aerosol transport test if the specification in Table E–1 of this subpart is met for each channel.

Tables to Subpart E of Part 53

TABLE E–1—TEST CONDITIONS FOR § 53.52 COMPREHENSIVE 24-HOUR TESTS

24-hour test number	Power Line voltage	Initial temperature Deg C, Hours 1–8	Final temperature, Deg. C, Hours 22–24
1	105 ±1	≤ − 20.0	15.0 ±2.0
2	125 ±1	15.0 ±2.0	≥40.0
3	125 ±1	≥40.0	15.0 ±2.0
4	105 ±1	15.0 ±2.0	≤ − 20.0

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TABLE E-2—SUMMARY OF TEST REQUIREMENTS FOR REFERENCE AND CLASS I EQUIVALENT METHODS FOR $PM_{2.5}$

Performance Test	Test Procedure	Performance Specification	Test Conditions	Part 50, Appendix L Reference
Sample flow rate	§53.52	16.67 ± 5% actual L/min	a) specified filter b) ambient temp -20 to +40°C c) barometric pressure: 600 - 730 mm Hg d) additional filter pressure drop: 55 mm Hg e) line voltage: 105-125 Vac	Sec. 7.4.1, Sec. 7.4.2,
Sample flow rate regulation	§53.52	Ave. volumetric flow rate ± 5%		Sec. 7.4.3
Sample flow rate coefficient of variation	§53.52	CV_{flow}, 4% max		Sec. 7.4.3
Flow rate and average flow rate measurement accuracy	§53.52	Accuracy: ± 2%		Sec. 7.4.5
Ambient air temperature measurement accuracy	§53.52	Accuracy: ± 2°C	ambient temperature range: -20 to +40°C	Sec. 7.4.8
Ambient barometric pressure measurement accuracy	§53.52	Accuracy: ± 10 mm Hg	ambient pressure range: 600 to 800 mm Hg	Sec. 7.4.9
Filter temperature control (sampling)	§53.52	$T_{filter} \leq 3$ °C above ambient temperature	ambient temperature range: -20 to +40°C	Sec. 7.4.10
Elapsed sample time accuracy	§53.52	± 1 min	typical sampler operation, including various power interruptions.	Sec. 7.4.13
Filter temperature control (post sampling)	§53.53	$T_{ambient} \leq 3$ °C above ambient temperature	ambient temperature range: -20 to +40°C	Sec. 7.4.10
Sample flow rate cut off	§53.55	Flow rate cut-off if flow rate deviates more than 10 % from the specified nominal flow rate for >60 seconds	Nominal	Sec. 7.4.4
Sampler leak check facility	§53.54	External leakage: 100 mL/min, max Internal leakage: 100 mL/min, max	a) Controlled leak flow rate of 100 mL/min b) additional filter pressure drop of 55 mm Hg Filter blocked, with leak flow rate of 100 mL/min	Sec. 7.4.6
Field Precision	§53.56	< 40 $\mu g/m^3$ (24-hr) or 30 $\mu g/m^3$ (48-hr): Std. dev. < 2 $\mu g/m^3$ > 40 $\mu g/m3$ (24-hr) or 30 $\mu g/m^3$ (48-hr): CV < 5%	3 collocated samplers at 1 site for at least 10 days; based on levels >10 $\mu g/m3$	Sec. 5.1
THE FOLLOWING REQUIREMENT IS APPLICABLE TO CLASS I CANDIDATE EQUIVALENT METHODS				
Aerosol Transport	§53.57	Aerosol transport must be >98% for all channels	Determine aerosol transport through any new components added to the reference method before the filter for each channel.	---

Figures to Subpart E

DESIGNATION TESTING CHECKLIST

Auditee	Auditor signature	Date

Compliance Status: Y = Yes N = No NA = Not applicable/Not available				
Verification			**Verified by Direct Observation of Process or of Documented Evidence: Performance, Design or Application Spec.** *Corresponding to Sections of 40 CFR Part 53 or 40 CFR Part 50, App.L*	**Verification Comments** (Includes documentation of who, what, where, when, why) (Doc. #, Rev. #, Rev. Date)
Y	N	NA		
			PERFORMANCE SPEC/TEST	
			Sample flow rate coefficient of variation (§53.52) (L 7.4.3)	
			Filter temperature control (sampling) (§53.52) (L 7.4.10)	
			Elapsed sample time accuracy (§53.52) (L 7.4.13)	
			Filter temperature control (post sampling) (§53.53) (L 7.4.10)	
			APPLICATION SPEC/TEST	
			Field Precision (§53.56) (L 5.1)	
			Meets All App. L Requirements (53 subpart A, §53.2(a)(3)) (53 subpart E, §53.51(b))	
			Filter Weighing (L-8)	
			Field Sampling Procedure (L-10)	
			DESIGN SPEC./ TEST	
			Filter (L-6)	
			Range of Operational Conditions (L-7.4.7)	
THE FOLLOWING REQUIREMENTS APPLY ONLY TO CLASS I CANDIDATE EQUIVALENT METHODS				
			PERFORMANCE SPEC. TEST(CONT'D.)	
			Aerosol Transport (§53.57)	

Figure E-1 Designation testing checklist

PRODUCT MANUFACTURING CHECKLIST

Auditee _____ Auditor signature _____ Date _____

Compliance Status: Y = Yes N = No NA = Not applicable/Not available				
Verification			**Verified by Direct Observation of Process or of Documented Evidence: Performance, Design or Application Spec.** *Corresponding to sections of 40 CFR Part 53 or 40 CFR Part 50, App L*	Verification Comments (Includes documentation of who, what, where, when, why) (Doc. #, Rev. #, Rev. Date)
Y	N	NA		
			PERFORMANCE SPEC/TEST	
			Assembled operational performance (Burn-in test)	
			Sample flow rate (§53.52) (L 7.4.1, L 7.4.2)	
			Sample flow rate regulation (§53.52) (L 7.4.3)	
			Flow rate and average flow rate measurement accuracy (§53.52) (L 7.4.5)	
			Ambient air temperature measurement accuracy (§53.52) (L 7.4.8)	
			Ambient barometric pressure measurement accuracy (§53.52) (L 7.4.9)	
			Sample flow rate cut-off (§53.55) (L 7.4.4)	
			Sample air path leakage (§53.54 (L 7.4.6)	
			APPLICATION SPEC/TEST	
			Flow rate transfer standard (L-7.4.17)	
			Operational /Instructional manual (L-7.4.18)	
			DESIGN SPEC./ TEST	
			Impactor (jet width) (L-7.3.3; 53.51(c)(2))	
			Surface finish (L-7.3.7; 53.51(c)(2))	

Figure E-2 Product manufacturing checklist

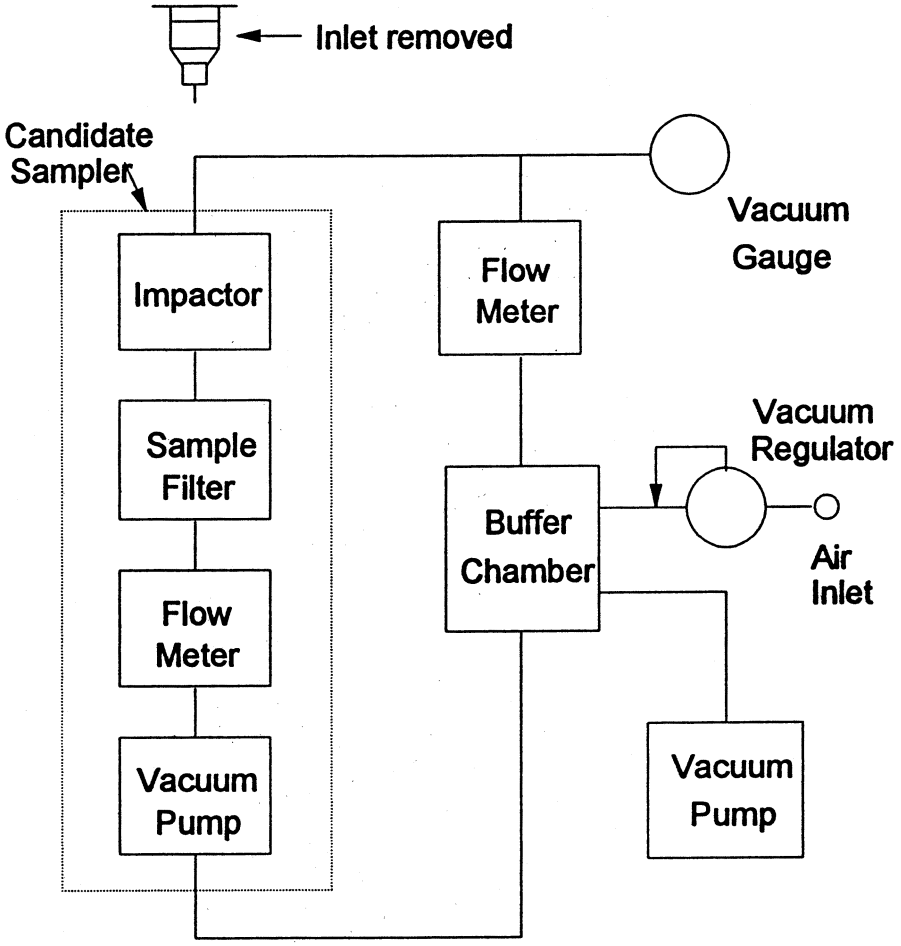

Figure E-3 Suggested test configuration for simulating reduced barometric pressure for the comprehensive test procedure (§53.52)

Appendix A to Subpart E of Part 53—References

1. ''Quality systems—Model for quality assurance in design, development, production, installation and servicing,'' ISO9001. July 1994. Available from American Society for Quality Control, 611 East Wisconsin Avenue, Milwaukee, WI 53202.

2. ''American National Standard—Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs.'' ANSI/ASQC E4–1994. January 1995. Available from American Society for Quality Control, 611 East Wisconsin Avenue, Milwaukee, WI 53202.

3. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Specific Methods (Interim Edition), section 2.12. EPA/600/R–94/038b, April 1994. Available from CERI, ORD Publications, U.S. Environmental Protection Agency, 26 West Martin Luther King Drive, Cincinnati, Ohio 45268. [Section 2.12 is currently under development and will not be available from the previous address until it is published as an addition to EPA/600/R–94/038b. Prepublication draft copies of section 2.12 will be available from Department E (MD–77B), U.S. EPA, Research Triangle Park, NC 27711 or from the contact identified at the beginning of this proposed rule].

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

5. ''Guidance for the Use and Application of Designation Testing and Sampler Manufacturing Checklists, as Required under 40 CFR 53.51'' U.S. EPA Publication No. [To be prepared.]

6. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements. Revised March, 1995. EPA–600/R–94–038d. Available from U.S. EPA, ORD Publications Office, Center for Environmental Research Information (CERI), 26 West Martin Luther King Drive, Cincinnati, Ohio 45268–1072 (513–569–7562).

5. Subpart F is added to read as follows:

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

Sec.
53.60 General provisions.
53.61 Test conditions for $PM_{2.5}$ reference method equivalency.
53.62 Test procedures: Full wind tunnel test.
53.63 Test procedures: Wind tunnel inlet aspiration test.
53.64 Test procedures: Static fractionator test.
53.65 Test procedures: Loading test.
53.66 Test procedures: Volatility test.

Tables to Subpart F of Part 53

Table F–1 Performance Specifications for $PM_{2.5}$ Class II Equivalent Samplers
Table F–2 Particle Size and Wind Speeds for Full Wind Tunnel Evaluation, Wind Tunnel Inlet Aspiration Test, and Statics Chamber Test
Table F–3 Critical Parameters of Idealized Ambient Particle Size Distributions
Table F–4 Estimated Mass Concentration of $PM_{2.5}$ for Idealized Coarse Aerosol Size Distribution
Table F–5 Estimated Mass Concentration Measurement of $PM_{2.5}$ for Idealized ''Typical'' Coarse Aerosol Size Distribution
Table F–6 Estimated Mass Concentration Measurement of $PM_{2.5}$ for Idealized Fine Aerosol Size Distribution

Figures to Subpart F of Part 53

Figure F–1 Flowchart for Determining Requirements for Class II Samplers Equivalent
Figure F–2 Designation Testing Checklist

Appendix A to Subpart F of Part 53—References

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

§ 53.60 General provisions.

(a) This subpart sets forth the specific requirements that a $PM_{2.5}$ sampler associated with a candidate Class II equivalent method must meet to be designated as an equivalent method for $PM_{2.5}$. This subpart also sets forth the explicit test procedures that must be carried out and the test results, evidence, documentation, and other materials that must be provided to EPA to demonstrate that a sampler meets all specified requirements for designation as an equivalent method.

(b) A candidate method described in an application for a reference or equivalent method application submitted under § 53.4 shall be determined by the EPA to be a Class II candidate equivalent method on the basis of the definition of a Class II equivalent method given in § 53.1.

(c) Any sampler associated with a Class II candidate equivalent method (Class II sampler) must meet all requirements for reference method samplers or Class I equivalent method samplers specified in subpart E of this part, as appropriate. In addition, a Class II sampler must meet the additional requirements as specified in § 53.60(d) of this part.

(d) Except as provided in paragraph (d) (1), (2) and (3) of this section, all Class II samplers are subject to the additional tests and performance requirements specified in § 53.62 (full wind tunnel test), § 53.65 (loading test), and § 53.66 (volatility test). Alternative tests and performance requirements, as described in paragraphs (d) (1), (2), and (3) of this section, are optionally available for certain Class II samplers which meet the requirements for reference method or Class I samplers given in Appendix L of part 50 of this chapter and in Subpart E of this part, except for specific deviations of the inlet, fractionator, or filter. These requirements and the exceptions in paragraphs (d) (1), (2), and (3) of this section are summarized in the flowchart given in Figure F–1 of this subpart.

(1) *Inlet deviation.* A sampler which has been determined to be a Class II sampler (rather than a reference method or Class II sampler) solely because the design or construction of its inlet deviates from the design or construction of the inlet specified in Appendix L for reference method samplers shall not be subject to the requirements of § 53.62 (full wind tunnel test), provided that it meets all requirements of § 53.63 (inlet aspiration test), § 53.65 (loading test), and § 53.66 (volatility test).

(2) *Fractionator deviation.* A sampler which has been determined to be a Class II sampler solely because the design or construction of its particle size fractionator deviates significantly from the design or construction of the particle size fractionator specified in 40 CFR part 50, Appendix L for reference method samplers shall not be subject to the requirements of § 53.62 (full wind tunnel test), provided that it meets all requirements of § 53.64 (static fractionator test), § 53.65 (loading test), and § 53.66 (volatility test).

(3) *Filter size deviation.* A sampler which has been determined to be a Class II sampler solely because the size of its sample collection filter deviates from the sampler filter size specified in Appendix L for reference method samplers shall not be subject to the requirements of § 53.62 (full wind tunnel test) nor § 53.65 (loading test), provided it meets all requirements of § 53.66 (volatility test).

(e) The test specifications and acceptance criteria for each test are summarized in Table F–1 of this subpart. The candidate sampler must demonstrate performance that meets the acceptance criteria for each applicable test to be designated as an equivalent method.

(f) *Overview of various test procedures for Class II samplers.* (1) *Full wind tunnel test.* This test procedure is designed to ensure that the candidate sampler's aspiration of an ambient aerosol and penetration of the sub 2.5-micron fraction to its sample filter will be comparable to that of a reference method sampler. The test conditions are

summarized in Table F–2 of this subpart (under the heading, ''Full Wind Tunnel Test'), and the candidate sampler must meet the acceptance criteria specified in Table F–1 of this subpart.

(2) *Wind tunnel inlet test.* The wind tunnel inlet aspiration test challenges the candidate sampler with a monodisperse aerosol that is specified in Table F–2 of this subpart (under the heading, ''Inlet Aspiration Test'). The aerosol is introduced into a wind tunnel environment, and the aspiration of the candidate sampler is compared with that of the reference method sampler at wind speeds of 2 km/hr and 24 km/hr. The acceptance criteria presented in Table F–1 of this subpart is based on the relative aspiration between the candidate sampler and federal reference method sampler.

(3) *Static 2.5-micron fractionator test.* The static 2.5-micron fractionator test determines the effectiveness of the candidate fractionator under static conditions for aerosols of the size and type specified in Table F–2 of this subpart (under the heading, ''Static Fractionator Test'). The candidate sampler must meet the acceptance criteria presented in Table F–1 of this subpart.

(4) *Loading test.* (i) The loading test is used to ensure that the performance of a candidate sampler is not significantly affected by the amount of material deposited on its interior surfaces between periodic cleaning. This test is divided into two distinct experiments:

(A) A mandatory demonstration of no significant performance shift over a 24-hour time period; and

(B) An optional demonstration of no significant performance shift over an extended time period for approval of a cleaning interval greater than 24 hours.

(ii) In the initial evaluation, the candidate sampler is operated in test environment equivalent to sampling 150 μg/m^3 coarse mode aerosol over a 24-hour time period. The candidate's performance must then be evaluated by § 53.62 (full wind tunnel evaluation) with the exception being a modification to the fractionator alone, in which case the performance may be optionally evaluated by § 53.64 (static fractionator test). If the results of the appropriate test meet the criteria presented in Table F1 of this subpart, then the candidate sampler passes the loading test under the condition that it be cleaned after each 24-hour use.

(iii) An extended loading test may be performed to gain approval of a longer time period between periodic cleaning of the fractionator. In this extended loading test, the candidate sampler is loaded with a mass equivalent to operating the unit in an environment of 150 μg/m^3 coarse mode aerosol over the time period proposed by the manufacturer between cleaning. Reevaluation of the expected mass collected is performed via the wind tunnel test or the static 2.5-micron fractionator test, depending upon which test was used for the initial evaluation. If the results meet the criteria presented in Table F–1 of this subpart, then the candidate sampler passes the loading test under the condition that it be cleaned at least as often as the proposed cleaning frequency.

(5) *Volatility test.* The volatility test challenges the candidate sampler with a polydisperse, semi-volatile liquid aerosol. This aerosol is simultaneously sampled by the candidate method sampler and a reference method sampler for a specified time period. Clean air is then passed through the samplers for an additional time period. The filters are then reweighed to determine residual mass of the collected aerosol. The candidate sampler passes the volatility test if the candidate method meets the specifications presented in Table F–1 of this subpart.

(g) *Test data.* All test data and other documentation obtained from or pertinent to these tests shall be identified, dated, signed by the analyst performing the test, and submitted to EPA as part of the equivalent method application. Schematic drawings of each particle delivery system and other information showing complete procedural details of the test atmosphere generation, verification, and delivery techniques for each test performed shall be submitted to EPA. All pertinent calculations shall be clearly presented. In addition, manufacturers are required to complete and submit the designation testing checklist presented in Figure 2 of this subpart as part of the application.

§ 53.61 Test conditions.

(a) *Sampler surface preparation.* Internal surfaces of the candidate sampler shall be cleaned and dried prior to performing any Class II sampler test in this Subpart. The internal collection surfaces of the sampler shall then be prepared in strict accordance with the operating instructions specified in the sampler's operating manual referred to in § 53.4(b)(3).

(b) *Sampler setup.* Set up and start up of all test samplers shall be in strict accordance with the operating instructions specified in the manual referred to in § 53.4(b)(3), unless otherwise specified within this subpart.

(c) *Sampler adjustments.* Once the test sampler or samplers have been set up and the performance tests started, manual adjustment shall be permitted only between test points for all applicable tests. Manual adjustments and any periodic maintenance shall be limited to only those procedures prescribed in the manual referred to in § 53.4(b)(3). The submitted records shall clearly indicate when any manual adjustment or periodic maintenance was made and shall describe the operations performed.

(d) *Sampler malfunctions.* If a test sampler malfunctions during any of the applicable tests that test run shall be repeated. A detailed explanation of all malfunctions and the remedial actions taken shall be submitted as part of the equivalent method application.

(e) *Particle concentration measurements.* All measurements of particle concentration must be made such that the relative error in measurement is less than 5.0 percent. Relative error is defined as (s x 100 percent)/(X), where s is the sample standard deviation of the particle concentration detector, X is the measured concentration, and the units of s and X are identical.

(f) *Operation of test measurement equipment.* All test measurement equipment shall be setup, calibrated, and maintained according to the manufacturer's instructions by qualified personnel only. All appropriate calibration information and manuals for this equipment shall be kept on file.

(g) *Aerosol generation parameters.* This section prescribes conventions regarding aerosol generation techniques. Size-selective performance tests outlined in §§ 53.62, 53.63, 53.64, and 53.65 specify the use of the vibrating orifice aerosol generator (VOAG) for the production of test aerosols. The volatility test in § 53.66 specifies the use of a nebulized polydisperse aerosol.

(1) *Particle aerodynamic diameter.* The VOAG produces near-monodisperse droplets through the controlled breakup of a liquid jet. When the liquid solution consists of a non-volatile solute dissolved in a volatile solvent, the droplets dry to form particles of near-monodisperse size.

(i) The physical diameter of a generated spherical particle can be calculated from the operating parameters of the VOAG as:

$$D_p = \left(\frac{6\ Q\ C_{vol}}{\Pi\ f} \right)^{1/3} \quad (1)$$

where:

D_p=particle physical diameter, μm

Q=liquid volumetric flow rate, μm^3/sec

C_{vol}=volume concentration (particle volume produced per drop volume), dimensionless

f=frequency of applied vibrational signal, sec^{-1}.

(ii) A given particle's aerodynamic behavior is a function of its physical particle size, particle shape, and density. Aerodynamic diameter is defined as the diameter of a unit density (ρ_o=1 g/m^3) sphere having the same settling velocity as the particle under consideration. For converting a spherical particle of known density to aerodynamic diameter, the governing relationship is:

$$D_{ae} = \frac{\sqrt{\rho_p}\,\sqrt{C_{D_p}}\,D_p}{\sqrt{\rho_o}\,\sqrt{C_{D_{ae}}}} \quad (2)$$

where

D_{ae}=particle aerodynamic diameter, µm

ρ_p=particle density, g/cm^3

ρ_o=aerodynamic particle density=1 g/m^3

C_{Dp}=Cunningham's slip correction factor for physical particle diameter, dimensionless

C_{Dae}=Cunningham's slip correction factor for aerodynamic particle diameter, dimensionless.

(iii) At room temperature and standard pressure, the Cunningham's slip correction factor is solely a function of particle diameter:

$$C_{Dae} = 1 + \frac{0.1659}{D_{ae}} + \frac{0.053}{D_{ae}} \exp\left(-8.33\, D_{ae}\right) \quad (3)$$

or

$$C_{D_p} = 1 + \frac{0.1659}{D_p} + \frac{0.053}{D_p} \exp\left(-8.33\, D_p\right) \quad (4)$$

(iv) Since the slip correction factor is itself a function of particle diameter, the aerodynamic diameter cannot be solved directly but can be determined by iteration.

(2) *Solid particle generation.* As specified in Table F–2 of this subpart, all solid particle tests in this subpart shall be conducted using particles composed of ammonium fluorescein. For use in the VOAG, liquid solutions of known volumetric concentration can be prepared by diluting fluorescein powder ($C_{20}H_{12}O_5$, FW=332.31, CAS 2321–07–5) with aqueous ammonia. Guidelines for preparation of fluorescein solutions of the desired volume concentration (C_{vol}) are presented by Vanderpool and Rubow (1988) (Reference 2 in Appendix A of this subpart). For purposes of converting particle physical diameter to aerodynamic diameter, an ammonium fluorescein density of 1.35 g/cm^3 shall be used. Mass deposits of ammonium fluorescein shall be extracted and analyzed using solutions of 0.01 N ammonium hydroxide.

(3) *Liquid particle generation.* (i) *Oleic acid particles.* (A) Tests prescribed in § 53.63 for inlet aspiration require the use of liquid particle tests composed of oleic acid tagged with uranine to enable subsequent fluorometric quantitation of collected aerosol mass deposits. Oleic acid ($C_{18}H_{34}O_2$, FW=282.47, CAS 112–80–1) has a density of 0.8935 g/cm^3. Because the viscosity of oleic acid is relatively high, significant errors can occur when dispensing oleic acid using volumetric pipettes. For this reason, it is recommended that oleic acid solutions be prepared by quantifying dispensed oleic acid gravimetrically. The volume of oleic acid dispensed can then be calculated simply by dividing the dispensed mass by the oleic acid density.

(B) Oleic acid solutions tagged with uranine shall be prepared as follows. A known mass of oleic acid shall first be diluted using absolute ethanol. The desired mass of the uranine tag should then be diluted in a separate container using absolute ethanol. Uranine ($C_{20}H_{10}O_5Na_2$, FW=376.3, CAS 518–47–8) is the disodium salt of fluorescein and has a density of 1.53 g/cm^3. In preparing uranine tagged oleic acid particles, the uranine content shall not exceed 20 percent on a mass basis. Once both oleic acid and uranine solutions are properly prepared, they can then be combined and diluted to final volume using absolute ethanol.

(C) Calculation of the physical diameter of the particles produced by the VOAG requires knowledge of the liquid solution's volume concentration (C_{vol}). Because uranine is essentially insoluble in oleic acid, the total particle volume is the sum of the oleic acid volume and the uranine volume. The volume concentration of the liquid solution shall be calculated as:

$$C_{vol} = \frac{V_u + V_{oleic}}{V_{sol}} = \frac{(M_u/\rho_u) + (M_{oleic}/\rho_{oleic})}{V_{sol}} \quad (5)$$

where:

V_u=uranine volume, ml

V_{oleic}=oleic acid volume, ml

V_{sol}=total solution volume, ml

M_u=uranine mass, g

ρ_u=uranine density, g/cm^3

M_{oleic}=oleic acid mass, g

ρ_{oleic}=oleic acid density, g/cm^3

(D) For purposes of converting the particles' physical diameter to aerodynamic diameter, the density of the generated particles shall be calculated as:

$$\rho_p = \frac{M_u + M_{oleic}}{(M_u/\rho_u) + (M_{oleic}/\rho_{oleic})} \quad (6)$$

(E) Mass deposits of oleic acid shall be extracted and analyzed using solutions of 0.01 N sodium hydroxide.

(ii) *Glycerol.* Tests prescribed in § 53.66 for conducting volatility tests shall be conducted using ACS reagent grade glycerol ($C_3H_8O_3$, FW=92.09, CAS 56–81–5) with a minimum purity of 99.5 percent.

§ 53.62 Test Procedure: Full wind tunnel test.

(a) *Overview.* The full wind tunnel test evaluates the effectiveness of the candidate sampler at 2 km/hr and 24 km/hr for aerosols of the size and type specified in Table F–2 of this subpart (under the heading, ''Full Wind Tunnel Test''). For each wind speed, a smooth curve is fit to the effectiveness data and corrected for the presence of multiplets in the wind tunnel calibration aerosol. The cutpoint diameter (Dp_{50}) at each wind speed is then be determined from the corrected effectiveness curves. The two resultant penetration curves are then numerically integrated with three idealized ambient particle size distributions to provide an estimate of measured mass concentration. Critical parameters for these idealized distributions are presented in Table F–3 of this subpart.

(b) *Technical definitions.* Effectiveness is the ratio (expressed as a percentage) of the mass concentration of particles of a specific size reaching the sampler filter or filters to the mass concentration of particles of the same size approaching the sampler.

(c) *Facilities and equipment required.* (1) *Wind tunnel.* The particle delivery system shall consist of a blower system and a wind tunnel having a test section of sufficiently large cross-sectional area such that the test sampler, or portion thereof, as installed in the test section for testing, blocks no more than 15 percent of the test section area. The wind tunnel blower system must be capable of maintaining uniform wind speeds at the 2 km/hr and 24 km/hr.

(2) *Aerosol generation system.* A vibrating orifice aerosol generator shall be used to produce monodisperse solid particles of ammonium fluorescein with equivalent aerodynamic diameters as specified in Table F–2 of this subpart. The geometric standard deviation for each particle size and type generated shall not exceed 1.1 (for primary particles) and the proportion of multiplets (doublets and triplets) in all test particle atmosphere shall not exceed 10 percent. The aerodynamic particle diameter, as established by the operating parameters of the vibrating orifice aerosol generator, shall be within the tolerance specified in Table F–2 of this subpart.

(3) *Particle size verification equipment.* The size of the test particles shall be verified during this test by use of a suitable instrument (e.g., scanning electron microscope, optical particle counter, time-of-flight apparatus). The instrument must be capable of measuring solid and liquid test particles with a size resolution of 0.1 μm or less. The accuracy of the particle size verification technique shall be 0.15 μm or better.

(4) *Wind speed measurement.* The wind speed in the wind tunnel shall be determined during the tests using an appropriate technique capable of a precision of 5 percent or better (e.g., hot-wire anemometry). For the wind speeds specified in Table F–2 of this subpart, the wind speed and turbulence intensity (longitudinal component and macro scale) shall be measured at a minimum of 12 test points in a cross-sectional area of the test section of the wind tunnel. The mean wind speed in the test section must be within ±10 percent of the value specified in Table F–2 of this subpart, and the variation at any test point in the test section may not exceed 10 percent of the measured mean.

(5) *Aerosol rake.* The cross-sectional uniformity of the particle concentration in the sampling zone of the test section shall be established during the tests using an array of isokinetic samplers, referred to as a rake. Not less than five evenly spaced isokinetic samplers shall be used to determine the particle concentration spatial uniformity in the sampling zone. The sampling zone shall be a rectangular area having a horizontal dimension not less than 1.2 times the width of the test sampler at its inlet opening and a vertical dimension not less than 25 centimeters.

(6) *Total aerosol isokinetic sampler.* A single isokinetic sampler may be used in place of the array of isokinetic samplers for the determination of particle mass concentration used in the calculation of sampling effectiveness of the test sampler in § 53.62(e)(5). In this case, the array of isokinetic samplers must be used to demonstrate particle concentration uniformity prior to the replicate measurements of sampling effectiveness.

(7) *Fluorometer.* A series of calibration standards shall be prepared to encompass the minimum and maximum concentrations measured during size-selective tests. Prior to each calibration and measurement, the fluorometer shall be zeroed using an aliquot of the same solvent used for extracting aerosol mass deposits.

(8) *Sampler flow rate measurements.* All flow rate measurements used to calculate the test atmosphere concentrations and the test results must be accurate to within ±2 percent, referenced to a NIST-traceable primary standard. Any necessary flow rate measurement corrections shall be clearly documented. All flow rate measurements shall be performed and reported in actual volumetric units.

(d) *Test procedures.* (1) Establish and verify wind speed.

(i) Establish a wind speed specified in Table F–2 of this subpart.

(ii) Measure the wind speed and turbulence intensity (longitudinal component and macro scale) at a minimum of 12 test points in a cross-sectional area of the test section of the wind tunnel using a device as described in § 53.62(c)(4).

(iii) Verify that the mean wind speed in the test section of the wind tunnel during the tests is within 10 percent of the value specified in Table F–2 of this subpart. The wind speed measured at any test point in the test section shall not differ by more than 10 percent from the mean wind speed in the test section.

(2) *Generate aerosol.* Generate particles of a size and type specified in Table F–2 of this subpart using a vibrating orifice aerosol generator. Check for the presence of satellites and adjust the generator as necessary. Calculate the physical particle size using the operating parameters of the vibrating orifice aerosol generator and record. Determine the particle's aerodynamic diameter from the calculated physical diameter and the known density of the generated particle. The calculated aerodynamic diameter must be within the tolerance specified in Table F–2 of this subpart.

(3) *Introduce particles into the wind tunnel.* Introduce the generated particles into the wind tunnel and allow the particle concentration to stabilize.

(4) *Verify the quality of the test aerosol.* (i) Extract a representative sample of the aerosol from the sampling test zone and measure the size distribution of the collected particles using an appropriate sizing technique. If the measurement instrumentation does not provide a direct measure of aerodynamic diameter, calculate the geometric mean aerodynamic diameter using the known density of the particle type in conjunction with the measured mean physical diameter. The determined mean aerodynamic diameter of the test aerosol must be within 0.15 μm of the aerodynamic diameter calculated from the operating parameters of the vibrating orifice aerosol generator. The geometric

standard deviation of the primary particles must not exceed 1.1.

(ii) Determine the population of multiplets in the collected sample. The multiplet population of the particle test atmosphere must not exceed 10 percent of the total particle population.

(5) *Aerosol uniformity and concentration measurement.* (i) Install an array of five or more evenly spaced isokinetic samplers in the sampling zone [§ 53.62(c)(5)]. Collect particles on appropriate filters over a time period such that the relative error of the measured particle concentration is less than 5.0 percent.

(ii) Determine the quantity of material collected with each isokinetic sampler in the array using a calibrated fluorometer. Calculate and record the mass concentration for each isokinetic sampler as:

$$C_{iso(ij)} = \frac{M_{iso(ij)}}{Q_{(ij)} \times t_{(ij)}} \quad (7)$$

Where

i=replicate number

j=isokinetic sampler number

M_{iso}=mass of material collected with the isokinetic sampler

Q=isokinetic sampler volumetric flow rate

t=sampling time.

(iii) Calculate and record the mean mass concentration as:

$$\overline{C}_{iso(i)} = \frac{\sum_{j=1}^{n} C_{iso(ij)}}{n} \quad (8)$$

Where

I=replicate number

j=isokinetic sampler number

n=total number of isokinetic samplers.

(iv) Precision calculation. (A) Calculate the coefficient of variation of the mass concentration measurements as:

$$CV_{iso(i)} = \sqrt{\frac{\sum_{j=1}^{n} C^2_{iso(ij)} - \frac{1}{n}\left(\sum_{j=1}^{n} C_{iso(ij)}\right)^2}{n-1}} \Big/ \overline{C}_{iso(i)} \times 100\% \quad (9)$$

Where

i=replicate number

j=isokinetic sampler number

n=total number of isokinetic samplers.

(B) If the value of CViso(I) for any replicate exceeds 10 percent, the particle concentration uniformity is unacceptable and step 5 must be repeated. If adjustment of the vibrating orifice aerosol generator or changes in the particle delivery system are necessary to achieve uniformity, steps 2 through 5 must be repeated. When an acceptable aerosol spatial uniformity is achieved, remove the array of isokinetic samplers from the wind tunnel.

(6) *Alternative measure of wind tunnel total concentration.* If a single isokinetic sampler is used to determine the mean aerosol concentration in the wind tunnel, install the sampler in the wind tunnel with the sampler nozzle centered in the sampling zone [§ 53.62(c)(6)].

(i) Collect particles on an appropriate filter over a time period such that the relative error of the measured concentration is less than 5.0 percent.

(ii) Determine the quantity of material collected with the isokinetic sampler using a calibrated fluorometer.

(iii) Calculate and record the mass concentration as $C_{iso(I)}$ as in § 53.62(e)(4)(ii).

(iv) Remove the isokinetic sampler from the wind tunnel.

(7) *Measure the aerosol with the candidate sampler.* (i) Install the test sampler (or portion thereof) in the wind tunnel with the sampler inlet opening centered in the sampling zone. To meet the maximum blockage limit of § 53.62(c)(1) or for convenience, part of the test sampler may be positioned external to the wind tunnel provided that neither the geometry of the sampler nor the length of any connecting tube or pipe is altered. Collect particles for a time period such that the relative error of the measured concentration is less than 5.0 percent.

(ii) Remove the test sampler from the wind tunnel.

(iii) Determine the quantity of material collected with the test sampler using a calibrated fluorometer. Calculate and record the mass concentration for each replicate as:

$$C_{cand(i)} = \frac{M_{cand(i)}}{Q_{(i)} \times t_{(i)}} \quad (10)$$

Where

i=replicate number

M_{cand}=mass of material collected with the candidate sampler

Q=candidate sampler volumetric flow rate

t=sampling time.

(iv) (A) Calculate and record the sampling effectiveness of the candidate sampler as:

$$E_{(i)} = \frac{C_{cand(i)}}{\overline{C}_{iso(i)}} \times 100\% \quad (11)$$

Where:

i = replicate number.

(B) If a single isokinetic sampler is used for the determination of particle mass concentration, replace $C_{iso(I)}$ with C_{iso}.

(8) *Obtain a minimum of three replicate measures of sampling effectiveness and calculate the mean sampling effectiveness.* (i) Repeat steps in paragraphs (d) (5) through (7) of this section, as appropriate, to obtain a

minimum of three valid replicate measurements of sampling effectiveness.

(ii) Calculate and record the average sampling effectiveness of the test sampler for the particle size and type as:

$$\bar{E} = \frac{\sum_{i=1}^{n} E_{(i)}}{n} \quad (12)$$

Where:
i = replicate number
n = number of replicates.

(iii) *Sampling effectiveness precision.* (A) Calculate and record the coefficient of variation for the replicate sampling effectiveness measurements of the test sampler as:

$$CV_E = \sqrt{\frac{\sum_{i=1}^{n} E_{(i)}^2 - \frac{1}{n}\left(\sum_{i=1}^{n} E_{(i)}\right)^2}{n-1}} \; \frac{1}{\bar{E}} \times 100\% \quad (13)$$

Where:
i = replicate number
n = number of replicates.

(B) If the value of CV_E exceeds 10 percent, the test run (steps in paragraphs (d)(2) through (8) of this section) must be repeated until an acceptable value is obtained.

(9) *Repeat for each particle size and type for the selected wind speed.* Repeat steps in paragraphs (d)(2) through (8) of this section until the sampling effectiveness has been measured for all particle sizes and types specified in Table F–2 of this subpart.

(10) *Repeat for each wind speed.* Repeat steps in paragraphs (d)(1) through 9 of this section until tests have been successfully conducted for both wind speeds of 2 km/hr and 24 km/hr.

(e) *Calculations.* (1) Graphical treatment of effectiveness data. For each wind speed given in Table F–2 of this subpart, plot the particle sampling effectiveness of the test sampler as a function of aerodynamic particle diameter (D_{ae}) on semi-logarithmic graph paper where the aerodynamic particle diameter is the particle size established by the parameters of the VOAG in conjunction with the known particle density. Construct a best-fit, smooth curve through the data by extrapolating the sampling effectiveness curve through 100 percent at an aerodynamic particle size of 0.5 µm and 0 percent at an aerodynamic particle size of 10 µm. Correction for the presence of multiplets shall be performed using the techniques presented by Marple, et al (1987).

(2) *Cutpoint determination.* For each wind speed determine the sampler Dp50 cutpoint defined as the aerodynamic particle size corresponding to 50 percent effectiveness from the multiplet corrected smooth curve.

(3) *Expected mass concentration calculation.* For each wind speed, calculate the estimated mass concentration measurement for the test sampler under each particle size distribution (Tables F–4, F–5, and F–6 of this subpart) and compare it to the mass concentration predicted for the reference sampler, as follows:

(i) Determine the value of corrected effectiveness using the best-fit curve at each of the particle sizes specified in the first column of Table F–4 of this subpart. Record each corrected effectiveness value as a decimal between 0 and 1 in column 2 of Table F–4 of this subpart.

(ii) Calculate the interval estimated mass concentration measurement by multiplying the values of corrected effectiveness in column 2 by the interval mass concentration values in column 3 and enter the products in column 4 of Table F–4 of this subpart.

(iii) Calculate the estimated mass concentration measurement by summing the values in column 4 and entering the total as the estimated mass concentration measurement for the test sampler at the bottom of column 4 of Table F–4 of this subpart.

(iv) Calculate the estimated mass concentration ratio between the candidate method and the reference method as:

$$R_c = \frac{C_{cand(est)}}{C_{ref(est)}} \times 100\% \quad (14)$$

Where:

$C_{cand(est)}$=estimated mass concentration measurement for the test sampler, µg/m³; and

$C_{ref(est)}$=estimated mass concentration measurement for the reference sampler, µg/m³ (calculated for the reference sampler and specified at the bottom of column 7 of Table F–4 of this subpart).

(v) Repeat steps in paragraphs (e) (1) through (3) of this section for Tables F–5 and F–6 of this subpart.

(f) *Evaluation of test results.* The candidate method passes the wind tunnel effectiveness test if the Rc value for each wind speed meets the specification in Table F–1 of this subpart for each of the three particle size distributions.

§ 53.63 Test Procedure: Wind tunnel inlet aspiration test.

(a) *Overview.* This test applies to a candidate sampler which differs from the reference method sampler only with respect to the design of the inlet. The purpose of this test is to compare the aspiration of a Class II candidate sampler to that of the reference method sampler's inlet. This wind tunnel test uses a 3.5-micron liquid aerosol in conjunction with wind speeds of 2 km/hr and 24 km/hr. The test atmosphere concentration is alternately measured with the candidate sampler and a reference method device, both of which are operated without the 2.5-micron fractionation device installed. The test conditions are summarized in Table F–2 of this subpart (under the heading of wind tunnel inlet aspiration test). The candidate sampler must meet or exceed the acceptance criteria given in Table F–1 of this subpart.

(b) *Technical definition.* Relative aspiration is the ratio (expressed as a percentage) of the aerosol mass concentration measured by the candidate sampler to that measured by a reference method sampler.

(c) *Facilities and equipment required.* The facilities and equipment are identical to those required for the full wind tunnel test [§ 53.62(c)].

(d) *Test procedure.* (1) Establish the wind tunnel test atmosphere. Follow the procedures in § 53.62(e)(1) through § 53.62(e)(4) to establish a test atmosphere for one of the two wind speeds specified in Table F–2 of this subpart.

(2) *Measure the aerosol concentration with the reference sampler.* (i) Install the reference sampler (or portion thereof) in the wind tunnel with the sampler inlet opening centered in the sampling zone. To meet the maximum blockage limit of § 53.62(c)(1) or for convenience, part of the test sampler may be positioned external to the wind tunnel provided

that neither the geometry of the sampler nor the length of any connecting tube or pipe is altered. Collect particles for a time period such that the relative error of the measured concentration [as defined in § 53.61(5)] is less than 5.0 percent.

(ii) Determine the quantity of material collected with the reference method sampler using a calibrated fluorometer. Calculate and record the mass concentration as:

$$C_{ref(i)} = \frac{M_{ref(i)}}{Q_{(i)} \times t_{(i)}} \quad (15)$$

Where:

i=replicate number

M_{ref}=mass of material collected with the reference method sampler

Q=reference method sampler volumetric flowrate

t=sampling time.

(iii) Remove the reference method sampler from the tunnel.

(3) *Measure the aerosol concentration with the candidate sampler.* (i) Install the candidate sampler (or portion thereof) in the wind tunnel with the sampler inlet centered in the sampling zone. To meet the maximum blockage limit of § 53.62(c)(1) or for convenience, part of the test sampler may be positioned external to the wind tunnel provided that neither the geometry of the sampler nor the length of any connecting tube or pipe is altered. Collect particles for a time period such that the relative error of the measured concentration is less than 5.0 percent.

(ii) Determine the quantity of material collected with the candidate sampler using a calibrated fluorometer. Calculate and record the mass concentration as:

$$C_{cand(i)} = \frac{M_{cand(i)}}{Q_{(i)} \times t_{(i)}} \quad (16)$$

Where:

i=replicate number

M_{cand}=mass of material collected with the candidate sampler

Q=candidate sampler volumetric flow rate

t=sampling time.

(iii) Remove the candidate sampler from the wind tunnel.

(4) Repeat steps in paragraphs (d) (2) and (3) of this section. Alternately measure the tunnel concentration with the reference sampler and the candidate sampler until four reference sampler and five candidate sampler measurements of the wind tunnel concentration are obtained.

(e) *Calculations.* (1) *Aspiration ratio.* Calculate aspiration ratio for each candidate sampler run as:

$$A_{(i)} = \frac{C_{cand(i)}}{(C_{ref(i)} + C_{ref(i+1)}) \times \frac{1}{2}} \quad (17)$$

where

i=replicate number.

(2) *Precision of aspiration ratio.* Calculate the precision of aspiration ratio measurements as the coefficient of variation for each aspiration ratio:

$$CV_A = \sqrt{\frac{\sum_{i=1}^{n} A_{(i)}^2 - \frac{1}{n}\left(\sum_{i=1}^{n} A_{(i)}\right)^2}{n-1}} \Big/ \bar{A}_{(i)} \times 100\% \quad (18)$$

where:

i=replicate number

n=total number of measurements of aspiration ratio.

(f) *Evaluation of test results.* The candidate method passes the inlet aspiration test if all values of A and CV_A meet the acceptance criteria specified in Table F–1 of this subpart.

§ 53.64 Test Procedure: Static fractionator test.

(a) *Overview.* This test applies only to those candidate methods in which the sole deviation from the reference method is in the design of the 2.5-micron fractionation device. The purpose of this test is to ensure that the fractionation characteristics of the candidate fractionator are acceptably similar to that of the reference method sampler. It is recognized that various methodologies exist for quantifying fractionator effectiveness. The following commonly-employed techniques are provided for purposes of guidance. Other methodologies for determining sampler effectiveness may be used contingent upon prior approval by the Agency.

(1) *Wash-off method.* Effectiveness is determined by measuring the aerosol mass deposited in the candidate sampler's afterfilter versus the aerosol mass deposited in the fractionator. The material deposited in the fractionator is recovered by washing its internal surfaces. For these wash-off tests, a fluorometer must be used to quantitate the aerosol concentration. Note that if this technique is chosen, the candidate must be reloaded with coarse aerosol prior to each test point when reevaluating the curve as specified in the loading test.

(2) *Static chamber method.* Effectiveness is determined by measuring the aerosol mass concentration sampled by the candidate's sampler's afterfilter versus that which exists in a static chamber. A calibrated fluorometer must be used to quantify the collected aerosol deposits. The aerosol concentration is calculated as the measured aerosol mass divided by the sampled air volume.

(3) *Divided flow method.* Effectiveness is determined by comparing the aerosol concentration upstream of the candidate sampler's fractionator versus that concentration which exists downstream of the candidate fractionator. These tests may utilize either fluorometry or a real-time aerosol measuring device to determine the aerosol concentration.

(b) *Technical definition.* Effectiveness under static conditions is the ratio (expressed as a percentage) of the mass concentration of particles of a given size reaching the sampler filter to the mass concentration of particles of the same size approaching the sampler.

(c) *Facilities and equipment required.*

(1) *Aerosol generation.* Methods for generating aerosols shall be identical to those prescribed in § 53.62(c)(2).

(2) *Particle delivery system.* Acceptable apparatus for delivering the generated aerosols to the candidate fractionator is dependent on the effectiveness measurement methodology and are defined as follows:

(i) *Wash-off test apparatus.* The aerosol may be delivered to the candidate fractionator through direct piping (with or without an in-line mixing chamber). Particle size and quality validation shall be conducted at the point where the fractionator attaches.

(ii) *Static chamber test apparatus.* The aerosol shall be introduced into a chamber and sufficiently mixed such that the aerosol concentration within the chamber is spatially uniform. The chamber must be of sufficient size to house at least four total filter samplers, as well as the inlet of the candidate size discriminator. Particle size validation and quality validation shall be conducted on representative aerosol samples extracted from the chamber.

(iii) *Divided flow test apparatus.* The apparatus shall allow the aerosol concentration to be measured upstream and downstream of the fractionator. The particles shall be delivered to the divided flow apparatus via a symmetrical flow path.

(3) *Particle concentration measurement.*

(i) *Fluorometry.* Fluorometers used for quantifying extracted aerosol mass deposits shall be set up, maintained, and calibrated according to the manufacturer's instructions. A series of calibration standards shall be prepared to encompass the minimum and maximum concentrations measured during size-selective tests. Prior to each calibration and measurement, the fluorometer shall be zeroed using an aliquot of the same solvent used for extracting aerosol mass deposits.

(ii) *Number concentration measurement.* A number counting device may be used in conjunction with the divided flow test apparatus as described above. This device must have a resolution and accuracy such that primary particles may be distinguished from multiplets for all test aerosols. The measurement of number concentration shall be accomplished by integrating the primary particle peak.

(d) *Setup.* (1) *Remove the inlet from the candidate fractionator.* All tests procedures shall be conducted with the inlet removed from the candidate sampler.

(2) *Surface treatment of the fractionator.* Rinsing aluminum surfaces with alkaline solutions has been found to adversely affect subsequent fluorometric quantitation of aerosol mass deposits. If wash-off tests are to be used for quantifying aerosol penetration, internal surfaces of the fractionator must first be plated with electroless nickel. Specifications for this plating are specified in MIL.C–26074 Grade B, Class 4 (Reference 4 in appendix A of Subpart E).

(e) *Test Procedure: Wash off method.* (1) *Clean and dry internal surfaces.* Thoroughly clean and dry all internal surfaces of the candidate particle size fractionator. The internal surfaces of the fractionator shall then be prepared in strict accordance with the operating instructions specified in the samplers operating manual. Note: The procedures in this paragraph must be omitted if this test is being used to evaluate the fractionator after being loaded as specified in § 53.65.

(2) *Generate aerosol.* Follow the procedures for aerosol generation prescribed in § 53.62(e)(2).

(3) *Verify the quality of the test aerosol.* Follow the procedures for verification of test aerosol size and quality prescribed in § 53.62(e)(4).

(4) *Determine effectiveness for the particle size and type being produced.* (i) Collect particles downstream of the fractionator on an appropriate filter over a time period such that the relative error of the measurement is less than 5.0 percent.

(ii) Determine the quantity of material collected on the afterfilter of the candidate method using a calibrated fluorometer. Calculate and record the aerosol mass concentration for the sampler filter as:

$$C_{cand(i)} = \frac{M_{cand(i)}}{Q_{(i)} \times t_{(i)}} \quad (19)$$

where:

i=replicate number

M_{cand}=mass of material collected with the candidate sampler

Q=candidate sampler volumetric flowrate

t=sampling time.

(iii) Wash all interior surfaces upstream of the filter and determine the quantity of material collected using a calibrated fluorometer. Calculate and record the fluorometric mass concentration of the sampler wash as:

$$C_{wash(i)} = \frac{M_{wash(i)}}{Q_{(i)} \times t_{(i)}} \quad (20)$$

where:

i=replicate number

M_{wash}=mass of material washed from the interior surfaces of the fractionator

Q=candidate sampler volumetric flowrate

t=sampling time.

(iv) Calculate and record the sampling effectiveness of the test sampler for this particle size as:

$$E_{(i)} = \frac{C_{wash(i)}}{C_{cand(i)} + C_{wash(i)}} \times 100\% \quad (21)$$

where i=replicate number.

(v) Repeat steps in paragraphs (e)(4)(9) through (iv) of this section, as appropriate, to obtain a minimum of three replicate measurements of sampling effectiveness.

(vi) Calculate and record the average sampling effectiveness of the test sampler as:

$$\overline{E} = \frac{\sum_{i=1}^{n} E_{(i)}}{n} \quad (22)$$

where:

i=replicate number

n=number of replicates.

(vii) (A) Calculate and record the coefficient of variation for the replicate sampling effectiveness measurements of the test sampler as:

$$CV_E = \sqrt{\frac{\sum_{i=1}^{n} E_{(i)}^2 - \frac{1}{n}\left(\sum_{i=1}^{n} E_{(i)}\right)^2}{n-1}} \times \frac{1}{\overline{E}} \times 100\% \quad (23)$$

where:

i=replicate number

n=total number of measurements.

(B) If the value of CV_E exceeds 10 percent, then steps in paragraphs (e) (2) through (4) of this section must be repeated. Note that the sampler must be loaded according to the test procedures in § 53.65 prior to retesting each point if this test is being used as a post-evaluation to satisfy the requirements of § 53.65.

(5) Repeat steps in paragraphs (e) (1) through (4) of this section for each particle size and type specified in Table F–2 of this subpart.

(f) *Test procedure: Static chamber method.*

(1) *Generate aerosol.* Follow the procedures for aerosol generation prescribed in § 53.62(e)(2).

(2) *Verify the quality of the test aerosol.* Follow the procedures for verification of test aerosol size and quality prescribed in § 53.62(e)(4).

(3) *Introduction of particles into chamber.* Introduce the particles into the static chamber and allow the particle concentration to stabilize.

(4) *Install and operate the candidate sampler and at least four total filters.* (i) Install the fractionator and an array of four or more equally spaced filter samplers such that the filters surround and are in the same plane as the inlet of the fractionator.

(ii) Collect particles on an appropriate filter for a time period such that the relative error of the measured concentration is less than 5.0 percent.

(5) *Calculate the aerosol spatial uniformity in the chamber.* (i) Determine the quantity of material collected with each total filter sampler in the array using a calibrated fluorometer. Calculate and record the mass concentration for each total filter sampler as:

$$C_{total(ij)} = \frac{M_{total(ij)}}{Q_{(ij)} \times t_{(ij)}} \quad (24)$$

where:

i=replicate number

j=total filter sampler number

M_{total}=mass of material collected with the total filter sampler

Q=total filter sampler volumetric flowrate

t=sample time.

(ii) Calculate and record the mean mass concentration as:

$$\overline{C}_{total(i)} = \frac{\sum_{j=1}^{n} C_{total(ij)}}{n} \quad (25)$$

where:

n=total number of samplers

i=replicate number

j=filter sampler number.

(iii) (A) Calculate and record the coefficient of variation of the total mass concentration as:

$$CV_{total} = \sqrt{\frac{\sum_{j=1}^{n} C_{total(ij)}^2 - \frac{1}{n}\left(\sum_{j=1}^{n} C_{total(ij)}\right)^2}{n-1}} \times \frac{1}{\overline{C}_{total(i)}} \times 100\% \quad (26)$$

where:

i=replicate number

j=total filter sampler number

n=number of total filter samplers.

(B) If the value of CV_{total} exceeds 10 percent, then the particle concentration uniformity is unacceptable, alterations to the static chamber test apparatus must be made, and steps in paragraphs (f) (1) through (5) of this section must be repeated.

(6) *Calculate the effectiveness of the candidate sampler.* (i) Determine the quantity of material collected on the candidate sampler's afterfilter using a calibrated fluorometer. Calculate and record the mass concentration for the candidate sampler as:

$$C_{cand(i)} = \frac{M_{cand(i)}}{Q_{(i)} \times t_{(i)}} \quad (27)$$

where:

i=replicate number

M_{cand}=mass of material collected with the candidate sampler

Q=candidate sampler volumetric flowrate

t=sample time.

(ii) Calculate and record the sampling effectiveness of the candidate sampler as:

$$E_{(i)} = \frac{C_{cand(i)}}{\overline{C}_{total(i)}} \times 100\% \quad (28)$$

where i=replicate number.

(iii) Repeat step in paragraph (f)(4) through (6) of this section, as appropriate, to obtain a minimum of three replicate measurements of sampling effectiveness.

(iv) Calculate and record the average sampling effectiveness of the test sampler as:

$$\overline{E} = \frac{\sum_{i=1}^{n} E_{(i)}}{n} \quad (29)$$

where i=replicate number.

(v)(A) Calculate and record the coefficient of variation for the replicate sampling effectiveness measurements of the test sampler as:

$$CV_E = \sqrt{\frac{\sum_{i=1}^{n} E_{(i)}^2 - \frac{1}{n}\left(\sum_{i=1}^{n} E_{(i)}\right)^2}{n-1}} \times \frac{1}{\bar{E}} \times 100\% \quad (30)$$

where:
i = replicate number
n = number of measurements of effectiveness.

(B) If the value of CV_E exceeds 10 percent, then the test run (steps in paragraphs (f) (2) through (6) of this section).

(7) Repeat steps in paragraphs (f) (1) through (6) of this section for each particle size and type specified in Table F–2 of this subpart.

(g) *Test procedure: Divided flow method.*—(1) *Generate calibration aerosol.* Follow the procedures for aerosol generation prescribed in § 53.62(e)(2).

(2) *Verify the quality of the calibration aerosol.* Follow the procedures for verification of calibration aerosol size and quality prescribed in § 53.62(e)(4).

(3) *Introduce the calibration aerosol into the static chamber and allow the particle concentration to stabilize.*

(4) *Validate that transport is equal for the divided flow option.*

(i) With fluorometry (this applies only if fluorometry is used for detection of particles):

(A) Install a total filter on each leg of the divided flow apparatus.

(B) Collect particles simultaneously through both legs at 16.7 aLpm onto an appropriate filter for a time period such that the relative error of the measured concentration is less than 5.0 percent.

(C) Determine the quantity of material collected on each filter using a calibrated fluorometer. Calculate and record the mass concentration measured in each leg as:

$$C_i = \frac{M_i}{Q_i \times t_i} \quad (31)$$

where:
i = replicate number
M = mass of material collected with the total filter
Q = candidate sampler volumetric flowrate.

(D) Repeat steps in paragraphs (g)(4)(i) (A) through (C) of this section at until a minimum of three replicate measurements are performed.

(ii) With a number counting device such as an aerosol detector:

(A) Remove all flow obstructions from the flow paths of the two legs.

(B) Quantify the aerosol concentration of the primary particles in each leg of the apparatus.

(C) Repeat steps in paragraphs (g)(4)(i) (A) through (B) of this section at until a minimum of three replicate measurements are performed.

(iii) (A) Calculate the mean concentration and coefficient of variation as:

$$\bar{C} = \frac{\sum_{i=1}^{n} C_{(i)}}{n} \quad (32)$$

$$CV = \sqrt{\frac{\sum_{i=1}^{n} C_{(i)}^2 - \frac{1}{n}\left(\sum_{i=1}^{n} C_{(i)}\right)^2}{n-1}} \times \frac{1}{\bar{C}} \times 100\% \quad (33)$$

where:
i = replicate number
n = number of replicates.

(B) If the coefficient of variation is not less than 10 percent, then adjustments may be made in the setup, and this step must be repeated.

(5) *Determine the sampling effectiveness of the test sampler with the inlet removed by one of the following procedures.* (i) With fluorometry as a detector:

(A) Install the particle size fractionator. Install a filter downstream of one leg and a total filter on the bypass leg of the flow dividing apparatus.

(B) Collect particles simultaneously through both legs at 16.7 aLpm onto appropriate filters for a time period such that the relative error of the measured concentration is less than 5.0 percent.

(C) Determine the quantity of material collected on each filter using a calibrated fluorometer. Calculate and record the mass concentration measured by the total filter and that measured after penetrating through the candidate fractionator as follows:

$$C_{total(i)} = \frac{M_{total(i)}}{Q_{(i)} \times t_{(i)}} \quad (34)$$

$$C_{cand(i)} = \frac{M_{cand(i)}}{Q_{(i)} \times t_{(i)}} \quad (35)$$

where i= replicate number.

(ii) With a number counting device as a detector:

(A) Install the particle size fractionator into one of the legs of the divided flow apparatus.

(B) Quantify and record the aerosol number concentration of the primary particles passing through the fractionator as $C_{cand(I)}$.

(C) Divert the flow from the leg containing the candidate fractionator to the bypass leg. Allow sufficient time for the aerosol concentration to stabilize.

(D) Quantify and record the aerosol number concentration of the primary particles passing through the bypass leg as $C_{total(I)}$.

(iii) Calculate and record sampling effectiveness of the candidate sampler as:

$$E_{(i)} = \frac{C_{cand(i)}}{\bar{C}_{total(i)}} \times 100\% \quad (36)$$

where i = replicate number.

(6) Repeat step in paragraph (g)(5) of this section, as appropriate, to obtain a minimum of three replicate measurements of sampling effectiveness.

(7) Calculate the mean and CV for replicate measurements.

(i) Calculate and record the mean sampling effectiveness of the candidate sampler as:

$$\overline{E} = \frac{\sum_{i=1}^{n} E_{(i)}}{n} \quad (37)$$

Where i=replicate number.

(ii)(A) Calculate and record the coefficient of variation for the replicate sampling effectiveness measurements of the candidate sampler as:

$$CV_E = \sqrt{\frac{\sum_{i=1}^{n} E_{(i)}^2 - \frac{1}{n}\left(\sum_{i=1}^{n} E_{(i)}\right)^2}{n-1}} \times \frac{1}{\overline{E}} \times 100\% \quad (38)$$

Where:
i=replicate number
n=number of replicates.

(B) If the coefficient of variation is not less than 10 percent, then the test run must be repeated (steps in paragraphs (g) (1) through (7) of this section).

(8) Repeat steps in paragraphs (g) (1) through (7) of this section for each particle size and type specified in Table F–2 of this subpart.

(h) *Calculations.* (1) *Treatment of multiplets.* For all measurements made by fluorometric analysis, data shall be corrected for the presence of multiplets as described in § 53.62(f)(1). Data collected using a real-time device with sufficient resolution to discriminate primary particles from multiplets will not require multiplet correction.

(2) *Cutpoint determination.* For each wind speed determine the sampler Dp_{50} cutpoint defined as the aerodynamic particle size corresponding to 50 percent effectiveness from the multiplet corrected smooth curve.

(3) *Graphical analysis and numerical integration with ambient distributions.* Follow the steps outlined in § 53.62(f)(3) through § 53.62(f)(4) to calculate the estimated concentration measurement ratio between the candidate sampler and a reference method sampler.

(i) *Test evaluation.* The candidate method passes the static fractionator test if the values of R_c and Dp_{50} for each distribution meets the specifications in Table F–1 of this subpart.

§ 53.65 Test Procedure: Loading Test

(a) *Overview.* (1) The loading tests are designed to quantify any appreciable changes in a candidate method's performance as a function of coarse aerosol collection. This test is divided into two phases:

(i) A mandatory demonstration that the candidate method is capable of single-day sampling with periodic maintenance after each 24 hours of operation; and

(ii) An optional demonstration that the candidate is capable of multi-day sampling with the periodic maintenance schedule as defined by the manufacturer.

(2) In the first phase, the candidate sampler is first exposed to a laboratory-generated aerosol equivalent to sampling a nominal concentration of 150 μg/m^3 over a 24-hour time period. Following this initial loading, the candidate sampler's effectiveness as a function of particle aerodynamic diameter must then be evaluated using by performing the test in § 53.62 (full wind tunnel test). A sampler which fits the category of fractionator deviation in § 53.60(e)(2) may opt to perform the test in § 53.64 (static fractionator test) in lieu of the full wind tunnel test. The candidate sampler is approved for single day sampling with maintenance after each 24 hours of operation if the criteria in Table F–1 of this subpart are met for the 24-hour loading test.

(3) In the test for extended periodic maintenance, the candidate sampler is exposed to a mass of coarse aerosol equivalent to sampling a mass concentration of 150 μg/m^3 over the time period that the manufacturer has specified between periodic cleaning. The candidate sampler's effectiveness as a function of particle aerodynamic diameter must then be evaluated by performing the test in § 53.62 (full wind tunnel test). A sampler which fits the category of fractionator deviation in § 53.60(e)(2) may opt to perform the test in § 53.64 (static fractionator test) in lieu of the full wind tunnel test. If the criteria presented in Table F–1 of this subpart are met for this test, the candidate sampler is approved for multi-day sampling with the periodic maintenance schedule as specified by the manufacturer. For example, if the candidate sampler passes the reevaluation tests following loading with an aerosol mass equivalent to sampling a 150 μg/m^3 aerosol continuously for 7 days, then the sampler is approved for 7 day field operation before cleaning is required.

(b) *Technical Definitions.* (1) *Effectiveness after loading.* Effectiveness after loading is the ratio (expressed as a percentage) of the mass concentration of particles of a given size reaching the sampler filter to the mass concentration of particles of the same size approaching the sampler.

(2) *Effectiveness after extended loading.* Effectiveness after extended loading is the ratio (expressed as a percentage) of the mass concentration of particles of a given size reaching the sampler filter to the mass concentration of particles of the same size approaching the sampler.

(c) *Facilities and equipment required.* (1) *Particle delivery system.* The particle delivery system shall consist of a static chamber or a low velocity wind tunnel having a sufficiently large cross-sectional area such that the test sampler, or portion thereof, may be installed in the test section. At a minimum, the system must have a sufficiently large cross section to house the candidate sampler inlet as well as a collocated isokinetic nozzle for measuring total aerosol concentration. The mean velocity in the test section of the static chamber or wind tunnel shall not exceed 2 km/hr.

(2) *Aerosol generation equipment.* For purposes of these tests, the test aerosol shall be produced from commercially available, bulk Arizona road dust. To provide direct interlaboratory comparability of sampler loading characteristics, the bulk dust is specified as 0–10 μm ATD available from Powder Technology Incorporated (Burnsville, MN). To efficiently deagglomerate the bulk test dust, either a fluidized bed aerosol generator, Wright dust feeder, or sonic nozzle shall be used for the aerosol generation. Other dust generators may be used contingent upon prior approval by the Agency.

(3) *Isokinetic sampler.* Mean aerosol concentration within the static chamber or wind tunnel shall be established using a single isokinetic sampler containing a preweighed high-efficiency total filter.

(d) *Test Procedure: 24 hour loading test.* (1) *Clean the candidate sampler.* Internal surfaces of the candidate sampler shall be thoroughly cleaned and dried prior to performing these tests. The internal fractionator surfaces shall then be prepared in strict accordance

with the operating instructions in the sampler's operating manual referred to in § 53.4(b)(3). Install the candidate sampler's inlet and the isokinetic sampler within the test chamber or wind tunnel.

(2) *Generate a dust cloud.* Generate a dust cloud composed of Arizona test dust and introduce the dust cloud into the chamber. Allow sufficient time for the particle concentration to become steady within the chamber.

(3) *Sample aerosol with a total filter and the candidate sampler.* Sample the aerosol for a sufficient time to produce an equivalent time weighted concentration (TWC) of 3600 μg hr /m^3. For example, this TWC level may be achieved by sampling a 150 μg/m^3 mean concentration for 24 hours. Alternatively, a 900 μg/m^3 concentration may be sampled for a 4-hour time period to produce an equivalent TWC value. Following shutdown of the system, record the sampling time and all aerosol generation parameters.

(4) *Determine the time-weighted concentration.* (i) Weigh the isokinetic sampler's total filter on a gravimetric balance such that the relative error is less than 5.0 percent. Subtract the filter's initial mass from the final mass to determine the collected aerosol mass.

(ii)(A) Calculate and record the TWC as:

$$TWC = \frac{M \times t}{Q} \quad (39)$$

where:
M=collected aerosol mass, μg
Q=candidate volumetric flowrate, m^3/hr
t=sampling time, hr.

(B) If the value of TWC deviates from 3600 μg hr /m^3 ± 15 percent, then the loaded mass is unacceptable and steps in paragraphs (d) (1) through (3) of this section must be repeated.

(5) *Determine the candidate's performance after loading.* The candidate sampler's effectiveness as a function of particle aerodynamic diameter must then be evaluated using by performing the test in § 53.62 (full wind tunnel test). A sampler which fits the category of fractionator deviation in § 53.60(e)(2) may opt to perform the test in § 53.64 (static fractionator test) in lieu of the full wind tunnel test.

(e) *Test Procedure: Extended loading test.* (1) *Calculate the target loading mass.* Calculate and record the time weighted concentration of Arizona road dust which is equivalent to exposing the sampler in an environment of 150 μg/m^3 over the time specified by the vendor as:

$$Target\ TWC = 150\ \mu g/m^3 \times t \quad (40)$$

where t = the number of hours specified by the manufacturer prior to periodic cleaning.

(2) *Clean the candidate sampler.* Internal surfaces of the candidate sampler shall be cleaned and dried prior to performing these loading tests. The internal fractionator surfaces shall then be prepared in strict accordance with the operating instructions specified in the sampler's operating manual referred to in § 53.4(b)(3). Install the candidate sampler's inlet and the isokinetic sampler within the test chamber or wind tunnel.

(3) *Generate a dust cloud.* Generate a dust cloud composed of Arizona test dust and introduce the dust cloud into the chamber. Allow sufficient time for the particle concentration to become steady within the chamber.

(4) *Sample aerosol with a total filter and the candidate sampler.* Sample the aerosol for a time sufficient to produce an equivalent TWC equal to that of the target TWC ±15 percent. Following shutdown of the system, record the sampling time and all aerosol generation parameters.

(5) *Determine the time weighted concentration.* Weigh the isokinetic sampler's total filter on a gravimetric balance such that the relative measurement error is less than 5.0 percent. Subtract the filter's initial mass from the final mass to determine the collected aerosol mass.

(i) (A) Calculate and record the TWC as:

$$TWC = \frac{M \times t}{Q} \quad (41)$$

(B) If the value of TWC deviates from the target TWC ± 15 percent, then the loaded mass is unacceptable and steps in paragraphs (e) (1) through (4) of this section must be repeated.

(6) *Determine the candidate's effectiveness after extended loading.* The candidate sampler's effectiveness as a function of particle aerodynamic diameter must then be evaluated by performing the test in § 53.62 (full wind tunnel test). A sampler which fits the category of fractionator deviation in § 53.60(e)(2) may opt to perform the test in § 53.64 (static fractionator test) in lieu of the full wind tunnel test.

(f) *Test results.* (1) *24-hour test results.* If the ΔC's determined in the effectiveness evaluation pass the criteria established in Table F–1 of this subpart for the 24-hour loading test, then the candidate passes this test with the stipulation that the sampling train be cleaned after each 24 hours of operation.

(2) *Extended test results.* If the ΔC's determined in the effectiveness evaluation pass the criteria established in Table F–1 of this subpart for the extended loading test, then the candidate sampler passes this test with the stipulation that the sampling train be cleaned at least of often as the frequency tested.

§ 53.66 Test Procedure: Volatility test.

(a) *Overview.* This test procedure is designed to ensure that the candidate sampler's volatility losses when sampling semi-volatile ambient aerosol will be comparable to that of a federal reference method sampler. The candidate sampler must meet or exceed the acceptance criteria in Table F- 1 of this subpart.

(b) *Technical definition.* Residual mass (RM) is defined as the difference between the final filter weight following the blow-off phase and the initial filter weight preceding the loading phase.

(c) *Facilities and equipment required.* (1) *Chambers and test atmosphere.* This test requires two chambers, one inside the other. The internal chamber is used to produce a well-mixed test atmosphere from which the sampling is performed. The air velocity in the chamber shall be 2.0 km/hr ± 10 percent, perpendicular to the sampling inlet. The test section shall be sufficiently large such that the inlet, or portion installed thereof, shall block no more than 15percent of the chamber cross section in the test area. At least one reference and one candidate sampler must be tested simultaneously. Such a configuration is designated as a case. Each case needs to be repeated three times for each of the different blow-off phases (1, 2, 3, 4 hours in duration). The external chamber is used to condition, handle and weigh filters. The temperature in both chambers shall be maintained at 22 ± 0.5 °C. The relative humidity (RH) in both chambers shall be maintained at 40 percent ± 3 percent.

(2) *Aerosol generation system.* A pressure nebulizer shall be used to produce a polydisperse aerosol at a mass median diameter of less than 2.5 μm. The polydisperse aerosol shall be generated from A.C.S. reagent grade glycerol of 99.5 percent minimum purity. To provide direct interlaboratory comparability of sampler volatility characteristics, the required nebulizer is Part # 5207, manufactured by Seamless, a division of Professional Medical Products, Inc (Greenwood, SC). The concentration of the aerosol inside the internal chamber shall not exceed 2 mg/m^3, or any concentration that would overload the filters; (such overloading can be observed as ''wetted areas'). The concentration inside the chamber shall be at least 1 mg/m^3 to obtain significant filter loading.

(3) *Air velocity verification.* The chamber air velocity must be measured using an appropriate technique capable of 5 percent precision or better.

(d) *Test procedures.* (1) This procedure shall be used to test the performance of candidate equivalent methods of type I and type II in which suspended particulate matter is collected on a filter. Two candidate samplers and two reference method samplers must be tested. One reference method sampler and one candidate sampler must be simultaneously subjected to the entire test procedure to ensure that both samplers are exposed to the identical aerosol. This can be achieved by using a manifold which allows connection of two samplers outside the internal chamber.

(2) This method consists of three consecutive phases. In the first phase designated as A, temperature, relative humidity inside and outside the internal chamber must be maintained at the levels in paragraph (d)(1) of this section and the aerosol concentration and size distribution inside the internal chamber must be stabilized at the level prescribed in paragraph (d)(1) of this section. The samplers'' filters are conditioned dynamically by drawing aerosol-free air. Such air can be produced by filtering air from the external chamber through the absolute (HEPA) filter. The duration of filter conditioning shall be sufficient to obtain complete filter equilibration. In the second phase, designated as B, both samplers shall draw aerosol-laden air at a constant flow rate for 30 minutes. In the third phase designated as C, samplers draw aerosol-free and aerosol compound vapor free air, to produce partial volatilization of the collected aerosol, over single time periods of 1, 2, 3, and 4 hours. In each test, phase C is preceded by phase A and phase B using a new set of filters. Phase C shall be conducted immediately after completion of the phase B. The setup used in phase A can be used to produce air needed in phase C.

(e) *Filter handling.* Careful handling of the filter during sampling, conditioning, and weighing is necessary to avoid errors due to damaged filters or loss of collected particles from the filters. All filters must be weighed immediately after phase A and phase C.

(f) *Temperature, humidity, and static charge considerations.*—(1) *Temperature and humidity.* The effects of temperature and humidity can be minimized by equilibrating the test filters at conditions inside the external chamber. Total dynamic conditioning can be established by sequential filter weighing every 30 minutes following repetitive dynamic conditioning. The filters are considered sufficiently conditioned if the sequential weights are repeatable to ±3μg. The temperature and relative humidity changes in which the filter is exposed during the entire procedure must not exceed ±+ 0.5 °C for the temperature and ± 3 percent RH, respectively.

(2) *Static charge.* The following procedure is suggested for minimizing charge effects. Place six or more Polonium static control devices (PSCD) inside the microbalance weighing chamber, (MWC). Two of them must be placed horizontally on the floor of the MWC and the remainder placed vertically on the back wall of the MWC. Taping two PSCD's together or using double-sided tape will help to keep them from falling. Place the filter that is to be weighed on the horizontal PSCDs facing aerosol coated surface up. Close the MWC and wait 1 minute. Open the MWC and place the filter on the balance dish. Wait 1 minute. If the charges have been neutralized the weight will stabilize within 30–60 seconds. Repeat the procedure of neutralizing charges and weighing as prescribed above several times (typically 2–4 times) until consecutive weights will differ by no more than 3 micrograms. Record the last measured weight and use this value for all subsequent calculations.

(g) *Artifacts.* Additional negative or positive artifacts in collected mass during the first sampling period may occur. Such artifacts shall be minimized by producing and preserving the chemical composition of the air inside the internal chamber to provide thermodynamic and physicochemical states of equilibrium for the particles.

(h) *Calculations.* Filters shall be weighed before the aerosol loading phase and immediately after the blow-off phase. The latter weight is subtracted from the former weight to calculate the residual mass (RM). The mass on the filter from the tested candidate sampler is multiplied by the volumetric sampling flows ratio, i.e., Frm flow rate/Candidate flow rate, to produce a corrected residual mass (CRM).

(i) *Test for comparability.* Comparability of the candidate method shall be established by calculating regression parameters for the regression of the CRMs obtained using candidate devices on RMs obtained using FRM devices. If the linear regression parameters [slope, intercept and correlation] meet the following values: Slope=1 ± 0.1, intercept=0 ± 0.15, correlation r ≥0.97, the candidate method passes this test for comparability.

Tables to Subpart F of Part 53

TABLE F–1.—PERFORMANCE SPECIFICATIONS FOR $PM_{2.5}$ CLASS II EQUIVALENT SAMPLERS

Performance test	Specifications	Acceptance criteria
Full Wind Tunnel Evaluation § 53.62.	VOAG produced aerosol at 2 km/hr and 24 km/hr	Dp_{50} = 2.5 μm ± 0.2 μm; Numerical Analysis Results: 95% ≤R_c≤105% for distributions presented in Tables F–4, F–5, and F–6.
Wind Tunnel Inlet Aspiration Test § 53.63.	3.5 μm liquid VOAG produced aerosol size in conjunction with wind speeds of 2 km/hr and 24 km/hr.	Relative Aspiration: 95% ≤Means≤105%, CV ≤ 10%.
Static Fractionator Test § 53.64.	Evaluation of the fractionator under static conditions. See Table F–2 for specifications regarding particles sizes and particle types.	Dp_{50} = 2.5 μm ± 0.2 μm; Numerical Analysis Results: 95% ≤R_c≤105% for distributions presented in Tables F–4, F–5, and F–6.

TABLE F–1.—PERFORMANCE SPECIFICATIONS FOR $PM_{2.5}$ CLASS II EQUIVALENT SAMPLERS—Continued

Performance test	Specifications	Acceptance criteria
Loading Test § 53.65	Loading of the clean candidate under laboratory conditions: 24 hour test, extended test.	24 hour test and Extended test; Dp_{50} = 2.5 μm ± 0.2 μm; Numerical Analysis Results: 95% $\leq R_c \leq$105% for distributions presented in Tables F–4, F–5, and F–6.
Volatility Test § 53.66	Polydisperse liquid aerosol produced by air nebulization of A.C.S. reagent grade glycerol, 99.5% minimum purity.	Regression Parameters Slope = 1 ± 0.1, Intercept = 0 ± 0.15 r ≥ 0.97.

TABLE F–2.—PARTICLE SIZES AND WIND SPEEDS FOR FULL WIND TUNNEL EVALUATION, WIND TUNNEL INLET ASPIRATION TEST, AND STATIC CHAMBER TEST

Primary partical mean size [a] (μm)	Full wind tunnel test		Inlet aspiration test		Static fractionator test	Volatility test
	2 km/hr	24 km/hr	2 km/hr	24 km/hr		
1.5±0.25	S	S			S	
2.0±0.25	S	S			S	
2.5±0.25	S	S			S	
2.8±0.25	S	S			S	
3.5±0.25	S	S	L	L	S	
4.0±0.5	S	S			S	
Polydisperse Glycerol Aerosol						L

[a] Aerodynamic diameter.
S=solid particles. L=liquid particles.

TABLE F–3.—CRITICAL PARAMETERS OF IDEALIZED AMBIENT PARTICLE SIZE DISTRIBUTIONS

Idealized distribution	Fine particle mode			Coarse particle mode			$PM_{2.5}$/PM_{10} ratio	FRM sampler expected mass conc. (μg/m³)
	MMD (μm)	Geo. std. Dev.	Conc. (μg/m³)	MMD (μm)	Geo. std. Dev.	Conc. (μg/m³)		
Coarse	0.50	2	12.0	10	2	88.0	0.27	13.814
"Typical"	0.50	2	33.3	10	2	66.7	0.55	34.284
Fine	0.85	2	85.0	15	2	15.0	0.94	78.539

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TABLE F-4.—ESTIMATED MASS CONCENTRATION MEASUREMENT OF $PM_{2.5}$ FOR IDEALIZED COARSE AEROSOL SIZE DISTRIBUTION.

Particle Aerodynamic Diameter (μm)	Test Sampler			Ideal Sampler		
	Fractional Sampling Effectiveness	Interval Mass Concentration (μg/m³)	Estimated Mass Concentration Measurement (μg/m³)	Fractional Sampling Effectiveness	Interval Mass Concentration (μg/m³)	Estimated Mass Concentration Measurement (μg/m³)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
<0.500	1.000	6.001		1.000	6.001	6.001
0.625		2.129		0.999	2.129	2.127
0.750		0.982		0.998	0.982	0.980
0.875		0.730		0.997	0.730	0.728
1.000		0.551		0.995	0.551	0.548
1.125		0.428		0.991	0.428	0.424
1.250		0.346		0.987	0.346	0.342
1.375		0.294		0.980	0.294	0.288
1.500		0.264		0.969	0.264	0.256
1.675		0.251		0.954	0.251	0.239
1.750		0.250		0.932	0.250	0.233
1.875		0.258		0.899	0.258	0.232
2.000		0.272		0.854	0.272	0.232
2.125		0.292		0.791	0.292	0.231
2.250		0.314		0.707	0.314	0.222
2.375		0.339		0.602	0.339	0.204
2.500		0.366		0.480	0.366	0.176
2.625		0.394		0.351	0.394	0.138
2.750		0.422		0.230	0.422	0.097
2.875		0.449		0.133	0.449	0.060
3.000		0.477		0.067	0.477	0.032
3.125		0.504		0.030	0.504	0.015
3.250		0.530		0.012	0.530	0.006
3.375		0.555		0.004	0.555	0.002
3.500		0.579		0.001	0.579	0.001
3.625		0.602		0.000	0.602	0.000
3.750		0.624		0.000	0.624	0.000
3.875		0.644		0.000	0.644	0.000
4.000		0.663		0.000	0.663	0.000
4.125		0.681		0.000	0.681	0.000
4.250		0.697		0.000	0.697	0.000
4.375		0.712		0.000	0.712	0.000
4.500		0.726		0.000	0.726	0.000
4.625		0.738		0.000	0.738	0.000
4.750		0.750		0.000	0.750	0.000
4.875		0.760		0.000	0.760	0.000
5.000		0.769		0.000	0.769	0.000
5.125		0.777		0.000	0.777	0.000
5.250		0.783		0.000	0.783	0.000
5.375		0.789		0.000	0.789	0.000
5.500		0.794		0.000	0.794	0.000
5.625		0.798		0.000	0.798	0.000
5.75		0.801		0.000	0.801	0.000
		$C_{sam(exp)}$ =			$C_{ideal(exp)}$ =	13.814

Table F-5.—Estimated Mass Concentration Measurement of $PM_{2.5}$ for Idealized "Typical" Coarse Aerosol Size Distribution.

Particle Aerodynamic Diameter (μm)	Test Sampler			Ideal Sampler		
	Fractional Sampling Effectiveness	Interval Mass Concentration (μg/m³)	Estimated Mass Concentration Measurement (μg/m³)	Fractional Sampling Effectiveness	Interval Mass Concentration (μg/m³)	Estimated Mass Concentration Measurement (μg/m³)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
<0.500	1.000	16.651		1.000	16.651	16.651
0.625		5.899		0.999	5.899	5.893
0.750		2.708		0.998	2.708	2.703
0.875		1.996		0.997	1.996	1.990
1.000		1.478		0.995	1.478	1.471
1.125		1.108		0.991	1.108	1.098
1.250		0.846		0.987	0.846	0.835
1.375		0.661		0.980	0.661	0.648
1.500		0.532		0.969	0.532	0.516
1.675		0.444		0.954	0.444	0.424
1.750		0.384		0.932	0.384	0.358
1.875		0.347		0.899	0.347	0.312
2.000		0.325		0.854	0.325	0.277
2.125		0.314		0.791	0.314	0.248
2.250		0.312		0.707	0.312	0.221
2.375		0.316		0.602	0.316	0.190
2.500		0.325		0.480	0.325	0.156
2.625		0.336		0.351	0.336	0.118
2.750		0.350		0.230	0.350	0.081
2.875		0.366		0.133	0.366	0.049
3.000		0.382		0.067	0.382	0.026
3.125		0.399		0.030	0.399	0.012
3.250		0.416		0.012	0.416	0.005
3.375		0.432		0.004	0.432	0.002
3.500		0.449		0.001	0.449	0.000
3.625		0.464		0.000	0.464	0.000
3.750		0.480		0.000	0.480	0.000
3.875		0.494		0.000	0.494	0.000
4.000		0.507		0.000	0.507	0.000
4.125		0.520		0.000	0.520	0.000
4.250				0.000	0.532	0.000
4.375				0.000	0.543	0.000
4.500				0.000	0.553	0.000
4.625				0.000	0.562	0.000
4.750				0.000	0.570	0.000
4.875				0.000	0.577	0.000
5.000				0.000	0.584	0.000
5.125				0.000	0.590	0.000
5.250				0.000	0.595	0.000
5.375				0.000	0.599	0.000
5.500				0.000	0.603	0.000
5.625				0.000	0.605	0.000
5.75				0.000	0.608	0.000
		$C_{sam(exp)}$ =			$C_{ideal(exp)}$ =	34.284

Table F-6—Estimated Mass Concentration Measurement of $PM_{2.5}$ for Idealized Fine Aerosol Size Distribution.

Particle Aerodynamic Diameter (μm)	Test Sampler			Ideal Sampler		
	Fractional Sampling Effectiveness	Interval Mass Concentration (μg/m³)	Estimated Mass Concentration Measurement (μg/m³)	Fractional Sampling Effectiveness	Interval Mass Concentration (μg/m³)	Estimated Mass Concentration Measurement (μg/m³)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
<0.500	1.000	18.868		1.000	18.868	18.868
0.625		13.412		0.999	13.412	13.399
0.750		8.014		0.998	8.014	7.998
0.875		6.984		0.997	6.984	6.963
1.000		5.954		0.995	5.954	5.924
1.125		5.015		0.991	5.015	4.970
1.250		4.197		0.987	4.197	4.142
1.375		3.503		0.980	3.503	3.433
1.500		2.921		0.969	2.921	2.830
1.675		2.438		0.954	2.438	2.326
1.750		2.039		0.932	2.039	1.900
1.875		1.709		0.899	1.709	1.536
2.000		1.437		0.854	1.437	1.227
2.125		1.212		0.791	1.212	0.959
2.250		1.026		0.707	1.026	0.725
2.375		0.873		0.602	0.873	0.526
2.500		0.745		0.480	0.745	0.358
2.625		0.638		0.351	0.638	0.224
2.750		0.550		0.230	0.550	0.127
2.875		0.476		0.133	0.476	0.063
3.000		0.414		0.067	0.414	0.028
3.125		0.362		0.030	0.362	0.011
3.250		0.319		0.012	0.319	0.004
3.375		0.282		0.004	0.282	0.001
3.500		0.252		0.001	0.252	0.000
3.625		0.226		0.000	0.226	0.000
3.750		0.204		0.000	0.204	0.000
3.875		0.185		0.000	0.185	0.000
4.000		0.170		0.000	0.170	0.000
4.125		0.157		0.000	0.157	0.000
4.250		0.146		0.000	0.146	0.000
4.375		0.136		0.000	0.136	0.000
4.500		0.129		0.000	0.129	0.000
4.625		0.122		0.000	0.122	0.000
4.750		0.117		0.000	0.117	0.000
4.875		0.112		0.000	0.112	0.000
5.000		0.108		0.000	0.108	0.000
5.125		0.105		0.000	0.105	0.000
5.250		0.102		0.000	0.102	0.000
5.375		0.100		0.000	0.100	0.000
5.500		0.098		0.000	0.098	0.000
5.625		0.097		0.000	0.097	0.000
5.75		0.096		0.000	0.096	0.000
		$C_{sam(exp)}$ =			$C_{ideal(exp)}$ =	78.539

Figures to Subpart F of Part 53

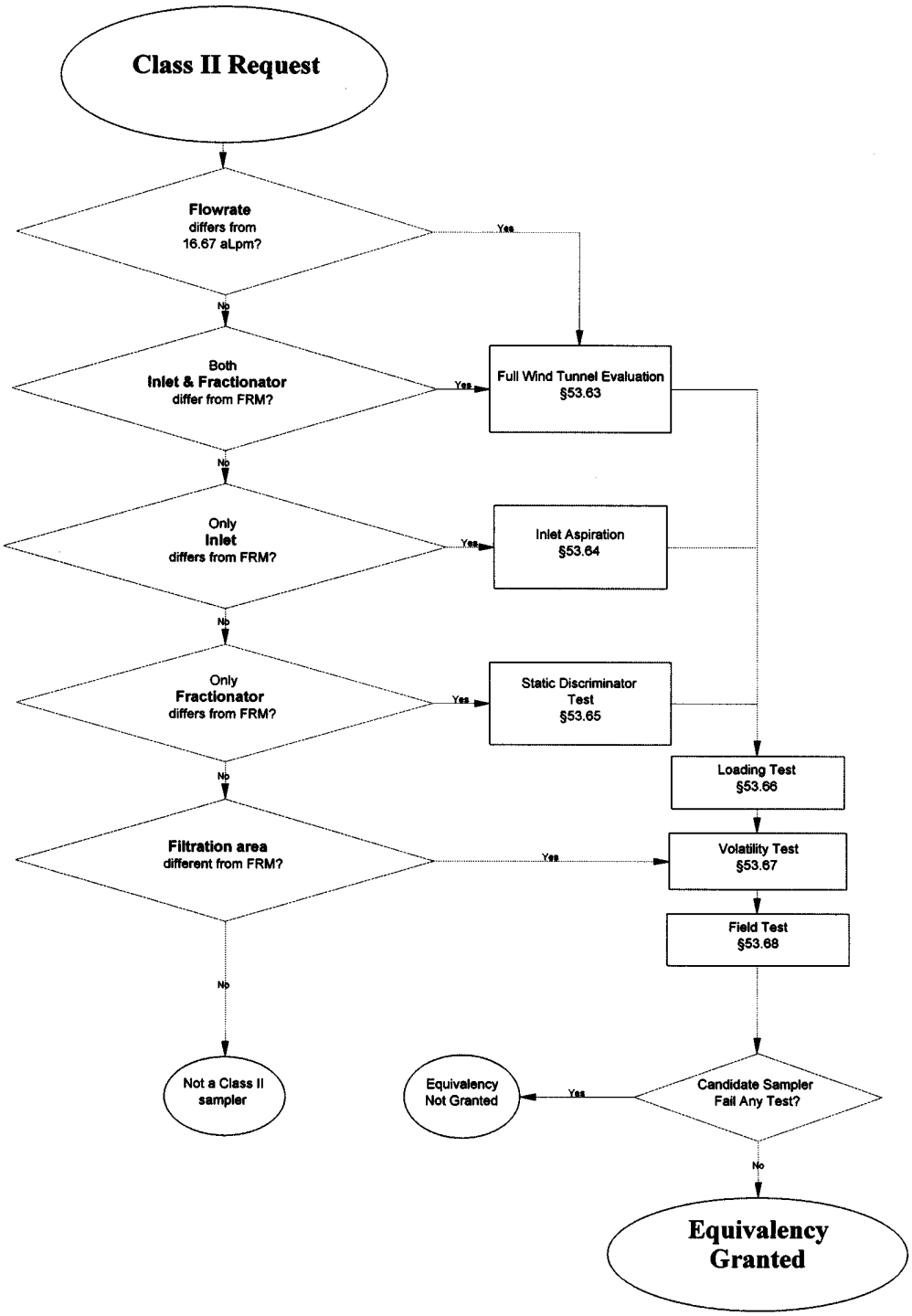

Figure F-1. Flowchart for determining requirements for Class II Sampler uivalency

DESIGNATION TESTING CHECKLIST FOR CLASS II

Auditee _____ Auditor signature _____ Date _____

Compliance Status: Y = Yes N = No NA = Not applicable/Not available				
Verification			**Verified by Direct Observation of Process or of Documented Evidence: Performance, Design or Application Spec.** *Corresponding to Sections of 40 CFR Part 53 Subpart F*	**Verification Comments** (Includes documentation of who, what, where, when, why) (Doc. #, Rev. #, Rev. Date)
Y	N	NA		
Subpart E: PERFORMANCE SPECIFICATIONS				
			Evaluation completed according to Subpart E §53.50 to §53.56	
Subpart E: Class I Sequential Tests				
			Class II samplers that are also Class I (sequentialized) have passed the tests in §53.57	
Subpart F: PERFORMANCE SPEC/TEST				
			Evaluation of Physical Characteristics of Clean Sampler - One of these tests must be performed §53.62 - Full Wind Tunnel §53.63 - Inlet Aspiration §53.64 - Static Fractionator	
			Evaluation of Physical Characteristics of Loaded Sampler **24 hour loading** §53.65(d) must be performed one of the following tests must be performed for evaluation after loading §53.62, §53.63, §53.64 **Extended loading** (optional) §53.65(e) must be performed one of the following tests must be performed for evaluation after loading §53.62, §53.63, §53.64	
			Evaluation of the Volatile Characteristics of the Class II Sampler §53.66	

Figure F-2. Designation testing checklist

BILLING CODE 6560–50–C

Appendix A to Subpart F of Part 53—References

1. Marple, V.A., K.L. Rubow, W. Turner, and J.D. Spangler, Low Flow Rate Sharp Cut Impactors for Indoor Air Sampling: Design and Calibration., JAPCA, 37: 1303–1307 (1987).
2. Vanderpool, R.W. and K.L. Rubow, ''Generation of Large, Solid Calibration Aerosols'', J. of Aer. Sci. and Tech., 9:65–69 (1988).

PART 58—[AMENDED]

1. The authority citation for part 58 continues to read as follows:

Authority: 42 U.S.C. 7410, 7601(a), 7613, and 7619.

2. Section 58.1 is amended by revising paragraph (s) and adding paragraphs (jj) through (vv) to read as follows:

§ 58.1 Definitions.

* * * * *

(s) *Traceable* means that a local standard has been compared and certified, either directly or via not more than one intermediate standard, to a National Institute of Standards and Technology (NIST)-certified primary standard such as a NIST-Traceable Reference Material (NTRM) or a NIST-certified Gas Manufacturer's Internal Standard (GMIS).

* * * * *

(jj) *Consolidated Metropolitan Statistical Area* 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 consolidated metropolitan statistical area (CMSA).''

(kk) *Core $PM_{2.5}$ SLAMS* means SLAMS sites which are the basic component sites of the $PM_{2.5}$ SLAMS regulatory network. Population-oriented core sites are intended to reflect community-wide exposure to air pollution.

(ll) *Equivalent method* means a method of sampling and analyzing the ambient air for an air pollutant that has been designated as an equivalent method in accordance with this part; it does not include a method for which an equivalent method designation has been canceled in accordance with 40 CFR 53.11 or 53.16.

(mm) *Metropolitan Statistical Area (MSA)* means the most recent area as designated by the U.S. Office of Management and Budget and population figures from the U.S. Bureau of the Census. The Department of Commerce defines a metropolitan area as ''one of a large population nucleus, together with adjacent communities which have a high degree of economic and social integration with that nucleus.''

(nn) *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 spatial averaging zones. MPAs are generally oriented toward areas with populations greater than 250,000, but for convenience, those portions of a State that are not part of MSAs can be considered as a single MPA. MPAs must be defined, where applicable, in a State monitoring plan.

(oo) *Particulate Matter Monitoring Plan* means a detailed plan, prepared by control agencies and submitted to EPA for approval, that describes their $PM_{2.5}$ and PM_{10} air quality surveillance network.

(pp) *$PM_{2.5}$* 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 appendix L 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.

(qq) *Population oriented monitoring or sites* applies to residential areas, commercial areas, recreational areas, industrial areas where workers from more than one company are located, and other areas where a substantial number of people may spend a significant fraction of their day.

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

(ss) *Reference method* means a method of sampling and analyzing the ambient air for an air pollutant that is 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 40 CFR 53.11 or 53.16.

(tt) *Spatial averaging zone (SAZ)* means an area with established, well defined boundaries, such as a county or census block, within a MPA that has relatively uniform concentrations of $PM_{2.5}$. Monitors within a SAZ that meet certain requirements as set forth in Appendix D of this part are used to compare with the primary annual $PM_{2.5}$ NAAQS using a spatial averaging procedure specified in Appendix K of 40 CFR Part 50. A SAZ may have one or more monitors. An MPA must have at least one SAZ and may have several SAZs.

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

(vv) *Annual State Air Monitoring Report (ASAMR)* 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.

3. Section 58.13 is amended by revising paragraph (d) and adding new paragraphs (e) and (f) as follows:

§ 58.13 Operating schedule.

* * * * *

(d) For PM_{10} samplers—a 24-hour sample must be taken a minimum of every sixth day.

(e) For $PM_{2.5}$ samplers, everyday sampling is required for all core SLAMS, including NAMS and PAMS core stations, except during seasons or as otherwise exempted by the Regional Administrator in accordance with EPA guidance. For other SLAMS, a minimum frequency of 1 in 6 day sampling schedule is allowed and suggested. Alternative sampling frequencies are also allowed for SLAMS sites which are principally intended for comparisons to the 24-hour NAAQS. Such modifications must be approved by the EPA Administrator in accordance with EPA guidance.

(f) *Alternatives to everyday sampling.* (1) $PM_{2.5}$ core SLAMS sites located in monitoring planning areas (as described in section 2.8 of Appendix D of this subpart) are required to sample every day with a reference or equivalent method operating in accordance with 40 CFR part 53 and Section 2 of Appendix C to 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 particle 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 to be established and included in EPA guidance. Unless the continuous fine particle analyzer satisfies the requirements of Section 2 of Appendix C to 40 CFR Part 58, however, the data derived from the correlated acceptable continuous monitor are not eligible for direct comparisons to the NAAQS in accordance with Part 50.

(2) A Metropolitan Statistical Area (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 two complete years and the area is determined to be attainment with the $PM_{2.5}$ NAAQS in accordance with Appendix K to 40 CFR Part 50. See Figure below. After this time and for as long as the area is in attainment with the $PM_{2.5}$ NAAQS, the correlated acceptable continuous option may be used in conjunction with 1 in 3 day intermittent sampling. Other core SLAMS may utilize correlated acceptable continuous monitors in conjunction with intermittent sampling on a 1 in 3 schedule for the first year of required $PM_{2.5}$ sampling.

(4) After one complete year of $PM_{2.5}$ sampling, if a violation of the NAAQS is determined (in accordance with Appendix K to 40 CFR part 50), then everyday sampling with reference or equivalent method would be required subsequently. Otherwise, the core SLAMS in this area may continue to sample a minimum of 1 in 3 days using a reference or equivalent method together with the correlated acceptable continuous monitor. Background and transport $PM_{2.5}$ core SLAMS in States with population-oriented core monitors may sample with correlated acceptable continuous alternative in accordance with the highest priority $PM_{2.5}$ core SLAMS for the State. In States without population-oriented core monitors or where operation of population-oriented core monitors has been exempted by the Regional Administrator, the background and transport $PM_{2.5}$ core SLAMS may also sample a minimum of 1 in 3 days. Background $PM_{2.5}$ sites which are downwind of areas without anthropogenic sources of $PM_{2.5}$, (e.g., the Pacific Ocean) may also sample 1 in 3 days.

(5) 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.

4. Section 58.14 is revised as follows:

§ 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) $PM_{2.5}$ NAAQS violations shall not be made based on data produced at an SPM site during the first 3 years following the effective date of the final rule. However, a notice of NAAQS violations resulting from SPMs shall be reported to EPA in the State's annual monitoring plan and be considered by the State in the design of its overall SLAMS network, and should be considered to become 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.

5. A new § 58.15 is added to read as follows:

§ 58.15 Designation of monitoring sites eligible for comparison to the $PM_{2.5}$ NAAQS.

(a) SLAMS and SPM monitors that will be used to make comparisons with the 24-hour and annual NAAQS for $PM_{2.5}$ shall be identified in the State's monitoring plan, subject to annual review and approval by the Regional Administrator, and designated as code ''B'' in EPA's AIRS monitoring site file.

(b) SLAMS and SPM monitors that will be used to make comparisons only with the 24-hour NAAQS for $PM_{2.5}$ shall be identified in the States monitoring plan, subject to annual review and approval by the Regional Administrator, and designated as code ''D'' in EPA's AIRS monitoring site file.

(c) All other $PM_{2.5}$ sites would be designated as code ''O'' sites in EPA's AIRS monitoring site file.

6. Section 58.20 is amended by revising paragraphs (d), (e) introductory text, and (e)(5); by redesignating paragraph (f) as (g); and adding a new paragraph (f) to read as follows:

§ 58.20 Air quality surveillance: Plan control.

* * * * *

(d) 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 § 2.8 of appendix D to this part as well as the minimum requirements for networks of SLAMS stations for $PM_{2.5}$ described in § 2.8.2 of 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 which are necessary. For $PM_{2.5}$, the review must identify needed changes to core stations, monitoring planning areas, spatial averaging zones, or monitoring sites which are eligible for comparison to the NAAQS.

(e) Provide for having a SLAMS network description, including monitoring planning areas and spatial averaging zones for $PM_{2.5}$, available for public inspection and submission to the Administrator upon request. The network description must be available at the time of plan revision submittal except for PM_{10} and $PM_{2.5}$, which must be available by 6 months after the effective date of promulgation and must contain the following information for each SLAMS:

* * * * *

(5) The monitoring objective, spatial scale of representativeness, and for $PM_{2.5}$, the monitoring planning area, spatial averaging zone, and the site code designation to identify which site will be used to determine violations of the appropriate PM NAAQS (annual or 24-

hour), as defined in appendix D to this part.

(f) Provide for having a list of all $PM_{2.5}$ monitoring locations including SLAMS, NAMS and SPMs, which are included in the State's monitoring plan and are intended for comparison to the NAAQS, available for public inspection

* * * * *

7. Section 58.23 is amended by revising the introductory text and adding a new paragraph (c) to read as follows:

§ 58.23 Monitoring network completion.

By January 1, 1983, with the exception of PM_{10} samplers which shall be within 6 months of the date of publication of the final rule and with the exception of $PM_{2.5}$ samplers which shall be as described in paragraph (c) of this section.

* * * * *

(c) Each $PM_{2.5}$ station in the SLAMS network must be in operation in accordance with the minimum requirements of appendix D of this part, be sited in accordance with the criteria in appendix E to this part, and be located as described on the station's AIRS site identification form, according to the following schedule:

(1) Within 1 year of the effective date of promulgation, the required core $PM_{2.5}$ SLAMS for at least one MPA must be in operation;

(2) Within 2 years of promulgation, all other required core-population oriented sites and core background and transport sites must be in operation; and

(3) Within 3 years of promulgation, a continuous PM monitor in areas with greater than 1 million population, all NAMS sites and all additional required $PM_{2.5}$ SLAMS must be in operation.

8–9. In § 58.26, revise the section heading paragraph (b) introductory text and add paragraphs (d) and (e) to read as follows:

§ 58.26 Annual State Air Monitoring Report.

* * * * *

(b) The SLAMS annual data summary report must contain:

* * * * *

(d) For PM—

(1) The State shall submit a summary to the appropriate Regional Office (for SLAMS) or Administrator (through the Regional Office) (for NAMS) which details proposed changes to the PM Monitoring Plan and to be in accordance with the annual network review requirements § 58.25. This shall discuss the existing PM networks, including modifications to the number, size or boundaries of monitoring planning areas and spatial averaging zones; number and location of PM SLAMS; number or location of core $PM_{2.5}$ SLAMS; alternative sampling frequencies proposed for $PM_{2.5}$ SLAMS (including core $PM_{2.5}$ SLAMS and $PM_{2.5}$ NAMS), core $PM_{2.5}$ SLAMS to be designated $PM_{2.5}$ NAMS; and PM SLAMS to be designated PM NAMS.

(2) the State shall submit an annual summary to the appropriate Regional Office of all the ambient air quality monitoring PM data from all special purpose monitors which are described in the States monitoring plan and are intended for SIP purposes. These include those population oriented SPMs which are eligible for comparison to the PM NAAQS. The State shall certify the data in accordance with paragraph (c) of this section.

(e) The Annual State Air Monitoring Report shall be submitted to the Regional Administrator by July 1 or by alternative annual date to be negotiated between the State and Regional Administrator. The Region shall provide review and approval/disapproval within 45 days. After the first 3 years following effective promulgation of the $PM_{2.5}$ NAAQS or once a SAZ has been determined to violate the NAAQS, then changes to an MPA shall require public review and notification.

§ 58.30 NAMS network establishment.

10. In § 58.30, paragraph (a) introductory text is revised to read as follows:

(a) By January 1, 1980, with the exception of PM_{10} samplers, which shall be by 6 months after the effective date of the final rule, and $PM_{2.5}$, which shall be by 3 years after the effective date of promulgation, the State shall:

* * * * *

11. In § 58.31, paragraph (f) is revised to read as follows:

§ 58.31 NAMS network description.

* * * * *

(f) The monitoring objective, spatial scale of representativeness, and for $PM_{2.5}$, the monitoring planning area, spatial averaging zone, and the site code designation to identify which site will be used to determine violations of the appropriate NAAQS (annual or 24-hour), as defined in appendix D to this part.

* * * * *

12. In § 58.34, the introductory text is revised to read as follows:

§ 58.34 NAMS network completion.

By January 1, 1981, with the exception of PM_{10} samplers, which shall be by 6 months after the effective date of final rule, and $PM_{2.5}$, which shall be by 3 years after the effective date of final rule:

* * * * *

13. In § 58.35, the first sentence of paragraph (b) is revised to read as follows:

§ 58.35 NAMS data submittal.

* * * * *

(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.

* * * * *

14. Revise Appendix A of part 58 to read as follows:

Appendix A to Part 58—Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS)

1. General Information.

1.1 This appendix specifies the minimum quality assurance/quality control requirements applicable to SLAMS air monitoring data submitted to EPA. State and local agencies are encouraged to develop and maintain quality assurance programs more extensive than the required minimum.

1.2 To assure the quality of data from air monitoring measurements, two distinct and important interrelated functions must be performed. One function is the control of the measurement process through broad quality assurance activities, such as establishing policies and procedures, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is the control of the measurement process through the implementation of specific quality control procedures, such as calibrations, checks, replicates, routine self-assessments, etc. In general, the greater the control of a given monitoring system, the better will be the resulting quality of the monitoring data. The results of quality assurance reviews and assessments indicate whether the control efforts are adequate or need to be improved.

1.3 Documentation of all quality assurance and quality control efforts implemented during the data collection, analysis, and reporting phases is important to data users, who can then consider the impact of these control efforts on the data quality (see Reference 1 of this appendix). Both qualitative and quantitative assessments of the effectiveness of these control efforts should identify those areas most likely to impact the data quality and to what extent.

1.4 Periodic assessments of SLAMS data quality are required to be reported to EPA. To provide national uniformity in this assessment and reporting of data quality for all SLAMS networks, specific assessment and reporting procedures are prescribed in detail in sections 3, 4, and 5 of this appendix. On the other hand, the selection and extent of the quality assurance and quality control

activities used by a monitoring agency 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 system requirements, in section 2 of this appendix, are specified in general terms to allow each State to develop a quality assurance program that is most efficient and effective for its own circumstances.

2. Quality System Requirements

2.1 Each State and local agency 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

(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, and approved by the appropriate Regional Administrator, or the Administrator's designee. The Quality Assurance Program will be reviewed during the systems audits described in section 2.5 of the appendix.

2.2 Primary guidance for developing the quality assurance program is contained in References 2–7 of this appendix, which also contain many suggested procedures, checks, and control specifications. Reference 7 of this appendix describes specific guidance for the development of a Quality Assurance Program for SLAMS. Many specific quality control checks and specifications for manual methods are included in the respective reference methods described in part 50 of this chapter or in the respective manual equivalent method descriptions available from EPA (see 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. Quality assurance procedures for VOC, NOx (including NO and NO_2), O_3, and carbonyl measurements at PAMS must be consistent with EPA guidance. Quality assurance and control programs must follow the requirements established by ANSI E–4 (Reference 2 of this appendix) and must undergo systems audits demonstrating attainment of the requirements. This guidance, and any other pertinent information from appropriate sources, should be used by the agencies in developing their quality assurance programs. As a minimum, each quality assurance program 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 actions 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) Quality control procedures for air pollution episode monitoring;

(12) Recording and validating data;

(13) Data quality assessment (precision and accuracy);

(14) Documentation of quality assurance and quality control information; and

(15) Control of pertinent documents and records in print and electronic forms.

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, SO_2, NO, and NO_2 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.

2.3.2 Test concentrations for O_3 must be obtained in accordance with the UV photometric calibration procedure specified in appendix D of part 50 of this chapter, or by means of a certified ozone transfer standard. Consult References 11 and 12 for guidance on primary and transfer standards for O_3.

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.

2.4 National Performance Audit Program. Agencies operating SLAMS are required to participate in EPA's National Performance Audit Program. These audits are described in sections 2.0.10 and 2.0.11 of Reference 7. For further instructions, agencies should contact either the appropriate EPA Regional Quality Assurance Coordinator or the National Performance Audit Program Coordinator, Quality Assurance Branch (MD–77B), National Exposure Research Laboratory, 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 three years by the appropriate EPA Regional Office. Quality assurance and control programs must follow the requirements established by ANSI E–4 (Reference 2 of this appendix) and described in Reference 7. For further instructions, agencies should contact either the appropriate EPA Regional Quality Assurance Coordinator or the Systems Audit Quality Assurance Coordinator, Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division (MD–14), 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 being routinely produced. Measurement accuracy and precision are estimated for both automated and manual methods. The individual results of these tests for each method or analyzer shall be reported to EPA as specified in section 4. EPA will then calculate quarterly integrated estimates of precision and accuracy 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 The integrated estimates of the data quality will be calculated on the basis of ''reporting organizations'' and may also be calculated for each region and for the entire nation. These estimates will primarily pool all methods for each pollutant, but estimates may also be made for specific instrument types identified by EPA method code, which is uniquely related to each reference and equivalent method designated by the EPA under part 53 of this chapter. A ''reporting organization'' is defined as a State, subordinate organization within a State, or other organization that is responsible for a set of stations that monitors the same pollutant and for which precision or accuracy 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 precision or accuracy among all stations in the organization can be expected to be reasonably homogeneous, as a result of common factors. Common factors that should be considered by States in defining reporting organizations include:

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

(2) Common calibration facilities; and

(3) Support by a common laboratory or headquarters. 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 for guidance. 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. Concentration and flow rate standards must be as specified in sections 2.3 or 3.4 of this Appendix. In addition, working standards and equipment used for accuracy audits must not be the same standards and equipment used for routine calibrations. Additional information and guidance in the technical aspects of conducting these tests may be found in Reference 7 or in the operation or instruction manual associated with the analyzer or sampler. Concentration measurements reported from analyzers or analytical systems (indicated concentrations) should be based on stable readings and must

be derived by means of the same calibration curve and data processing system used to obtain the routine air monitoring data (see Reference 1 and Reference 7 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.

3.1.1 Methods for SO_2, NO_2, O_3 and CO. A one-point precision check must be performed at least once every two weeks on each automated analyzer used to measure SO_2, NO_2, O_3 and CO. The precision check is made by challenging the analyzer with a precision check gas of known concentration (effective concentration for open path analyzers) between 0.08 and 0.10 ppm for SO_2, NO_2, 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 1.0 ppm SO_2, NO_2, 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 the Regional Administrator's 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 above. 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 the test result and repeat the test. If possible, open path analyzers should be tested during periods when the atmospheric pollutant concentrations are relatively low and steady.

3.1.1.3 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.

3.1.2 Methods for particulate matter. A one-point precision check must be performed at least once every two weeks on each automated analyzer used to measure PM_{10} and $PM_{2.5}$. 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.

3.1.2.1 Standard procedure: Use a flow rate transfer standard certified in accordance with section 2.3.3 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.

3.1.2.2 Alternative procedure:

3.1.2.2.1 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—

3.1.2.2.1.1 the flow meter is audited with an external flow rate transfer standard at least every 6 months;

3.1.2.2.1.2 records of at least the 3 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

3.1.2.2.1.3 the instrument and flow meter give no indication of improper operation.

3.1.2.2.2 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.

3.1.2.2.3 For either procedure, the percent differences between the actual and indicted flow rates are used to assess the precision of the monitoring data as described in section 5.1 of this Appendix A (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.

3.2 Accuracy of Automated Methods.

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 for 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 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:

Audit level	Concentration range, ppm		
	SO_2, O_3	NO_2	CO
1	0.03–0.08	0.03–0.08	3–8
2	0.15–0.20	0.15–0.20	15–20
3	0.35–0.45	0.35–0.45	35–45
4	0.80–0.90	.....	80–90

NO_2 audit gas for chemiluminescence-type NO_2 analyzers must also contain at least 0.08 ppm NO.

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_X 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 1.0 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 Administrators'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 the specifications of section 2.3. The gas standards and equipment used for auditing must not be the same as the standards and equipment used for calibration or calibration span adjustments. The auditor should not be the operator or analyst who conducts the routine monitoring, calibration, and analysis.

3.2.1.6 For point 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 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. 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 tested. The percent differences between these concentrations are used to assess the accuracy of the monitoring data as described in section 5.2.

3.2.2 Methods for particulate matter.

3.2.2.1 Each calendar quarter, audit the flow rate of each SLAMS $PM_{2.5}$ analyzer and 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 PM10 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. 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 as described in section 5.4.1.

3.3 *Precision of Manual Methods.*

3.3.1 For each network of manual methods other than for $PM_{2.5}$, 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. For each network of manual methods for $PM_{2.5}$, select one or more monitoring sites within the reporting organization for duplicate, collocated sampling as follows: for 1 to 10 sites, select 1 site; for 11 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, PM_{10}, and $PM_{2.5}$ shall be considered separately from one another. 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. 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 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 in lieu of a $PM_{2.5}$ measurement if the latter measurement is unavailable.

3.3.4 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.

3.3.5 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. The paired samplers must each have the same designation number. 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. The every-6-day schedule used by many monitoring agencies is recommended. Report the measurements from both samplers at each collocated sampling site, including measurements falling below the limits specified in 5.3.1. The percent differences in measured concentration ($\mu g/m^3$) between the two collocated samplers are used to calculate precision as described in section 5.3.

3.4 *Accuracy of Manual Methods.* The accuracy of manual sampling methods is assessed by auditing a portion of the measurement process. For particulate matter methods, the flow rate during sample collection is audited. For SO_2 and NO_2 methods, the analytical measurement is audited. For Pb methods, the flow rate and analytical measurement are audited.

3.4.1 Methods for $PM_{2.5}$ and PM_{10}.

3.4.1.1 Each calendar quarter, audit the flow rate of each $PM_{2.5}$ sampler and audit at least 25 percent of the PM_{10} samplers such

that each PM_{10} sampler is audited at least once per year. If there are fewer than four PM_{10} 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. 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 as described in section 5.4.1.

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 SO_2 Methods.

3.4.2.1 Prepare audit solutions from a working sulfite-tetrachloromercurate (TCM) solution as described in section 10.2 of the SO_2 Reference Method (appendix A of part 50 of this chapter). 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 SO_2/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 SO_2/ml) and the corresponding indicated concentrations (in µg SO_2/ml). The percent differences between these concentrations are used to calculate accuracy as described in section 5.4.2.

3.4.3 NO_2 Methods. Prepare audit solutions from a working sodium nitrite solution as described in the appropriate equivalent method (see Reference 8). 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 NO_2/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 NO_2/ml) and the corresponding indicated concentrations (in µg NO_2/ml). The percent differences between these concentrations are used to calculate accuracy as described in section 5.4.2.

3.4.4 Pb Methods.

3.4.4.1 For the Pb Reference Method (appendix G of part 50 of this chapter), 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. 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 (¾ 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 Pb analytical equipment being audited. Prepare audit samples in the following concentration ranges:

Range	Pb concentration, µg/strip	Equivalent ambient Pb concentration, µg/m³ [1]
1	100–300	0.5–1.5
2	600–1000	3.0–5.0

[1] Equivalent ambient Pb concentration in µg/m³ is based on sampling at 1.7 m³/min for 24 hours on a 20.3 cm×25.4 cm (8 inch×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 77. The percent differences between the concentrations are used to calculate analytical accuracy as described in section 5.4.2.

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.

4. Reporting Requirements

For each pollutant, prepare a list of all monitoring sites and their 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 and accuracy tests it has carried out during the quarter. The quarterly reports of precision and accuracy data must be submitted consistent with the data reporting requirements specified for air quality data as set forth in § 58.35(c). Each organization shall report all collocated measurements including those falling below the levels specified in section 5.3.1. 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 methods 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 and accuracy.

4.2 Annual Reports.

4.2.1 When precision and accuracy estimates for a reporting organization have been calculated for all four quarters of the calendar year, EPA will calculate the properly weighted probability limits for precision and accuracy 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

Calculation of estimates of integrated precision and accuracy are carried out by EPA according to the following procedures. Reporting organizations should report the results of individual precision 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. Estimates of the precision of automated methods are calculated from the results of biweekly precision checks as specified in section 3.1. 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.

$$d_i = \frac{Y_i - X_i}{X_i} \times 100 \quad (1)$$

5.1.1.2 For each analyzer, the quarterly average (d_j) is calculated with equation 2, and the standard deviation (S_j) 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.

$$d_j = \frac{1}{n} \sum_{i=1}^{n} d_i \quad (2)$$

$$S_j = \sqrt{\frac{1}{n-1}\left[\sum_{i=1}^{n} d_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} d_i\right)^2\right]} \quad (3)$$

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_a) 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.

$$D = \frac{1}{k}\sum_{j=1}^{k} d_j \quad (4)$$

$$D = \frac{n_1 d_1 + n_2 d_2 + \ldots + n_j d_j + \ldots + n_k d_k}{n_1 + n_2 + \ldots + n_j + \ldots + n_k} \quad (4a)$$

$$S_a = \sqrt{\frac{1}{k}\sum_{j=1}^{k} S_j^2} \quad (5)$$

$$S_a = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2 + \ldots + (n_j - 1)S_j^2 + \ldots + (n_k - 1)S_k^2}{n_1 + n_2 + \ldots + n_j + \ldots + n_k - k}} \quad (5a)$$

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.

Upper 95 Percent Probability

Limit=D+1.96 S_a (6)

Lower 95 Percent Probability

Limit=D−1.96 S_a (7)

5.2 Accuracy of Automated Methods. Estimates of the accuracy of automated methods are calculated from the results of independent audits as described in section 3.2. 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.

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.

$$D = \frac{1}{n}\sum_{i=1}^{n} d_i \quad (8)$$

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.

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

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. Estimates of precision of manual methods are calculated from the results obtained from collocated samplers as described in section 3.3. 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, 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:

TSP: 20 μg/m³;
SO_2: 45 μg/m³;
NO_2: 30 μg/m³;
Pb: 0.15 μg/m³;
PM_{10}: 20 μg/m³; and
$PM_{2.5}$: 6 μg/m³.

5.3.1.2 For each selected measurement pair, the percent difference (d_i) is calculated, using equation 10,

$$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} \times 100 \quad (10)$$

where Y_i is the pollutant concentration measurement obtained from the duplicate sampler and X_i is the concentration measurement obtained from the primary sampler designated for reporting air quality for the site. For each site, the quarterly average percent difference (d_j) is calculated from equation 2 and the standard deviation (S_j) is calculated from equation 3, where n=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 percentage difference (D) and the pooled standard deviation (S_a) are calculated, using equations 4 and 5, or using equations 4a and 5a if different numbers of paired measurements are obtained at the collocated sites. For these calculations, the k of equations 4, 4a, 5 and 5a is the number of collocated sites.

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

Upper 95 Percent Probability

$$\text{Limit}=D + 1.96\ S_a/\sqrt{2} \quad (11)$$

Lower 95 Percent Probability

$$\text{Limit}=D \pm 1.96\ S_a/\sqrt{2} \quad (12)$$

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

5.4.1 Particulate Matter Samplers other than $PM_{2.5}$ (including reference method Pb samplers).

5.4.1.1 Single Sampler Accuracy. For the flow rate audit described in Section 3.4.1, the percentage difference (d_i) for each audit is calculated using equation 1, where X_i represents the known flow rate and Y_i 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 (S_a) 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 SO_2, NO_2, and Pb.

5.4.2.1 Single Analysis-Day Accuracy. For each of the audits of the analytical methods for SO_2, NO_2, and Pb described in sections 3.4.2, 3.4.3, and 3.4.4, the percentage difference (d_j) at each concentration level is calculated using equation 1, where X_j represents the known value of the audit sample and Y_j represents the value of SO_2, NO_2, or Pb indicated by the analytical method.

5.4.2.1 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 (S_a) 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.

6.0 Annual Operational Evaluation of $PM_{2.5}$ Methods.

All $PM_{2.5}$ monitoring methods or analyzers used in SLAMS shall be evaluated annually, as described in this section, to quantitatively assess the quality of the SLAMS data being routinely produced. This evaluation is derived from the results of collocated $PM_{2.5}$ measurements made at each monitoring station at least 6 times per year and applies to both automated and manual methods. Individual samplers or monitors are screened for bias and excessive imprecision. Estimates of integrated measurement precision and accuracy, in the form of 95 percent probability limits, for each designated $PM_{2.5}$ method are determined for each reporting organization and on a national basis. Reporting organizations are defined as in section 3 of this Appendix. The results of the latter evaluation shall be used to review instrument and reporting organization performance. The absolute value of the 95 percent probability limits on a national basis for each designated method must be within 15 percent for the method to maintain its reference or equivalent method designation.

6.1 Operational field test audits. For each SLAMS $PM_{2.5}$ monitor, collocate a $PM_{2.5}$ reference method sampler, referred to as an ''audit sampler,'' and operate it simultaneously with the SLAMS monitor at least 6 times per year. These collocated audits are required even for SLAMS $PM_{2.5}$ monitors located at sites that have a collocated $PM_{2.5}$ monitor as required under section 3.3 of this appendix, unless the collocated monitor is a $PM_{2.5}$ reference method sampler and is a designated audit device as described in the Section 2.12 of the Quality Assurance Handbook (Reference 7). The collocated audit sampler shall be located between 2 and 4 meters from the SLAMS monitor, with its inlet at the same height above ground as the inlet of the SLAMS monitor. Calibration and operation of the audit sampler and analysis of the audit sample filter shall be as specified in the sampler's operation or instruction manual and in general accordance with the guidance provided in Section 2.12 of Reference 7. Calibration and operation of the SLAMS monitor shall be the same as for its routine SLAMS operation, and it shall not receive any special or non-scheduled service immediately prior to, or specifically associated with, the collocated sample collection. The 6 or more collocated $PM_{2.5}$ measurement pairs shall be obtained at approximately equal intervals over the year, such as every other month, and shall be reported to the EPA as set forth in Section 4 of this Appendix for other precision and accuracy test results. All collocated measurements shall be reported, even those which might be considered invalid because of identified malfunctions or other problems occurring during the sample collection period. Collocated measurements shall be reported to EPA only for methods and analyzers approved for use in SLAMS monitoring under part 58 of this chapter. The EPA will calculate annual evaluations from the reported test measurements, as described in sections 6.2 and 6.3.

6.2 Screening Test for Bias and Excessive Imprecision of Individual Monitors. This section describes a simple test, based on the

binomial distribution, that checks for gross bias or inadequate precision in the field operation of either the SLAMS monitor or the audit sampler. However, since the audit sampler is a reference method, the test results apply primarily to the SLAMS monitor. The test uses the collocated audit measurements described in section 6.1, and may be used with 4 to 12 measurement pairs.

6.2.1 (1) For the annual evaluation, the EPA will calculate the relative percent difference (RPD) for each measurement pair obtained for the year as:

$$RPD = 100 \times (C - C_{audit}) / [0.5 \times (C + C_{audit})] \quad (13)$$

where

C = the concentration measured by the SLAMS monitor, and

C_{audit} = the concentration measured by the audit sampler.

(2) All collocated measurements will be used for this test, even those which might be considered invalid because of identified malfunctions or other problems occurring during the sample collection period.

6.2.2 There are three situations that can develop from analyzing the collocated data:

Situation A: All the RPD's are within 15% in absolute value. For situation A, the SLAMS monitor shows no indication of bias or inadequate precision and therefore passes this screening test.

Situation B: Some or all of the RPD's are extreme in that they exceed 15% in absolute value, and the extreme RPD's all have the same sign (for example, −19, −21, −16). This may indicate a bias. For situation B, Table A–2 specifies the minimum number of extreme RPD's, all having the same sign, that indicates that the SLAMS monitor has a significant, unacceptable bias with respect to the audit reference method.

Situation C: Some or all of the RPD's are extreme in that they exceed 15% in absolute value, and the extreme RPD's do not all have the same sign (for example, −17, +19, −18). This may indicate unacceptable precision. For situation C, Table A–2 specifies the minimum number of extreme RPD's, all not having the same sign, that indicate that the SLAMS monitor has excessive imprecision with respect to the audit reference method.

6.2.3 If either bias (Situation B) or excessive imprecision (Situation C) is indicated by this screening test for a particular SLAMS monitor, the reporting organization will be notified by the EPA within 60 days after the end of the year that no monitors of the type (identified by its reference or equivalent method designation number) that failed the screening test shall be used for further SLAMS monitoring at any SLAMS site in the reporting organization unless and until the probable cause or causes of the test failure have been identified and corrected, the correction has been appropriately addressed in the applicable quality assurance plan, and the organization has received approval by the EPA Regional Office to resume use of monitors of the type identified for SLAMS purposes. General guidance in identifying and correcting common or typical types of such quality assurance problems for reference methods and Class I equivalent methods is provided in section 2.12 of Reference 7 of this appendix.

TABLE A–2.—TABLE FOR DETERMINING BIAS OR EXCESSIVE INADEQUATE PRECISION FOR SCREENING TEST

Number of measurement pairs	Situation B Number of RPD's of absolute value over 15%—all having the same sign—that indicate significant bias of the SLAMS monitor	Situation C Number of RPD's of absolute value over 15%—all not having the same sign—that indicate excessive imprecision of the SLAMS monitor
4	2	3
5	2	3
6	3	4
7	3	4
8	3	4
9	3	5
10	4	5
11	4	5
12	4	6

6.2.4 The basis of this test is as follows:

6.2.4.1 For both instruments, the precision is assumed to be a percentage of the concentration being measured. The distributions of the instruments measurements are assumed to be normal, with an operating precision (1.96 × standard deviation) of no more than 15%. The relative percent difference (RPD) is then approximately normally distributed, with a standard deviation of about 15 × sqrt(2)/1.96 = 10.7%. Thus, the absolute value of RPD will exceed 15% approximately 20% of the time.

6.2.4.2 In the first situation (situation A), all the RPD's are within 15% in absolute value, and the performance is acceptable.

6.2.4.3 When encountering a situation where RPD's are to one extreme or the other (situation B), one can set up the following hypotheses. Null Hypothesis: The mean measurements of both instruments are the same. Alternative Hypothesis: The mean of measurement of the SLAMS instrument is higher (lower) than the mean measurement of the audit instrument. The test of these hypotheses is based on the binomial distribution. Table A–2 gives the number of extreme values, for various numbers of measurement pairs, that would lead to a rejection of the null hypothesis in favor of the alternative hypothesis.

6.2.4.4 When encountering the situation where RPD's are extreme in both directions (situation C), one can set up the following hypotheses. Null Hypothesis: The precisions of both instruments are less than or equal to 15% (2-sigma). Alternative Hypothesis: The precision of at least one instrument exceeds 15%. Again, the test is based on the binomial distribution, and Table A–2 gives the number of extreme values, for various numbers of measurement pairs, that would lead to a rejection of the null hypothesis in favor of the alternative hypothesis.

6.2.4.5 These tests described above are stringent, using p=0.01, meaning that less than 1 time out of 100 would one expect to find the result randomly.

6.2.4.6 As an example, suppose one takes 6 pairs of simultaneous measurements and finds that 4 of the 6 RPD's for the SLAMS monitor are greater than 15% and *none* of the remaining two RPD's are below—15%. Since there are 4 RPD's with absolute value above 15% and they all have the same sign (*i.e.* they are all above 15%), this example would be situation B. Table A–2 indicates that for situation B with 6 measurement pairs, 3 or more extreme RPD's means that the SLAMS monitor is biased (in this case, higher) than the audit (reference) method.

6.3 Integrated Precision and Accuracy for Reporting Organizations and for Specific Methods.

This section describes how integrated estimates of monitoring data quality are calculated for specific monitoring methods (as identified by a unique reference or equivalent method designation number) on a national basis and for each reporting organization. These estimates are based on the collocated audit measurements described in section 6.1.

6.3.1 Annual evaluation. Using the collocated measurement pair data, as described in Section 6.1 for the applicable year, the EPA shall determine the operating precision for each designated method, on a national basis and for each reporting organization, as follows:

6.3.1.1. For each monitoring station for which $PM_{2.5}$ data has been reported to AIRS during the year, calculate the percent difference (d_i) for each measurement pair using equation 1 in section 5.1.1 of this Appendix, where Y_i is the concentration measurement from the SLAMS monitor for the I-th audit measurement pair, X_i is the concentration measurement from the audit sampler. Include only stations at which at least 4 collocated measurement pairs are available for the year, and only measurement pairs in which X_i is above the limit for $PM_{2.5}$ specified in section 5.3.1 of this Appendix.

6.3.1.2 For each monitoring station for which $PM_{2.5}$ data has been reported to AIRS, calculate the average (d_j) and the standard deviation (S_j) for the year for each station at which the method is used for SLAMS monitoring, using equations 2 and 3

(respectively) in section 5.1.1 of this Appendix, where n is the number of measurement pairs reported for the year. Include only stations at which at least 4 collocated measurement pairs are available for the year.

6.3.1.3 For each designated method and for each reporting organization, calculate the average of averages (D) and the pooled estimate of standard deviation (S_a), using equations 4a and 5a (respectively) of Section 5.1.2, where k in this case is the number of stations in the reporting organization at which the method is used for SLAMS monitoring (and at least 4 measurement pairs are reported). Call these estimates $D_{R,M}$ and $S_{R,M,}$ where R identifies the reporting organization and M identifies the designated method.

6.3.1.4 For each designated method, calculate the average of averages (D) and the pooled standard deviation (S_a) at the national level using equations 4a and 5a (respectively) of Section 5.1.2, where k in this case is the number of sites nationwide at which the method is used for SLAMS monitoring (and at least 4 measurement pairs are reported). Call these estimates $D_{national,\ M}$ and $S_{national,\ M,}$ where M identifies the designated method. A 95 percent confidence interval shall also be determined for each national pooled standard deviation.

6.3.1.5 For each designated method, calculate the 95 percent probability limits for each reporting organization, using equations 6 and 7 of Section 5.1.2, where $D=D_{R,M}$ and $S_a=S_{R,M}$. Similarly, calculate the 95 percent probability limits for each method on a national basis, using equations 6 and 7 of Section 5.1.2, where $D=D_{national,M}$ and $S_a=S_{national,M}$.

Note: Pooling individual site estimates of precision across a reporting organization or across the nation using equation 5a assumes that the individual site estimates of precision using equation 3 are reasonably homogeneous across the year for a designated method.

6.3.2 Reporting organization method operational performance. A summary of the results calculated in section 6.3.1.5 shall be reported annually to the appropriate EPA Regional Office. If the absolute value of either the upper or lower probability limit for a reporting organization calculated in section 6.3.1.5 for any designated method is found to be greater than 15 percent or substantially higher than the corresponding limits calculated for the method on the national basis, the reporting organization shall be identified and notified by the EPA that its quality assurance in the operation of the particular $PM_{2.5}$ method may be inadequate. Each reporting organization so identified and notified must demonstrate, through an appropriate quality assurance plan or modified plan, that it will achieve better performance in future monitoring operations using the method. General guidance in identifying and correcting common or typical types of such quality assurance problems for reference methods and Class I equivalent methods is provided in section 2.12 of Reference 7 of this appendix.

6.3.3 National method operational performance. If the absolute value of either the upper or lower probability limit calculated in section 6.3.1.5 for any designated method on a national basis is found to be greater than 15 percent, the method shall be deemed to have failed the annual operational performance assessment test. This result shall constitute a ground for cancellation of the reference or equivalent method in accordance with § 53.11 of this chapter, and the EPA shall take the actions specified in that section within 150 days.

References in Appendix A of Part 58

1. Rhodes, R.C. Guideline on the Meaning and Use of Precision and Accuracy Data Required by 40 CFR part 58 appendices A and B. EPA–600/4–83/023. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, June, 1983.

2. ''American National Standard—Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs.'' ANSI/ASQC E4–1994. January 1995. Available from American Society for Quality Control, 611 East Wisconsin Avenue, Milwaukee, WI 53202.

3. ''EPA Requirements for Quality Management Plans.'' EPA QA/R–2. August 1994. Available from U.S. Environmental Protection Agency, ORD Publications Office, Center for Environmental Research Information (CERI), 26 W. Martin Luther King Drive, Cincinnati, OH 45268.

4. ''EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations.'' EPA QA/R–5. August 1994. Available from U.S. Environmental Protection Agency, ORD Publications Office, Center for Environmental Research Information (CERI), 26 W. Martin Luther King Drive, Cincinnati, OH 45268.

5. ''Guidance for the Data Quality Objectives Process.'' EPA QA/G–4. September 1994. Available from U.S. Environmental Protection Agency, ORD Publications Office, Center for Environmental Research Information (CERI), 26 W. Martin Luther King Drive, Cincinnati, OH 45268.

6. ''Quality Assurance Handbook for Air Pollution Measurement Systems, Volume 1—A Field Guide to Environmental Quality Assurance.'' EPA–600/R–94/038a. April 1994. Available from U.S. Environmental Protection Agency, ORD Publications Office, Center for Environmental Research Information (CERI), 26 W. Martin Luther King Drive, Cincinnati, OH 45268.

7. ''Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II—Ambient Air Specific Methods (Interim Edition).'' EPA–600/R–94/038b. April 1994. Available from U.S. Environmental Protection Agency, ORD Publications Office, Center for Environmental Research Information (CERI), 26 W. Martin Luther King Drive, Cincinnati, OH 45268. [Note: Section 2.12 of Volume II is currently under development and will not be available from the CERI address until it is published as an addition to EPA/600/R–94/038b. Prepublication draft copies of section 2.12 will be available from Department E (MD–77B), U.S. EPA, Research Triangle Park, NC 27711, or from the contact identified at the beginning of this proposed rule].

8. ''List of Designated Reference and Equivalent Methods.'' Available from U.S. Environmental Protection Agency, National Exposure Research Laboratory, Quality Assurance Branch, MD–77B, Research Triangle Park, NC 27711.

9. Technical Assistance Document for Sampling and Analysis of Ozone Precursors. Atmospheric Research and Exposure Assessment Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. EPA 600/8–91–215. October 1991.

10. ''EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards.'' EPA–600/R–93/224. September 1993. Available from U.S. Environmental Protection Agency, ORD Publications Office, Center for Environmental Research Information (CERI), 26 W. Martin Luther King Drive, Cincinnati, OH 45268.

11. Paur, R.J. and F.F. McElroy. Technical Assistance Document for the Calibration of Ambient Ozone Monitors. EPA–600/4–79–057. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, September, 1979.

12. McElroy, F.F. Transfer Standards for the Calibration of Ambient Air Monitoring Analyzers for Ozone. EPA–600/4–79–056. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, September, 1979.

Tables to Appendix A of Part 58

TABLE A–1.—MINIMUM DATA ASSESSMENT REQUIREMENTS

Method	Assessment method	Coverage	Minimum frequency	Parameters reported
Precision:				
Automated methods for SO_2, NO_2, O_3, and CO.	Response check at concentration between .08 and .10 ppm (8 & 10 ppm for CO) [2].	Each analyzer	Once per 2 weeks	Actual concentration [2] and measured concentration [3].

TABLE A–1.—MINIMUM DATA ASSESSMENT REQUIREMENTS—Continued

Method	Assessment method	Coverage	Minimum frequency	Parameters reported
Manual methods: All methods except PM_{25}.	Collocated samplers	1 site for 1–5 sites; 2 sites for 6–20 sites; 3 sites >20 sites; (sites with highest conc.).	Once per week	Two concentration measurements.
PM_{25} methods	Collocated samplers	1 site for 1–10 sites; 2 sites for 11–20 sites; 3 sites >20 sites; (sites with highest conc.).	Once per week	Two concentration measurements.
Accuracy:				
Automated methods for SO_2, NO_2, O_3, and CO.	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).	1. Each analyzer; 2. 25% of analyzers (at least 1).	1. Once per year; 2. Each calendar quarter.	Actual concentration[2] and measured (indicated) concentration[3] for each level.
Manual methods for SO_2, and NO_2.	Check of analytical procedure with audit standard solutions.	Analytical system	Each day samples are analyzed, at least twice per quarter.	Actual concentration and measured (indicated) concentration for each audit solution.
TSP, PM_{10}	Check of sampler flow rate	1. Each sampler; 2. 25% of samplers (at least 1).	1. Once per year; 2. Each calendar quarter.	Actual flow rate and flow rate indicated by the sampler.
PM_{25}	1. Check of sampler flow rate.	1. Each sampler, all locations.	1. Minimum of every calendar quarter, 4 checks per year.	1. Actual flow rate and flow rate indicated by sampler.
	2. Audit with reference method.	2. Each sampler, all locations.	2. Minimum of every other month, 6 measurements per year.	2. Particle mass concentration indicated by sampler and by audit reference sampler.
Lead	1. Check of sampler flow rate as TSP;.	1. Each sampler	1. Include with TSP	1. Same as for TSP.
	2. Check of analytical system with Pb audit strips.	2. Analytical system	2. Each quarter	2. Actual concentration and measured (indicated) concentration of audit samples (µg Pb/strip).

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

Appendix C—[Amended]

15. Appendix C, is amended by revising section 2.2 and adding sections 2.2.1 through 2.2.2.2 to read as follows:

2.2 Substitute PM samplers.

2.2.1 Substitute PM_{10} samplers.

2.2.1.1 For purposes of showing compliance with the NAAQS for particulate matter, a high volume TSP sampler described in Appendix B of part 50 of this chapter 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.

2.2.1.2 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 a 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 six days regardless of the PM_{10} sampling frequency.

2.2.2 Substitute $PM_{2.5}$ samplers.

2.2.2.1 For purposes of showing compliance with the NAAQS for particulate matter, a PM_{10} monitor designated as a reference or equivalent method for PM_{10} under part 53 of this chapter may be used in a SLAMS in lieu of a $PM_{2.5}$ monitor as long as the ambient concentration of particles measured by the PM_{10} monitor is below the $PM_{2.5}$ NAAQS. If the PM_{10} monitor measures a single value that is higher than the $PM_{2.5}$ 24-hour standard, or the annual average of its measurements is greater than the $PM_{2.5}$ annual standard, the PM_{10} monitor operating as a substitute $PM_{2.5}$ monitor must be replaced with a $PM_{2.5}$ monitor. For a PM_{10} measurement above the 24-hour $PM_{2.5}$ standard, the PM_{10} monitor should be replaced with a $PM_{2.5}$ monitor before the end of the calendar quarter following the quarter in which the high concentration occurred. For a PM_{10} annual average above the annual $PM_{2.5}$ standard, the $PM_{2.5}$ monitor should be operating by June 30 of the year following the exceedance.

2.2.2.2 In order to maintain historical continuity of ambient particulate matter trends and patterns for $PM_{2.5}$ NAMS that were previously PM_{10} NAMS, the PM_{10} monitor must be operated concurrently with the $PM_{2.5}$ monitor for a one-year period beginning with the $PM_{2.5}$ NAMS start-up date. The operating schedule for the PM_{10} monitor must be at least once every six days regardless of the $PM_{2.5}$ sampling frequency.

16. Appendix C amended by adding a new sections 2.4 through 2.4.6 to read as follows:

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 40 CFR 53.34 shall be modified 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.

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 R_j above 40 $\mu g/m^3$ for 24-hour samples or above 30 $\mu g/m^3$ for 48-hour samples.

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 6 of Appendix A of this section 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 2.4 must meet the general submittal requirements of sections 2.7.1 and 2.7.2.1 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 particulate 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 required above.

2.4.5.7 Such 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 will approve or disapprove the method by letter to the person or agency requesting such approval.

17. Appendix C is amended by adding a new section 2.5 to read as follows:

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 its approval for use under § 58.13(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.

18. Appendix C is amended by revising the section 2.7.1 to read as follows:

2.7.1 Requests for approval under sections 2.4, 2.6.2, or 2.8 must be submitted to: Director, National Exposure Assessment Laboratory, Department E, (MD–77B), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

19. Appendix C is amended by adding a new section 2.9 to read as follows:

2.9 Use of IMPROVE Samplers at a SLAMS. ''IMPROVE'' samplers may be used in SLAMS for monitoring of regional background 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 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 5.2, 5.3, and 5.4 of this Appendix).

20. Appendix C, section 6.0 amended by adding references, 4 through 6 to read as follows:

6.0 References

* * * * *

4. Eldred, R.A., Cahill, T.A., Wilkenson, L.K., et al., ''Measurements of fine particles and their chemical components in the IMPROVE/NPS networks,'' in ''Transactions of the International Specialty Conference on Visibility and Fine Particles,'' Air and Waste Management Association: Pittsburgh, PA, 1990; pp 187–196.

5. Sisler, J.F., Huffman, D., and Latimer, D.A.; ''Spatial and temporal patterns and the chemical composition of the haze in the United States: An analysis of data from the IMPROVE network, 1988–1991,'' ISSN No. 0737–5253–26, National Park Service, Ft. Collins, CO, 1993.

6. Eldred, R.A., Cahill, T.A., Pitchford, M., and Malm, W.C.; ''IMPROVE—a new remote area particulate monitoring system for visibility studies,'' Proceedings of the 81st Annual Meeting of the Air Pollution Control Association, Dallas, Paper 88–54.3, 1988.

Appendix D—[Amended]

21. In Appendix D the first three paragraphs and Table 1 of section 1 are revised as follows:

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 $PM_{2.5}$. These criteria will also be used by EPA in evaluating the adequacy of the SLAMS/NAMS/PAMS and core $PM_{2.5}$ networks.

The network of stations which 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 impact on ambient pollution levels of significant sources or source categories;

(4) To determine general background concentration levels;

(5) To determine the extent of Regional pollutant transport among populated areas; and in support of secondary standards; and

(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 that a minimum number of lead SLAMS and $PM_{2.5}$ are prescribed and the minimal network introduced in 58.20 is explained. The optimum size of a particular SLAMS network involves trade offs among data needs and available resources which EPA believes can best be resolved during the network design process.

* * * * *

TABLE 1.—RELATIONSHIP AMONG MONITORING OBJECTIVES AND SCALE OF REPRESENTATIVENESS

Monitoring objective	Appropriate siting scales
Highest concentration	Micro, Middle, neighborhood (sometimes urban[a]). Neighborhood, urban.
Population	Micro, middle, neighborhood.
Source impact	Neighborhood, urban, regional.
General/background	Urban/regional.
Regional transport	
Welfare-related impacts.	Urban/regional.

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

* * * * *

22. In Appendix D, section 2 is amended by revising the second paragraph and adding a new paragraph to the end of the section before section 2.1 to read as follows:

2. SLAMS Network Design Procedures

* * * * *

The discussion of scales in sections 2.3 through 2.8 does not include all of the possible scales for each pollutant. The scales which are discussed are those which are felt to be most pertinent for SLAMS network design.

* * * * *

Information such as emissions density, housing density, climatological data, geographic 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 $PM_{2.5}$ or carbon monoxide SLAMS, and for defining the boundaries of $PM_{2.5}$ spatial averaging zone, air pollution control agencies will benefit from using such studies to evaluate the spatial distribution of pollutants.

* * * * *

23. Section 2.8 is revised as follows:

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 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 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 potentially 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 reference 17 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 middle and neighborhood scales. For purposes of establishing monitoring stations to represent large homogenous areas other than the above scales of representativeness and to characterize Regional transport, urban or regional scale stations would also be needed.

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 concentrations from mobile sources. 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 particulate matter is on this scale and on the neighborhood scale; core SLAMS especially should represent community-wide air pollution. 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 public health effects of particulate matter pollution. 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 PM_{10}, 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 $PM_{2.5}$ 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. 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.

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 $PM_{2.5}$, 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.

24. New sections 2.8.1, 2.8.2, 2.8.3, and 2.8.4 are added after Section 2.8 to read as follows:

2.8.1 Monitoring Planning Areas and Spatial Averaging Zones

2.8.1.1 Monitoring planning areas (MPA's) and spatial averaging zones (SAZ's) shall be used to conform to the population-oriented, spatial averaging approach used for the $PM_{2.5}$ NAAQS given in 40 CFR Part 50. MPA's are required to include all metropolitan statistical areas (MSA's) with population greater than 500,000, and all other areas determined to be in violation of the $PM_{2.5}$ NAAQS.[1] Although not required, MPA's should generally be designated to also include all MSA's with population greater than 250,000 which have measured or modeled $PM_{2.5}$ concentrations greater than 80 percent of the $PM_{2.5}$ NAAQS. Monitoring planning areas for other designated parts of the State are optional.

2.8.1.2 The SAZs shall define the area within which monitoring data will be averaged for comparison with the annual $PM_{2.5}$ NAAQS. This approach is directly related to epidemiological studies used as the basis for the $PM_{2.5}$ NAAQS. A SAZ should characterize an area of relatively similar annual average air quality (e.g., the annual average concentrations at individual sites should 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 0.8). Moreover, the entire SAZ should principally be affected by the same major emission sources of particulate matter.

2.8.1.3 Each monitoring planning area shall have at least one spatial averaging zone, which may or may not cover the entire MPA. In metropolitan statistical areas (MSA's) for which MPA's are required, the SAZ's shall completely cover the entire MSA. Exceptions to the requirement are allowed (say for areas with low population density) provided that it receives approval from the appropriate EPA Regional Administrator. In MPA's for other areas, the SAZ's are not required to completely cover the entire MPA. All MPA's and SAZ's shall be defined on the basis of existing, delineated mapping data limited to State boundaries, county boundaries, zip codes, census blocks, or census block groups; however, SAZ's shall not overlap in their geographical coverage.

2.8.1.4 Spatial averaging zones should generally include a minimum of 250,000 and not more than two million population, but all areas in the ambient air may become a spatial averaging zone. The SAZ should emphasize population that spends a substantial portion of time within the zone to reflect exposure from multiple spatial locations, but does not need to account for all day-night population shifts. Consequently, large MSA's with population greater than one million should be subdivided into smaller portions, such as counties, to better reflect the variability in exposure to the average population for large numbers of people.

2.8.1.5 A SAZ can be represented by a single monitoring location, but in most cases multiple locations will be needed. For example, a single monitor may not be adequate to characterize the average air quality in a large geographic area; in large areas of relatively low population or population density, population centers and monitoring sites may be geographically disjoint. In such cases, the spatial representativeness of the monitoring site should be considered in defining the SAZ boundaries. Until more monitoring stations are established, the monitored air quality in areas outside of SAZ's is unknown. Accordingly, a station that is established in the ambient air outside the boundaries of a SAZ but that is in or near a populated area, meets siting criteria, and produces quality-assured data (i.e., meets the requirements of Part 58, 58.13, and Appendices A, C, and E) can also be presumed to produce data that is eligible for comparison to both the 24-hour and annual NAAQS for $PM_{2.5}$ and to represent some zone. At the discretion of the responsible air pollution control agency, such a zone should be defined as a SAZ during the annual network review. In this way, the network coverage of the population can be gradually improved.

2.8.2 $PM_{2.5}$ Monitoring Sites within the State PM Monitoring Plan

2.8.2.0.1 The minimum required number and type of monitoring sites and sampling requirements for $PM_{2.5}$ are based on monitoring planning areas and spatial averaging zones for each MPA, which must be included in a monitoring plan and proposed by the States in accordance with § 58.20.

2.8.2.0.2 As stated in § 58.15, comparisons to the $PM_{2.5}$ NAAQS may be based on data from SPMs in addition to SLAMS (including NAMS, core SLAMS and collocated $PM_{2.5}$ sites at PAMS), which meet the requirements of part 58, 58.13, and appendices A, C and E, which are population-oriented and which are included in the monitoring plan. Figure 1 of this Appendix shows a conceptual (Venn) diagram illustrating which $PM_{2.5}$ sites in an MPA and SAZ are eligible for comparison with the $PM_{2.5}$ NAAQS. Special purpose monitors which meet part 58 requirements will be exempt from NAAQS comparisons with the $PM_{2.5}$ NAAQS for 3 years following promulgation of the $PM_{2.5}$ NAAQS to encourage $PM_{2.5}$ monitoring initially. After this time, however, any SPM which 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 SPM's are not established as a SLAMS the agency must document in its annual report, the technical basis for excluding it as a SLAMS.

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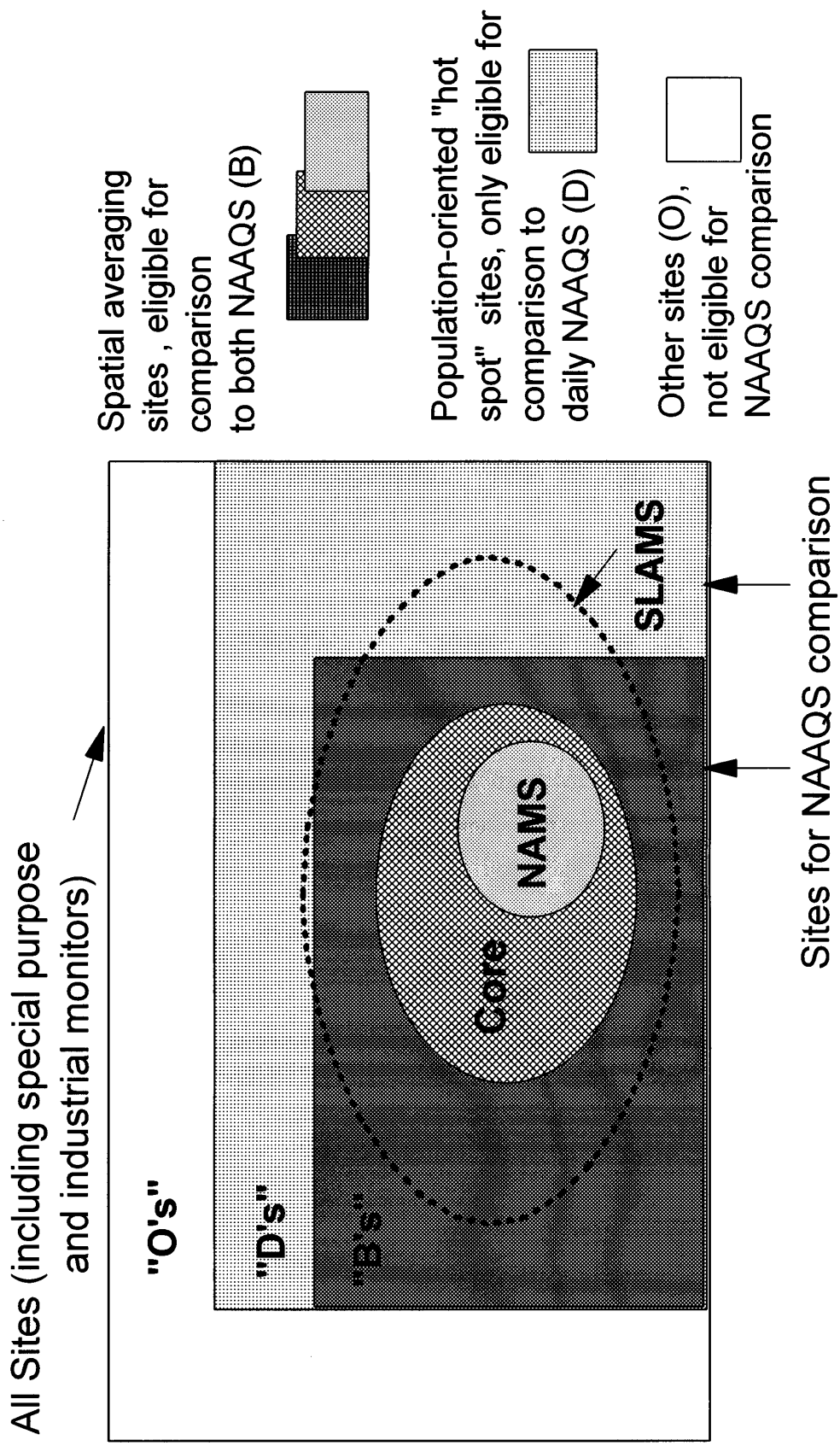
[1] The boundaries of MPA's do not have to necessarily correspond to those of MSA's and existing intra or interstate air pollution planning districts may be utilized.

Figure 1. *Sites in a Spatial Averaging Zone Eligible for Comparison to PM-2.5 NAAQS (Conceptual Venn Diagram)*



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2.8.2.0.3 Figure 1 is intended to show the relationship between NAAQS eligible sites to the entire monitoring network. Sites eligible for comparison to both standards and only the daily (i.e, 24-hour) standard are shown. The diagram applies to all the sites in a Monitoring Planning Area including special purpose, industrial as well as the NAMS/SLAMS/Core networks. The sub-areas shown do not necessarily represent contiguous geographic regions.

2.8.2.0.4 All sites eligible for $PM_{2.5}$ NAAQS comparisons would be designated ''B'' or ''D'', and all other sites would be designated ''O.'' Sites ''B'' and ''D'' must be NAMS/SLAMS or other population-oriented sites, be included in the State's Monitoring Plan and meet requirements of Part 58 .13 and Appendices A, C and E. The codes ''B,'' ''D'' and ''O'' would become new pollutant specific codes on the AIRS monitoring site file to identify PM–2.5 sites eligible for NAAQS comparisons. The codes could distinguish between State submitted codes and those receiving EPA Regional Office approval (as currently done with Exceptional Event data codes). This will reflect EPA review and approval of the site information presented in the State's annual Monitoring Plan.

2.8.2.0.5 Within each MPA and SAZ, 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.

2.8.2.1 Core Monitoring Stations for $PM_{2.5}$

Core monitoring stations or sites are a subset of the SLAMS network for $PM_{2.5}$ for which more frequent (daily) sampling of $PM_{2.5}$ is required. These core sites fall into three categories:

Population-oriented SLAMS monitors, background and transport sites, and sites to be collocated at PAMS.

2.8.2.1.2 Within each monitoring planning area, the responsible air pollution control agency shall install:

(a) At least two population-oriented core stations for $PM_{2.5}$, unless exempted by the Regional Administrator, including at least one station in a population oriented area of expected maximum concentration; (b) At least one station in an area of poor air quality and representative of maximum population impact and (c) At least one additional core monitor collocated at a PAMS site if the MPA is also a PAMS area.[2]

2.8.2.1.3 The site situated in the area of expected maximum concentration is analogous to NAMS ''category a.''[3] This will henceforth be termed a category a core SLAMS site. The site located in the area of poor air quality with high population density or representative of maximum population impact is analogous to NAMS, ''category b.''[4] This second site will be called a category b core SLAMS site.

2.8.1.1.4 Those MPA's which are substantially impacted by several different and geographically disjoint local sources of fine particles should have separate core sites to monitor each influencing source region.

2.8.2.1.5 Each spatial averaging zone in a required MPA shall have at least one core monitor; the SAZ for an optional MPA should have at least one core monitor; and there should be one core site for each SAZ with four or more SLAMS. Rural MPA's and areas with disperse towns and small cities may have a single core station per MPA but may have additional $PM_{2.5}$ stations of other categories.

2.8.2.1.6 The State shall also install at least one core SLAMS to monitor for regional background and at least one core SLAMS to monitor regional transport. These core monitoring stations may be population oriented and their requirement may be satisfied by a corresponding core monitoring in a representative area having similar air quality in another State.

2.8.2.1.7 Within each monitoring planning area, one core monitor 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 population-oriented core monitor for $PM_{2.5}$ may be included in a MPA/SAZ, however, a ''type b'' core site is strongly preferred to determine representative $PM_{2.5}$ concentrations in areas of high population density.

2.8.2.1.8 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 MPA's and SAZs is discussed further in section 2.8.3 of this appendix.

2.8.2.2. Other $PM_{2.5}$ SLAMS locations

In addition to the required core sites described in section 2.8.2.1 of this appendix, the State shall also be required to establish a minimum number of additional SLAMS. The number of stations shall be based on the total population outside the monitoring planning areas which contain population-oriented core SLAMS. There shall be one such additional SLAMS for each 250,000 people. This number of monitors are in addition to the core SLAMS required for monitoring planning areas. This may be satisfied, in part, by the regional background and regional transport core SLAMS if the latter sites are population-oriented. The minimum number of SLAMS may be developed anywhere in the State to satisfy the SLAMS monitoring objectives described in Section 1 of this appendix. Other SLAMS may also be established and are encouraged in a State $PM_{2.5}$ network.

2.8.2.3 Continuous fine particle monitoring at Core SLAMS

At least one continuous fine particle analyzer (e.g., beta attenuation analyzer; tapered-element, oscillating microbalance (TEOM); transimissometer; nephelometer; or other acceptable continuous fine particle monitor) shall be located at a core monitoring $PM_{2.5}$ site in each metropolitan area with a population greater than 1 million. The analyzer shall preferably sample the ambient air of the same spatial averaging zone as a category (b) core SLAMS. These analyzers shall be used to provide improved temporal resolution to better understand the processes and causes of elevated $PM_{2.5}$ concentrations and to facilitate public reporting of $PM_{2.5}$ air quality. The methodology and QA/QC requirements will be provided in supplementary EPA guidance.

2.8.2.4 Additional $PM_{2.5}$ Analysis Requirements

Air pollution control agencies shall archive $PM_{2.5}$ filters from all SLAMS sites for a minimum of one year after collection. All $PM_{2.5}$ filters from core NAMS sites shall be archived for a minimum of 5 years. These filters shall be made available for supplemental analyses at the request of EPA or to provide information to State and local agencies on the composition and trends for $PM_{2.5}$. The filters shall be archived in accordance with EPA guidance.

2.8.3 Selection of Monitoring locations within SAZs and MPA's

2.8.3.1 Figure 2 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 3 of this appendix shows the same hypothetical MPA as Figure 2 of this appendix and illustrates potential spatial averaging zones and the location of core monitoring sites within them. Figure 4 of this appendix illustrates which sites within the SAZs of the same MPA may be used for comparison to the $PM_{2.5}$ NAAQS.

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[2] The core monitor to be collocated 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

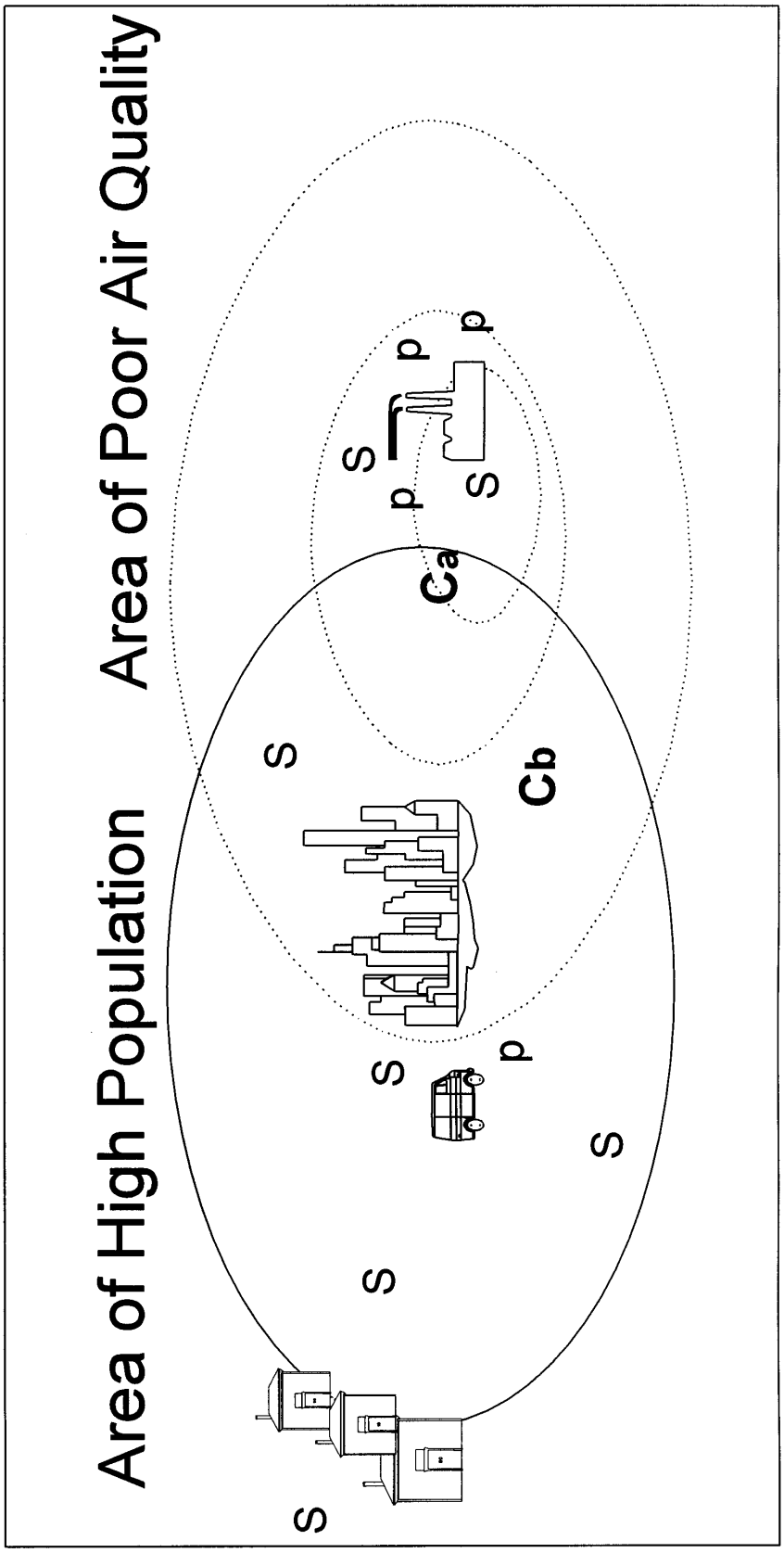
[3] The measured maximum concentrations at core population-oriented sites should be consistent with the averaging time of the NAAQS. Therefore, sites only with high concentrations for shorter averaging times (say 1-hour) should not be core SLAMS monitors and may in fact be more appropriately designated special purpose monitors.

[4] Population-oriented sites are representative of residential, recreational and business locations where people are present for a substantial portion of the NAAQS averaging time period or locations indicative of ambient air to which the population can be expected to be exposed.

Figure 2. Hypothetical Monitoring Planning Area

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

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



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2.8.3.2 In Figure 2 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. Each monitoring planning area is required to have at least two core population-oriented monitors (with PAMS areas requiring three) and may have as many 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. ''Ca'' denotes ''category a'' core SLAMS site (populated-oriented site in area of expected maximum concentration); shown within the populated area and closest to the area with highest concentration. '' Cb'' 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. ''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). Finally, '' p'' denotes a Special Purpose Monitor (a specialized monitor which may use a non-reference sampler).

2.8.3.3 A Monitoring Planning Area would have one or more Spatial Averaging Zones (SAZ) for aggregation of data for comparison to the annual NAAQS. The planning area has large gradients of average air quality and, as shown in Figure 3 is assigned 3 SAZs: 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 necessary). If a required Monitoring Planning Area has multiple SAZ's, then each SAZ must have at least one core location. Therefore, in this example with 3 SAZ's, the MPA must have at least one additional core site (i.e. one SLAMS in the downtown CBD must be a core site).

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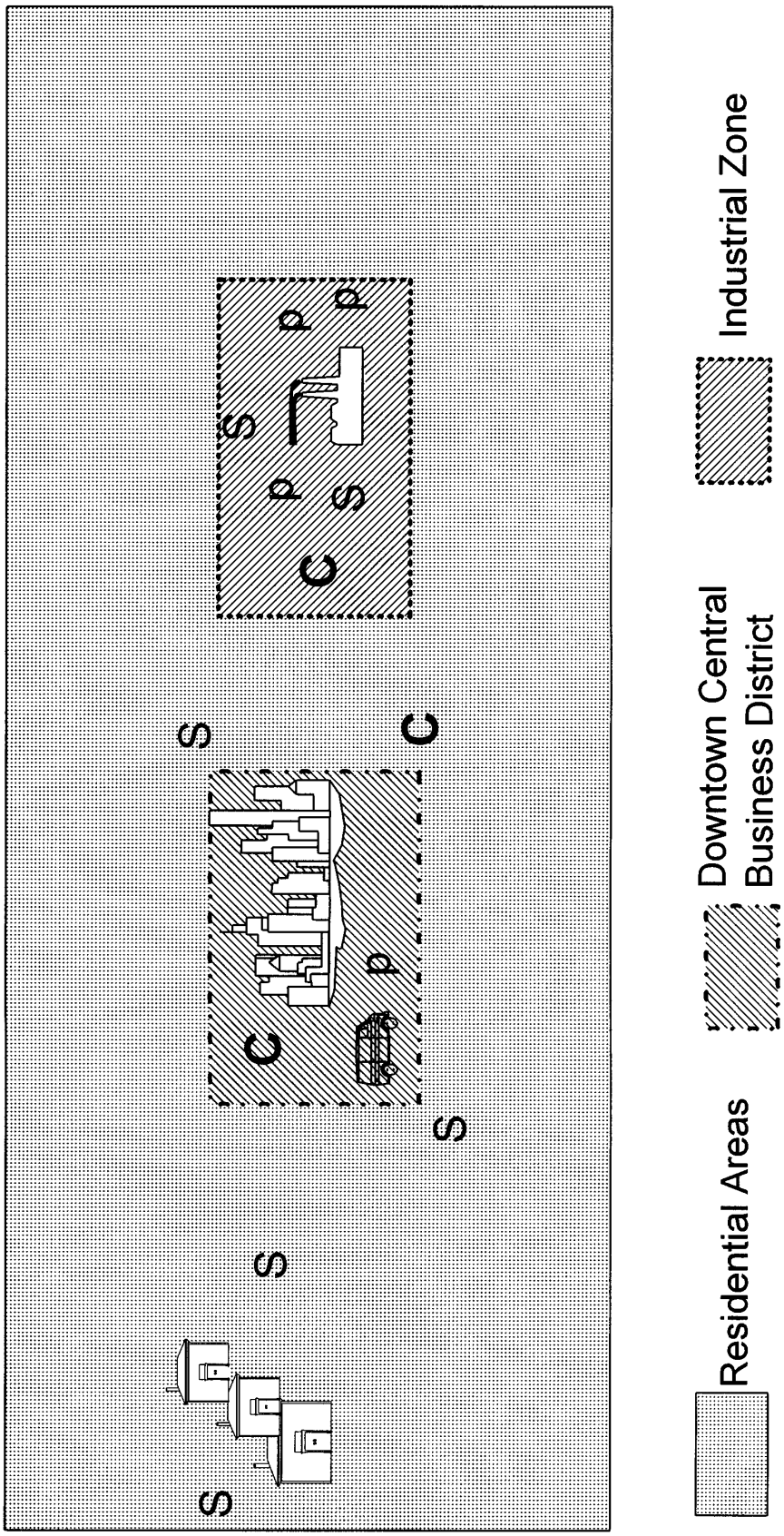
Figure 3. Hypothetical Monitoring Planning Area

Potential Spatial Averaging Zones

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



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2.8.3.4 The Figure 4 of this appendix diagram shows the designation of monitoring sites according to the eligible NAAQS with which comparisons are permitted. Note that site type ''B'' can be core, SLAMS or SPMs. D's may be SLAMS or SPMs. Within the residential zone, all monitors shown represent areawide air quality and can be averaged for comparison to the annual $PM_{-2.5}$ NAAQS and also be used for comparison to the daily $PM_{-2.5}$ standard. In the downtown CBD, one site is a local ''hot spot,'' used for comparison to the daily NAAQS only. The other site is typical of the CBD and can by itself represent this zone for comparison to the annual NAAQS. In this example area, the State might need to further subdivide the CBD into additional sub-zones: if concentration gradients are large or are associated with large areas/populations (e.g. Madison Avenue NYC with diesel buses). Then one or more sites in each sub-zone would be averaged and be eligible for comparison to the annual NAAQS. In the industrial zone shown, three sites shown are averaged for comparison to the annual NAAQS and are also used individually for comparison to the daily NAAQS. One site is additionally used for comparison to the daily standard and the remaining two special study sites shown either do not satisfy Part 58 requirements or are not in the Monitoring Plan and therefore are not eligible for comparison to either $PM_{2.5}$ NAAQS. One of the sites identified as ''B'' was a SPM. Finally note that all SPM's would be subject to the 3-year moratorium against data comparison to the NAAQS.

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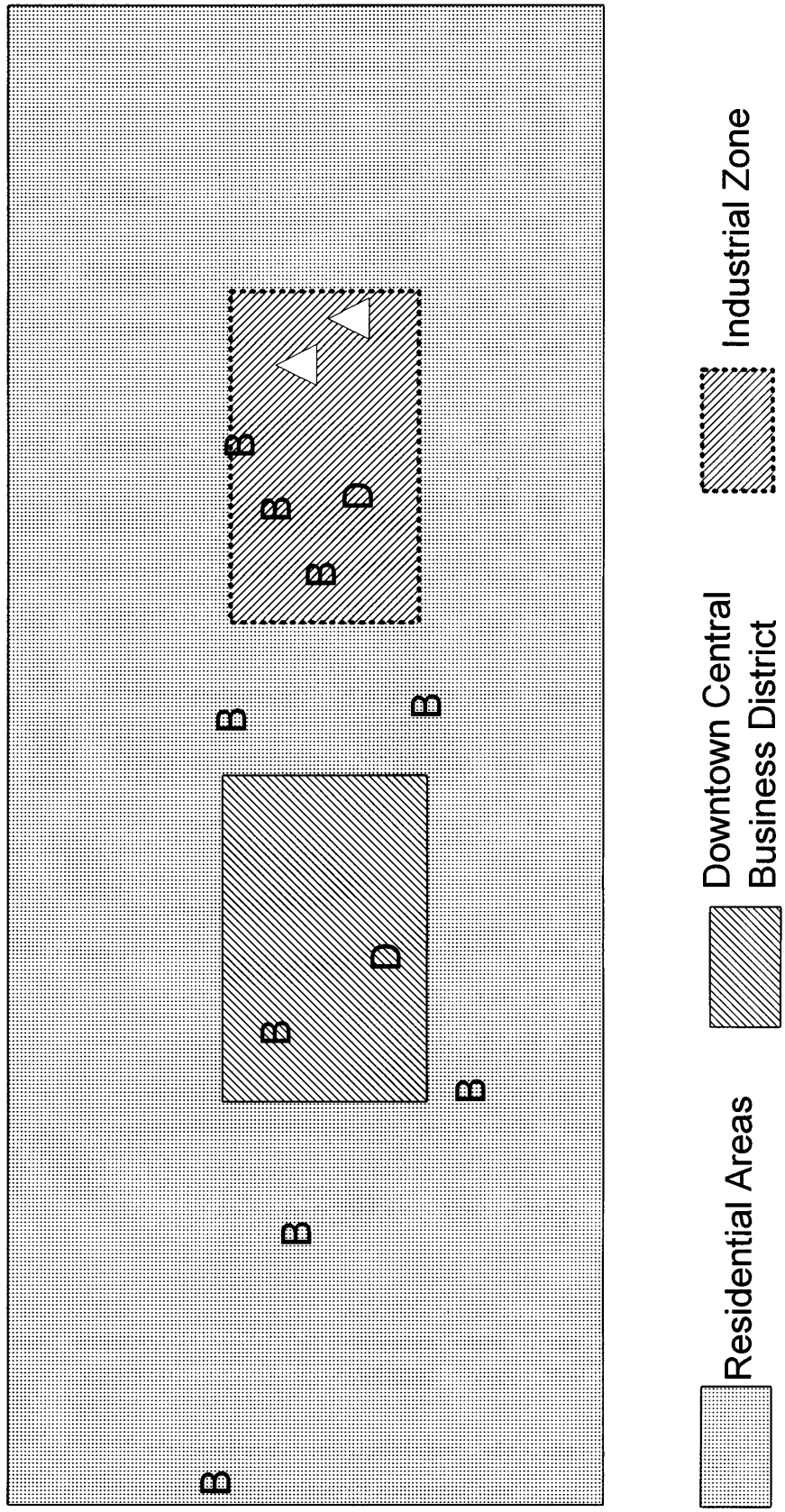
Figure 4. Hypothetical Monitoring Planning Area

Designated Sites for Comparison to the PM-2.5 NAAQS

B =Population oriented sites eligible for comparison to both annual and 24-hr NAAQS

D = Population-oriented sites only eligible for comparison to 24-hr (daily) NAAQS

△ = Other special study sites



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2.8.3.5 Figure 5 of this appendix illustrates how potential SAZs and $PM_{2.5}$ monitors might be located in a hypothetical MPA typical of a Western State. Figure 6 of this appendix shows how the MPA's, SAZs, and $PM_{2.5}$ monitors might be distributed within a hypothetical 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 spatial averaging areas. Figure 5 of this appendix illustrates a monitoring planning area for a hypothetical western State in which ''B's'' and ''D's'' represent the sites which are eligible for comparison the both NAAQS or the daily NAAQS only. Triangles are other special study sites. Spatial averaging zones are shown by shaded areas. 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 MPA's and SAZ's may not cover the entire State. NAAQS are indicated by ''X.'' The appropriate monitors within an SAZ would be averaged for comparison to the annual NAAQS and examined individually for comparison to the daily NAAQS. Other monitors are only eligible for comparison to the daily NAAQS. Both within the MPA's and in the remainder of the State, some special study monitors might not satisfy applicable part 58 requirements or will not be included in the State Monitoring Plan and will not be eligible for comparison to the NAAQS. The latter may include SLAMS monitors designated to study regional transport or to support secondary NAAQS in unpopulated areas.

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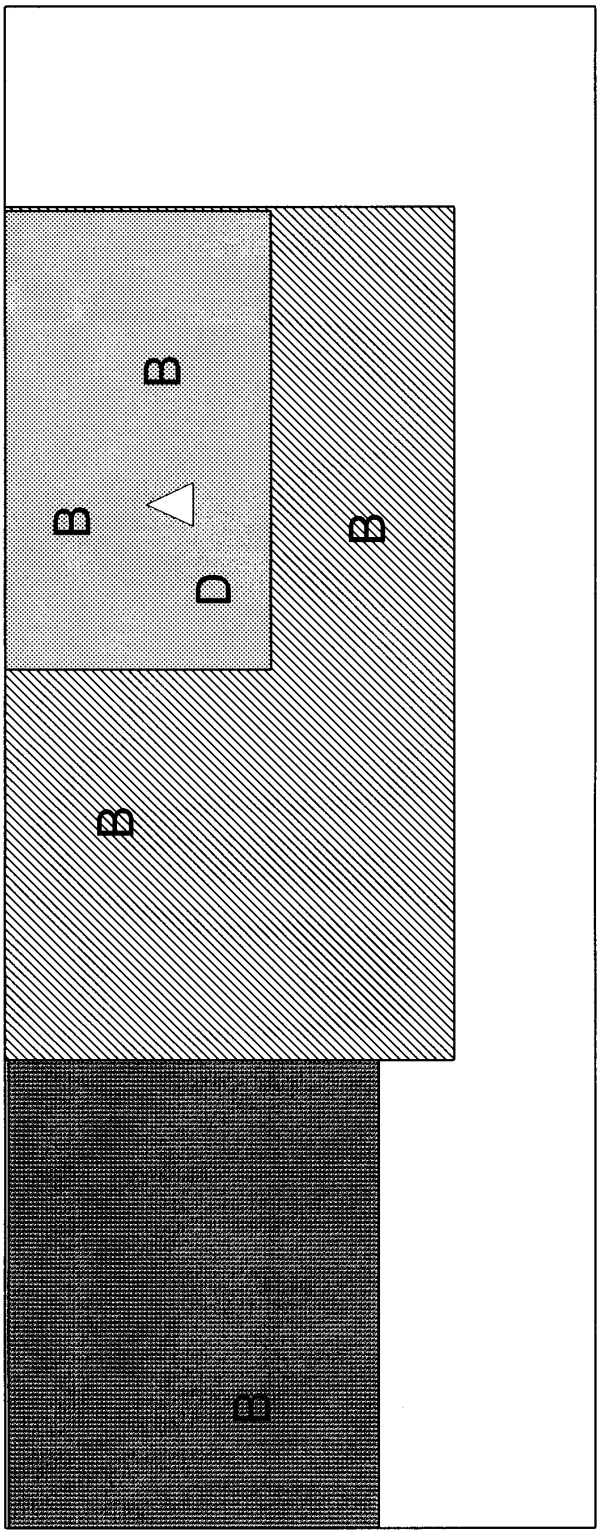
Figure 5. Hypothetical Monitoring Planning Area

Potential Spatial Averaging Zones in Western MPA

B =Population oriented sites eligible for comparison to both annual and 24-hr NAAQS

D = Population-oriented sites only eligible for comparison to 24-hr (daily) NAAQS

△ = Other special study sites



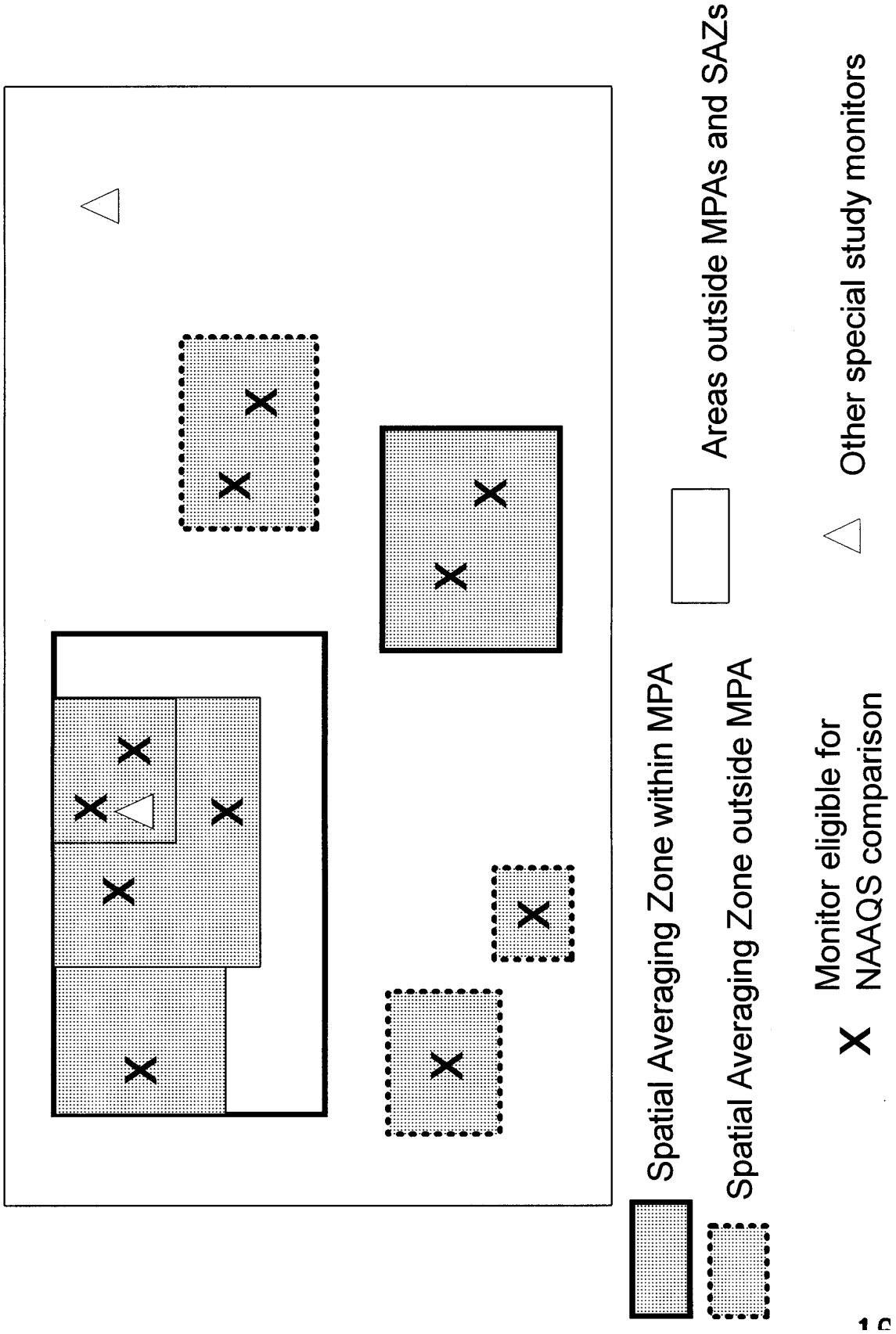
Industrial Zone

Area Source Impact ResidentialArea

Wood Smoke Impact Residential Area

Area not covered by monitoring and not included in a Spatial Averaging Zone

Figure 6. MPAs and SAZs in Hypothetical State



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2.8.4 Substitute PM Monitoring Sites

2.8.4.1 Appendix C (section 2.2) to part 58 describes conditions under which $PMPM_{10}$ samplers may be used as substitutes for $PM_{2.5}$ samplers and when such PM10 samplers must be replaced with $PM_{2.5}$ samplers. Analogous rules are described for TSP samples which can be used as substitutes for PM_{10}. This provision is intended to be used when PM concentrations are low and substitute samplers can be used to satisfy the minimum number of PM samplers needed for an adequate PM network. This may be most appropriate when sufficient resources to purchase new PM samplers may not exist and existing samplers can be temporarily used to serve a new PM network.

2.4.4.2 Monitoring sites at which PM_{10} samplers are intended to be used as substitute $PM_{2.5}$ samplers must be identified in the PM monitoring plan. In order for a PM_{10} sampler to be used as a substitute for $PM_{2.5}$, the existing PM_{10} samplers must meet the quality assurance requirements of appendix A of this part, the siting requirements of appendix E of this part, and are located in areas of suspected maximum concentrations as described in section 3 of this appendix, and if the PM_{10} levels are below the ambient $PM_{2.5}$ standards, analogous language applies to substitute TSP samplers for PM_{10}. Moreover, if existing TSP sites satisfy these criteria, the TSP samplers may continue to be used as substitutes for PM_{10} SLAMS samplers under the provisions of section 2.2 of Appendix C of this part.

2.4.4.3 If data produced by substitute PM samplers exceed the concentration levels described in Appendix C of this part, then this sampler shall be converted to a PM_{10} or $PM_{2.5}$ sampler, whichever is indicated. If the State does not believe that a PM_{10} or $PM_{2.5}$ sampler should alternatively be sited in a different location, 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 plan, then high concentrations at this site would not necessarily cause this site to become a PM_{10} site.

2.4.4.4 Consistent with § 58.1, combinations of SLAMS PM_{10} or $PM_{2.5}$ monitors and other monitors may occupy the same structure without any mutual effect on the regulatory definition of the monitors.

25. Section 3 is amended by revising the third and fifth paragraphs to read as follows:

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

* * * * *

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 $PM_{2.5}$, neighborhood scale for SO_2, and NO_2, and urban scale for O_3.

* * * * *

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. In the case of $PM_{2.5}$, category (b) is strongly. The analysis and interpretation of data from NAMS should consider the distinction between these types of stations as appropriate.

* * * * *

26. Section 3.7 is revised and section 3.7.1 through 3.7.6.4 are added to read as follows:

3.7 Particulate Matter Design Criteria for NAMS

3.7.1 Table 4 indicates the approximate number of permanent stations required in MSA's 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.

3.7.2 Through promulgation of the NAAQS for $PM_{2.5}$, the number of PM_{10} SLAMS is expected to decrease, but requirements to maintain PM_{10} NAMS remain in effect. The PM_{10} NAMS are retained to provide trends data, to support national assessments and decisions, and in some cases to continue demonstration that a NAAQS for PM_{10} is maintained as a requirement under a State Implementation Plan.

3.7.3 The $PM_{2.5}$ NAMS shall be a subset of the core SLAMS network. The $PM_{2.5}$ NAMS are planned as long-term monitoring stations concentrated in metropolitan areas. A target range of 200 to 300 stations shall be designated nationwide. The largest metropolitan areas (those with a population greater than approximately one million) shall have at least two $PM_{2.5}$ NAMS stations.

3.7.4 The number of total $PM_{2.5}$ NAMS per Region will be based on recommendations of the EPA Regional Offices, in concert with their State and local agencies, in accordance with the network design goals described in sections 3.7.5 and 3.7.6 of this Appendix. The selected stations should represent the range of conditions occurring in the Regions 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 is intended 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 national network with respect to geographic area and population. Table 5 presents the target number of 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 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 MSA's greater than 500,000 population. In certain urban areas particulate emissions from motor vehicle diesel exhaust currently is or is expected to be 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 Sec. 58.32. The Administrator's approval is necessary to insure 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]

Population category	High concentration (b)	Medium concentration (c)	Low concentration (d)
>1,000,000	6–10	4–8	2–4
500,000–1,000,000	4–8	2–4	1–2
250,000–500,000	3–4	1–2	0–1
100,000–250,000	1–2	0–1	0

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

3.7.6.2 High concentration areas are those for which: Ambient PM_{10} data show ambient

concentrations exceeding either PM_{10} NAAQS by 20 percent or more.

3.7.6.3 Medium concentration areas are those for which: Ambient PM_{10} data show ambient concentrations exceeding either 80 percent of the PM_{10} NAAQS.

3.7.6.4 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

EPA region	Number of NAMS [1]	Percent of national total
1	15 to 20	6 to 8.
2	20 to 30	8 to 12.
3	20 to 25	8 to 10.
4	35 to 50	14 to 20.
5	35 to 50	14 to 20.
6	25 to 35	10 to 14.
7	10 to 15	4 to 6.
8	10 to 15	4 to 6.
9	25 to 40	10 to 16.
10	10 to 15	4 to 6.
Total	205–295	100.

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

27. Section 4.2 is amended by redesignating Figures 1 and 2 as Figures 7 and 8.

28. Section 5 is revised to read as follows:

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 6.—SUMMARY OF SPATIAL SCALES FOR SLAMS AND REQUIRED SCALES FOR NAMS

Spatial scale	SO_2	CO	O_3	NO_2	Pb	PM_{10}	$PM_{2.5}$
Scales applicable for SLAMS							
Micro		✔			✔	✔	✔
Middle	✔	✔	✔	✔	✔	✔	✔
Neighborhood	✔	✔	✔	✔	✔	✔	✔
Urban	✔		✔	✔	✔	✔	✔
Regional	✔		✔		✔	✔	✔
Scales required for NAMS							
Micro		✔			✔	✔	[1] ✔
Middle					✔	✔	✔
Neighborhood	✔	✔	✔	✔	✔	✔	✔
Urban			✔	✔			[2] ✔
Regional							[2] ✔

[1] Only permitted if representative of many such micro-scale environments.
[2] Either urban or regional scale for regional transport sites.

28. Section 6 is amended by revising reference 18 to read as follows:

6. References

* * * * *

18. Network Design and Siting Criteria for $PM_{2.5}$ prepared for U.S. Environmental Protection Agency, Research Triangle Park, NC. In preparation.

29. Appendix E is amended by revising the heading of section 8, adding a sentence to the last paragraph of section 8.1 to read as follows, and in section 8.3 removing the term PM_{10} and adding in its place ''PM.''

Appendix E—Probe and Open Path Siting Criteria for Ambient Air Quality Monitoring

* * * * *

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

8.1 Vertical Placement

* * * Although microscale stations are not the preferred spatial scale for $PM_{2.5}$ sites, there are situations where microscale sites representative of several locations within an area where large segments of the population may live or work (*e.g.*, mid-town Manhattan in New York City). In these cases, the sampler inlet for such microscale $PM_{2.5}$ stations must also be 2–7 meters above ground level.

Appendix F—[Amended]

30. Appendix F is amended by redesignating section 2.7.3 as section 2.7.4 and adding a new section 2.7.3 to read as follows:

2.7.3 Annual Summary Statistics. Annual arithmetic mean (μg/m³) as specified in appendix K of 40 CFR part 50. All daily PM-fine values above the level of the 24-hour PM-fine NAAQS and dates of occurrence. Sampling schedule used such as once every 6 days, everyday, etc. Number of 24-hour average concentrations in ranges:

Range	Number of values
0 to 15 (μg/m³)	
16 to 30	
31 to 50	
51 to 70	
71 to 90	
91 to 110	
Greater than 110	

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