ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 50

[AD-FRL 2491-5]

Proposed Revisions to the National Ambient Air Quality Standards for Particulate Matter

AGENCY: Environmental Protection Agency.

ACTION: Proposed rule.

SUMMARY: In accordance with sections 108 and 109 of the Clean Air Act, EPA has reviewed and revised the criteria upon which the existing primary and secondary particulate matter standards are based. The revised criteria document is being published simultaneously with this notice. The existing primary standards for particulate matter (measured as "total suspended particulate matter" or "TSP") are 260 $\mu g/m^3$, averaged over a period of 24 hours and not to be exceeded more than once per year, and 75 $\mu g/m^3$ annual geometric mean. The secondary standard (also measured as TSP) is 150 $\mu g/m^3$, averaged over a period of 24 hours, and not to be exceeded more than once per year.

As a result of its review and revision of the health and welfare criteria, EPA proposes the following revisions to the particulate matter standards:

(1) That TSP as an indicator for particulate matter be replaced for both of the primary standards by a new indicator that includes only those particles with an aerodynamic diameter smaller than or equal to a nominal 10 micrometers (PM_{10});

(2) That the level of the 24-hour primary standard be changed to a value to be selected from a range of 150 to 250 $\mu g/m^3$ and that the current deterministic form of the standard be replaced with a statistical form that permits one expected exceedance of the standard level per year;

(3) That the level and form of the annual primary standard be changed to a value to be selected from a range of 50 to 65 $\mu g/m^3$, expressed as an expected annual arithmetic mean; and

(4) That the current 24-hour secondary TSP standard be replaced by an annual TSP standard selected from a range of 70 to 90 $\mu g/m^3$, expected annual arithmetic mean.

Because no scientific consensus exists on specific levels of the standards, and the analytical and policy bases for making these decisions under the statute are limited and difficult to implement, the Administrator isn not proposing specific standard levels within the above ranges. Rather, he is soliciting additional comment and information from the public to be considered in promulgating the final regulation, which will specify a specific level for each of the standards. Given the precautionary nature of the Act, the Administrator is inclined to select the levels of primary standards from the lower portion of the above ranges.

A new Federal Reference Method (Appendix J) is proposed to provide for measurement of PM_{10} in the ambient air. EPA also proposes to add a new Appendix K, which would provide guidance on the statistical nature of the proposed revisions to the standards. In addition, certain clarifying changes to Appendix B and Appendix G are proposed. This notice also proposes EPA's intention not to change how "particulate matter" is defined currently for purposes of the prevention of significant deterioration increments at 40 CFR 51.24(c) and 52.21(c).

Related notices published elsewhere in today's Federal Register set out proposed revisions to EPA's regulations concerning Ambient Air Monitoring Reference and Equivalent Methods (40 CFR Part 53), and Ambient Air Quality Surveillance (40 CFR Part 58). Proposed revisions to EPA's regulations concerning Requirements for Preparation, Adoption, and Submittal of Implementation Plans (40 CFR Part 51) with associated guidelines, and Approval and Promulgation of Implementation Plans (40 CFR Part 52) will be published later. Following the publication of these notices, the Agency will announce a supplementary review period for the limited purpose of taking comments on the implications, if any, of the proposed Parts 51 and 52 implementation requirements and guidelines for the Part 50 standards proposed today.

DATES: EPA will hold a public hearing on this notice and the related notices within 45 days. The time and place will be announced in a subsequent Federal Register notice. Written comments on this proposal, including any supplementary and rebuttal information submitted pursuant to section 307(d)(5) of the Clean Air Act, must be received by June 18, 1984.

ADDRESSES: Submit all comments (duplicate copies are preferred) except those relating to Prevention of Significant Deterioration increments (Parts 51 and 52) to: Central Docket Section (A-130), Environmental Protection Agency, Attn: Docket No. A-82-37, 401 M Street SW., Washington, D.C. 20460. Comments on Prevention of Significant Deterioration increments should be sent to the same address, Attn: Docket No. A-83-48. Dockets No. A-82-37 and No. A-83-48 are located in the Central Docket Section of the U.S. Environmental Protection Agency, West Tower Lobby, Gallery I, 401 M Street SW., Washington, D.C. The docket may be inspected between 8:00 a.m. and 4:00 p.m. on weekdays, and a reasonable fee may be charged for copying.

Availability of Related Information. The revised criteria document, Air Quality Criteria for Particulate Matter and Sulfur Oxides (three volumes, EPA-600/8-82-029a-c, December, 1982; Volume I NTIS #PB-84-156785, $19.00, Volume II NTIS #PB-84-156793, $43.00; Volume III NTIS #PB-84-156801, $47.00; complete set #PB-84-156777, $93.00; microfiche $4.50 for each volume) and the final revised staff paper, Review of the National Ambient Air Quality Standards for Particulate Matter: Assessment of Scientific and Technical Information—OAQPS Staff Paper (EPA-450/5-82-001, January, 1982; NTIS #PB-177874, $21.00 paper copy and $4.00 microfiche) are available from: U.S. Department of Commerce, National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. A limited number of copies of other documents generated in connection with this standard review, such as the control techniques document, can be obtained from: U.S. Environmental Protection Agency Library (MD-35), Research Triangle Park, N.C. 27711, telephone (919) 541-2777 (FTS 629-2777).

FOR FURTHER INFORMATION CONTACT: Mr. John Haines, Strategies and Air Standards Division (MD-12), U.S. Environmental Protection Agency, Research Triangle Park, N.C. 27711, telephone (919) 541-5531 (FTS 629-5531).

SUPPLEMENTARY INFORMATION:

INTRODUCTION

The Clean Air Act requires EPA to set, and periodically reexamine, "national ambient air quality standards" for widespread pollutants. These standards consist of "primary" standards designed to protect public health and "secondary" standards designed to protect public welfare. The statute requires primary standards to be set low enough to protect public health with an "adequate margin of safety." Once these standards have been set, states must submit "implementation plans" that contain control measures needed to attain the standards within specific statutory deadlines. These legislative requirements are discussed more fully in subsequent portions of this preamble.

In 1971, EPA established primary and secondary ambient air quality standards for particulate matter. It has now reviewed those standards and the specific criteria on which they are based, as required by the Clean Air Act, and is today proposing appropriate changes.

This proposal has been preceded by an exhaustive review of all available scientific information on the health and welfare effects of airborne particulate matter. As detailed below in the "Background" section, this review has taken over three years. It has included three public meetings of EPA's Clean Air Scientific Advisory Committee (CASAC),* five other formally announced public meetings, numerous informal meetings, and the review of written comments received throughout this process. Besides the CASAC scientists, the review has involved a large number of EPA staff, consultants, and external reviewers. In a number of areas, this wide-ranging discussion has led to significant agreement on a course of action. In one crucial area, however—the numerical stringency of the 24-hour and annual standards—the scientific and technical review has only produced relatively broad ranges of numbers from which the standard levels should be chosen.

The Administrator believes that, given the present design of the statute, the selection of a single air quality standard from each of the ranges of standards that have been recommended to him presents an extraordinarily difficult regulatory problem, one for which the existing legislative decision criteria may well be inadequate.

The review and assessment of scientific information by Agency and outside experts was intensive; it was not, however, intended to result in recommendations of any single level(s) of airborne particulate matter thought to be stringent enough to meet the statutory test of protecting public health with an "adequate margin of safety." Indeed, that review has revealed a highly limited data base—particularly where quantitative studies are concerned—and a wide range of views among qualified professionals about the exact pollution levels at which health effects are likely to occur. The setting of an "adequate margin of safety" below these levels calls for a further judgment—in an area for which the scientific data base is even more sparse and uncertain. No "scientific" approach for selecting any single recommended standard seems possible against this background. Instead, the EPA staff has identified—with CASAC concurrence—"ranges of interest" to aid the Administrator in choosing levels for both the 24-hour and annual standards. In each case, the staff and CASAC have concluded that a standard at the upper end of the range would provide little or no margin of safety, and that standards at lower levels within the range would provide correspondingly greater margins of safety. This preamble follows staff recommendations and focuses on the lower levels being considered. Under the statute, the task remaining is to decide at which level within each of these refined ranges the margin of safety should be considered "adequate." In the end it will be up to the Administrator to make this judgment by picking a single number from each range.

The final judgment on standards triggers the process by which the standards are met and maintained—a process that requires potentially major expenditures for compliance within a limited time period. Following promulgation of the standards, the states have nine months to design and submit "implementation plans" to achieve the health based standards within three years. If, for some areas, attainment in this time period is economically, socially, or technologically infeasible, the Administrator's options for adjusting the dealines are quite limited.

Despite the significant consequences that may flow from the establishment of standards, the statute as presently interpreted severly restricts the factors and analytical tools the Administrator may use to help pick these standards. The courts appear to have ruled that economic and technological feasibility have no function in deciding on an ambient standard. Given the scope of thoes statements, there is some doubt whether the Administrator may even consider the practical problems of implementation to guide his choice. Public health appears to be the sole criterion.

Yet long and expert review of public health issues has to date revealed no scientific method of assessing exactly what level of standards public health requires. The scientific review indicates substantial uncertainties concerning the health risks associated with lower levels of particulate matter. Assessing these risks is made even more complex by the fact that the composition of particulate matter and associated air pollutants can vary significantly from city to city.

Given the difficulty of this choice, EPA invites public comment on the general policy questions that it raises. If, indeed, only public health factors may be considered, what particular analytical approaches or methodologies may the Administrator apply to make his ultimate choice in a principled way? Is there room—at least scientific opinion is as lacking in definitive answers as it is here—to consider other, non-scientific factors in making the major social policy judgment of picking a precise number from a range of scientifically justified values? If so, what other factors should be considered, and in what manner?

BACKGROUND

Legislative Requirements Affecting This Proposal

The Standards

Two sections of the Clean Air Act govern the establishment and revision of national ambient air quality standards (NAAQS). Section 103 (42 U.S.C. 7408) directs the Administrator to identify pollutants which may reasonably be anticipated to endanger public health or welfare and to issue air quality criteria for them. These air quality criteria are to reflect the latest scientific information useful in indicating the kind and extents of all identifible effects on public health or welfare that may be expected from the presence of a pollutant in the ambient air.

Section 109(a) (42 U.S.C. 7409) directs the Administrator to propose and promulgate "primary" and "secondary" NAAQS for pollutants identified under section 108. Section 109(b)(1) defines a primary standard as one the attainment and maintenance of which in the judgment of the Administrator, based on the criteria and allowing for an adequate margin of safety, is required to protect the public health. The secondary standard, as defined in section 109(b)(2), must specify a level of air quality the attainment and maintenance of which in the judgment of the Administrator, based on the criteria, is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of the pollutant in the ambient air. Welfare effects are defined in section 302(h) (42 U.S.C. 7602(h)) to include effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, climate, damage to and deterioration of property, hazards to transportation, and effects on economic values and on personal comfort and well-being.

The courts have held that the requirement for an adequate margin of

*CASAC is a standing committee of scientific and engineers external to the Federal government established under section 109 of the Clean Air Act to advise the Administrator on the scientific basis for ambient air quality standards.

safety for primary standards was intended to address uncertainties associated with inconclusive scientific and technical information available at the time of standard setting. It was also intended to provide a reasonable degree of protection against hazards that research has not yet identified. *Lead Industries Association* v. *EPA*, 647 F.2d 1130, 1154 (D.C. Cir. 1980), *cert. denied*, 101 S. Ct. 621 (1980); *American Petroleum Institute* v. *Costle*, 665 F.2d 1176, 1177 (D.C. Cir. 1981), *cert. denied*, 102 S. Ct. 1737 (1982). These uncertainties in the available information and about unidentified human health effects are both components of the risk associated with pollution at levels below those at which human health effects can be said to occur with reasonable scientific certainty. Thus, in providing an adequate margin of safety, the Administrator is regulating not only to prevent pollution levels that have been demonstrated to be harmful, but also to prevent lower pollutant levels that he finds pose an unacceptable risk of harm, even if that risk is not precisely identified as to nature or degree. In weighing such risks for selecting a margin of safety, EPA has considered such factors as the nature and severity of the health effects involved, the size of the sensitive population(s) at risk, and the kind and degree of the uncertainties that must be addressed. Given that the "margin of safety" requirement by definition only comes into play where no conclusive showing of harm exists, such factors, which involve unknown or only partially quantified risks, have their inherent limits as guides to action. The selection of any particular approach to providing an adequate margin of safety is a policy choice left specifically to the Administrator's judgment. *Lead Industries Association* v. *EPA, supra*, 647 F.2d at 1161–62.

The courts, however, have set strict limits to the factors EPA may consider in establishing a margin of safety. Two recent judicial decisions state that the economic and technological feasibility of attaining ambient standards are not to be considered in setting them, even in the context of a margin of safety. *Lead Industries Association* v. *EPA, supra*, 647 F.2d at 1148–51; *American Petroleum Institute* v. *Costle, supra*, 665 F.2d at 1185, 1190. Such factors may, however, be considered to a degree in the development of State plans to implement the standards.

Section 109(d) of the Act (42 U.S.C. 7409(d)) requires periodic review and, if appropriate, revision of existing criteria and standards. The process by which EPA has reviewed the original criteria and standards for particulate matter under section 109(d) is described in a later section of this notice.

Related Control Requirements

States are primarily responsible for assuring attainment and maintenance of ambient air quality standards, once EPA has established them. Under section 110 of the Act (42 U.S.C. 7410), States are to submit, for EPA approval, State Implementation Plans (SIPs) that provide for the attainment and maintenance of such standards through control programs directed to sources of the pollutants involved. Other federal programs provide for nationwide reductions in emissions of these and other air pollutants through the Federal Motor Vehicle Control Program, which involves controls for automobile, truck, bus, motorcycle, and aircraft emissions under Title II of the Act (42 U.S.C. 7501 to 7534), and through the development of New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants for various categories of stationary sources under section 111 (42 U.S.C. 7411) and section 112 (42 U.S.C. 7412).

Particulate Matter and Existing Standards for TSP

"Particulate matter" is the generic term for a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. Particles originate from a variety of stationary and mobile sources. They may be emitted directly or formed in the atmosphere by transformations of gaseous emissions such as sulfur oxides, nitrogen oxides, and volatile organic substances. The major chemical and physical properties of particulate matter vary greatly with time, region, meteorology and source category, thus complicating the assessment of health and welfare effects as related to various indicators of particulate pollution. The characteristics, origins, concentrations and potential effects of particulate matter are discussed in more detail in the staff paper (SP; EPA, 1982a) and in the revised criteria document (CD; EPA, 1982b). The executive summary of the staff paper is reprinted in Addendum I to this notice.

On April 30, 1971, EPA promulgated primary and secondary NAAQS for particulate matter under section 109 of the Clean Air Act (36 FR 8186). The reference method for measuring attainment of these standards is the "high-volume" sampler (40 CFR Part 50, Appendix B), which effectively collects particulate matter up to a nominal size of 25 to 45 micrometers (μm) (so-called "total suspended particulate," or "TSP"). Thus, TSP is the current indicator for the particulate matter standards. The existing primary standards for particulate matter (measured as TSP) are 260 $\mu g/m^3$, averaged over a period of 24 hours and not to be exceeded more than once per year, and 75 $\mu g/m^3$ annual geometric mean. The secondary standard (measured as TSP) is 150 $\mu g/m^3$, averaged over a period of 24 hours, and not to be exceeded more than once per year. The scientific and technical bases for these standards are contained in the original criteria document, Air Quality Criteria for Particulate Matter (DHEW, 1969).

Development of Revised Air Quality Criteria for Particulate Matter

In 1976, as a result of internal agency review and the recommendations of a committee of EPA's Science Advisory Board, EPA decided to revise the existing criteria document for particulate matter. Because of competing priorities regarding revision of other criteria documents and the need to complete additional research on particulate matter, the process was scheduled to commence in 1979. With the endorsement of the Clean Air Scientific Advisory Committee (CASAC) of EPA's Science Advisory Board, EPA decided to review and revise the criteria document for particulate matter concurrently with that for sulfur oxides and to produce a combined particulate matter/sulfur oxides (PM/SO_x) criteria document.

On October 2, 1979 (44 FR 56731), EPA announced that it was in the process of revising the original criteria document for particulate matter and reviewing the existing air quality standards for possible revisions in accordance with section 109(d)(1) of the Clean Air Act.

In developing the revised criteria document, EPA has provided a number of opportunities for review and comment by organizations and individuals outside the Agency. Three drafts of the revised particulate matter/sulfur oxides criteria document, prepared by EPA's Environmental Criteria and Assessment Office (ECAO), have been made available for external review (45 FR 24913; 46 FR 9747; 46 FR 53210). EPA has received and considered numerous and often extensive comments on each of these drafts. CASAC has held three public meetings (August 20–22, 1980; July 7–9, 1981; November 16–18, 1981) to review successive drafts of the document. These meetings were open to the public and were attended by many individuals and representatives of

organizations who provided critical reviews and new information for consideration. Based on CASAC recommendations made after the first review meeting, five additional public meetings were held at which EPA, its consulting authors and reviewers, and other scientifically and technically qualified experts selected by EPA discussed the various chapters of the draft document and suggested ways of resolving outstanding issues (45 FR 74047; 45 FR 78224; 45 FR 76790; 45 FR 80350; 46 FR 1775).

The comments received on the successive drafts of the revised criteria document have been considered in the final document, issued simultaneously with this proposal. A summary of EPA's responses to the comments on the three external review drafts of the documents has been placed in the public docket (Docket No. A–82–37). Transcripts of the three CASAC meetings are also in the docket. In accordance with its established procedures, CASAC prepared a "closure" memorandum to the Administrator indicating its satisfaction with the final draft (December, 1981) of the criteria document and outlining key issues and recommendations. The closure memorandum, dated January 29, 1982, stated that the EPA office that prepared this document was "responsive to Committee advice as well as to comments provided by the general public * * *" The closure memorandum further states that the criteria document "fulfills the requirements set forth in section 108 of the Clean Air Act, which requires that the criteria document 'shall accurately reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health or welfare' from sulfur oxides and particulates in the ambient air." Following closure, minor technical and editorial refinements were made to the criteria document for printing (EPA, 1982b). The CASAC closure memorandum on the criteria document is reprinted in its entirety as Addendum II to this notice.

A number of scientific and technical issues were raised during the public review process. With respect to the particulate matter portions of the criteria document, the major issues included the relationship among various measures of particulate matter air quality, the implications of particle deposition and other studies for selecting a particulate matter indicator, and the development and application of criteria for deciding which epidemiological studies are most appropriate for use in revising air quality standards. A summary of these and other major scientific issues, as well as CASAC's conclusions, is included in the closure memorandum on the criteria document (Addendum II).

Review of the Standards: Development of Staff Paper

In the Spring of 1981, EPA's Office of Air Quality Planning and Standards (OAQPS) prepared the first draft of a staff paper, Review of the National Ambient Air Quality Standards for Particulate Matter (see Addendum I). This draft staff paper evaluated and interpreted the available scientific and technical information most revelant to the review of the air quality standards for particulate matter and presented staff recommendations on alternative approaches to revising the standards, based on the then-existent draft of the revised criteria document. This and a second draft of the paper were reviewed at two CASAC meetings (July 7–9, 1981; November 16, 1981). Numerous written and oral comments were received on the drafts from CASAC, representatives of organizations, individual scientists and other interested members of the public. A summary of major revisions in response to comments on the first draft is contained in an October 31, 1981 letter to CASAC (Padgett, 1981). Following the second CASAC meeting, the staff made further revisions in response to comments and prepared an executive summary that was reviewed by CASAC members before preparation of the closure memorandum on the staff paper. In January, 1982, EPA released the final OAQPS staff paper (EPA, 1982a), which reflects the various suggestions made by CASAC and members of the public. The January 29, 1982, CASAC closure memorandum states that the staff paper "has been modified in accordance with recommendations made by CASAC," is consistent with the criteria document, and provides the Administrator "with the kind and amount of technical guidance that will be needed to make appropriate revisions to the standard."

A number of major issues were raised during the public review process. The more important issues are outlined below.

1. Substantial discussion concerned the maximum size of particles (or particle size fraction) to be used in measuring particulate matter for regulatory purposes. Some groups favored retaining TSP and others called for alternative size-specific standards with nominal "size cuts" ("D_{50}", see later discussion) of 15 μm, 10μm, 5–7 μm, and 2.5 μm. After CASAC closure on the staff paper and criteria document, comments were received from one group favoring a so-called "D_0" of 10 μm (approximately equivalent to a nominal size cut [D_{50}] of 6 μm).

2. Much attention was focused on the development of numerical "ranges of interest" for selecting the level of alternative particulate matter standards and on which studies were most appropriate for use in standard setting. Significant criticisms were received on the major epidemiological studies of particulate matter exposures highlighting their limitations for use in standard setting. In a number of comments, specific suggestions for standards were made.

3. With respect to secondary standards, most attention focused on the basis for a fine (≤2.5 μm) particle standard related to visibility protection.

These and other major issues are discussed more fully in the executive summary of the staff paper (Addendum I) and in later sections of this notice. CASAC's discussion of these issues and its recommendations are contained in the closure memorandum on the staff paper (Addendum III).

Rulemaking Docket

EPA established a standard review docket for the particulate matter standard revision in July, 1979. With this proposal, EPA is establishing a rulemaking docket (Docket No. A–82–37) as required by section 307(d) of the Clean Air Act. The most relevant portions of the standard review docket (Docket No. A–79–29) and of a separate docket established for criteria document revision (Docket No. ECAO–CD–79–1) have been incorporated in this rulemaking docket. The balance of the standard review and criteria revision dockets will continue to be available for public reference.

RATIONALE FOR THE PRIMARY STANDARDS

In selecting primary standards for particulate matter, the Administrator must specify: (1) The particle size fraction that should be used as an indicator of particulate pollution; (2) the appropriate averaging times and forms of the standards; and (3) the numerical level(s) for the standards. Based on the assessment of relevant scientific and technical information in the criteria document, the staff paper (hereafter "SP") outlines a number of key factors to be considered when making decisions in each of these areas (SP, Section VI). Evaluation of the margin of safety afforded by a given particulate matter standard should include consideration of these specifications collectively, rather than focusing on any one. Both

the staff and CASAC made recommendations to focus consideration on a discrete range of policy options in each of these areas. In most respects, the Administrator has adopted the recommendations and supporting reasons contained in the staff paper and the CASAC closure memorandum. Rather than reiterating those discussions at length, the following discussion of the proposed standards focuses primarily on those considerations that were most influential in the Administrator's selection of a particular option, or that differ in some respect from considerations that influenced the staff and/or CASAC recommendations.

Since CASAC closure on the criteria document and staff paper in January, 1982, a number of studies on the health effects of particulate matter have appeared in the scientific literature. Examples that have been placed in the rulemaking docket include Proctor and Swift, 1982; Ostro, 1983; Mazumdar and Sussman, 1983; Mazumdar et al., 1982; Vena, 1983; Perry et al., 1983; Baxter et al., 1983; Avol et al., 1983; and Dockery et al., 1982. Although none of these studies has been used as a basis for this proposal, some of them could be of importance in a final decision. The public is invited to comment on the implications of these or any other recent studies for the standards. After conclusion of the public comment period, but before preparation of the promulgation notice, the Agency will prepare a document identifying and discussing the significance of any such studies it considers useful for the final decision and submit the document for CASAC and public review.

Pollutant Indicator

The Administrator concurs with the staff conclusions that (1) a separate general particulate matter standard (as opposed to a combination standard for particulate matter and SO_2) remains a reasonable public health policy choice, and (2) given current scientific knowledge and uncertainties, a size-specific (rather than chemical-specific) indicator should be used. The current indicator (TSP) is size-specific, but has been widely criticized because it directs control efforts toward larger particles that can dominate measured mass, but are of less concern to health than smaller particles. In assessing the information in the criteria document, the staff reached several conclusions summarized below (see SP, pp. 71–75):

(1) Health risks posed by inhaled particles are influenced both by the penetration and deposition of particles in the various regions of the respiratory tract, and by the biological responses to these deposited materials.

(2) The risks of adverse health effects associated with deposition of ambient fine and coarse particles in the thorax (tracheobronchial and alveolar regions of the respiratory tract) are markedly greater than for deposition in the extrathoracic (head) region. Maximum particle penetration to the thoracic region occurs during oronasal or mouth breathing.

(3) The risks of adverse health effects from extrathoracic deposition of general ambient particulate matter are sufficiently low that particles depositing only in that region can safely be excluded from the standard indicator.

(4) The size-specific indicator for primary standards should represent those particles capable of penetrating to the thoracic region, including both the tracheobronchial and alveolar regions.

Considering these conclusions in light of data on air quality composition, respiratory tract deposition and health effects, the need to provide protection for sensitive individuals who may breathe by mouth and/or oronasally, and the similar convention on particles penetrating the thoracic region recently adopted by the International Standards Organization (ISO, 1981), the staff recommended that the size-specific indicator include particles less than or equal to a nominal 10 μm "cut point."* This indicator ensures that the full range of particles penetrating to the sensitive alveolar region is included, and follows tracheobronchial penetration patterns in a somewhat conservative fashion. It places substantially greater emphasis on controlling smaller particles than does a TSP indicator, but does not completely exclude larger particles from all control. These and other factors considered in recommending a 10 μm cut point are outlined in the staff paper (SP, pp. 75–79).

The Administrator accepts the recommendations of the staff and CASAC and their underlying rationale and proposes to replace TSP as the particle indicator for the primary standards with a new indicator that includes only those particles less than a nominal 10 μm. This indicator is referred to as "thoracic particles" (TP) in the staff paper. For more general use in defining the standards, the regulated pollutant has been termed PM_{10}.

In proposing a PM_{10} indicator, the Administrator also invites public comment on certain information published and submitted after CASAC closure on the criteria document and staff paper. The American Mining Congress (AMC) has sponsored and submitted a new analysis (AMC, 1982) of particle deposition in the respiratory tract. The analysis, which was recently published as a preliminary communication (Swift and Proctor, 1982), suggests that the data used to represent particle deposition in the criteria document and staff paper overstate particle penetration to the thoracic regions of the respiratory tract because the experiments used artificial interventions (mouthpieces and nose clips) that do not simulate natural oronasal breathing. Swift and Proctor also attempt to quantify the extent of the overestimation by developing simulated particle deposition curves for oronasal breathing. Based on these simulations, AMC has recommended a particle size indicator that collects no particles greater than 10 μm ($D_0 \simeq 10$ μm), with a cut point (D_{50}) that EPA interprets as being approximately 6 μm.

The Swift and Proctor analysis is relevant to the final decision on a size indicator and should be considered during the public comment period. The Administrator is not, however, proposing the AMC recommendations, in part because the supporting analysis was only recently published as a preliminary communication and was not considered by CASAC, and in part because of reservations associated with the recommendations themselves. The likelihood that the data used to derive PM_{10} overstate thoracic deposition was recognized in a qualitative sense by CASAC (cf. July, 1981 transcript, p. 581) and presented as one reason for recommending 10 μm as an appropriately conservative particle indicator (cf. July, 1981 transcript, p. 584). Hence, the revised staff paper specifically reflected this argument with respect to mouthpiece results in its recommendations favoring 10 μm over 15 μm as the cutpoint (SP, pp. 76–77). The assumptions used by Swift and Proctor (1982), on the other hand, may result in underestimating thoracic particle deposition, at least in some cases; this would reduce any margin of safety associated with an indicator derived from these data. The Swift and Proctor analysis itself suggests that approximatley 10 to 20% of 10 μm

* The more precise term is 50% cut point or 50% diameter (D_{50}). This is the aerodynamic particle diameter for which the efficiency of particle collection is 50%. Larger particles are collected with substantially lower efficiency and smaller particles with greater (up to 100%) efficiency. In practical usage, acceptable ambient samplers with this cut point provide a reliable estimate of the total mass of suspended particulate matter of aerodynamic size less than or equal to 10 μm. See additional discussion regarding the proposed Federal Reference Method below and in the accompanying notice proposing revision of 40 CFR Part 53.

particles could penetrate to the thoracic region, rather than the 0% penetration implied by the AMC recommendation for a "D_0" of 10 μm. If the Swift and Proctor analysis were used in determining the cut-point for the final standard, this penetration would have to be taken into account.

An additional factor to be considered in the final decision is that a shift to an indicator other than PM_{10} would necessitate an adjustment in the level of a given standard to account for the reduced amount of particles collected. If the AMC proposal were selected following public comment, the levels of the standards would probably be adjusted downward by a factor reflecting the best estimate of the ratio of the mass of particles less than 6 μm to the mass less than 10 μm. Based on available interpolations, that ratio is estimated to be approximately 0.8 (Pace, 1982).

While the Administrator proposes a PM_{10} indicator at this time, the public is invited to comment on the appropriateness of using the AMC recommendations and supporting analysis to develop a different indicator for the primary standards and on the adjustment of the numerical level of the standard that would be appropriate if a different indicator were selected after consideration of comments on this issue.

Averaging Time and Form of the Standards

The Administrator concurs with staff and CASAC recommendations for retaining both 24-hour and annual primary standards for particulate matter. A single averaging time would not appear to provide adequate protection against potential effects from both long- and short-term exposures without being unduly restrictive. The form for both 24-hour and annual standards is discussed below.

1. In accordance with staff recommendations, the Administrator proposes that the 24-hour standard be stated in a statistical form, rather than the current deterministic form. When used with an appropriate standard level the statistical form can provide improved health protection that is less sensitive to changes in sampling frequency than the deterministic form and also can offer a more stable target for control programs. Recognition of the limitations of the deterministic form has led EPA to promulgate or propose statistical forms for the ozone and carbon monoxide standards (44 FR 8202; 45 FR 55066).

The proposed interpretation of the statistical form of the particulate matter standard is detailed in Appendix K of the proposed regulation. As presented there, the standard would be attained when the expected number of exceedances of the 24-hour standard level is no more than one per year. Generally, the determination would be based on three consecutive years of data. A difficulty in applying the single exceedance statistical form to particulate matter arises from the current practice of limiting the sampling frequency for particulate matter (typically only one 24-hour sample is collected every six days). This leads to an increased chance of misclassifying areas as non-attainment. The proposed approach for addressing this issue is presented in the accompanying proposal for 40 CFR Part 58.

An alternative form of the standard considered during this review was to permit multiple expected exceedances of the standard level. Analyses of air quality data indicate that a multiple exceedance form can provide even greater stability for control programs and reduce the possibility of incorrectly classifying areas as attainment or nonattainment because of unusual or infrequent meteorological conditions. If a multiple exceedance form were to be used, the level of the standard would be established at a lower numerical value than for a single exceedance standard to ensure comparable health protection, in accordance with CASAC's recommendation. Conceptual approaches for considering the interaction between standard level and number of exceedances are outlined in the staff paper (SP, pp. 81–83). The staff paper analysis does not, however, provide a complete comparison of the relative health protection, stability, and stringency of control afforded by a single as compared to a multiple exceedance standard. A more comprehensive analysis of these factors is underway and will be placed in the docket when completed. Pending completion of this analysis, the greater control of peak values available through the single exceedance form is preferred.

While the Administrator does not propose a multiple exceedance form for the 24-hour particulate matter standard at this time, the public is invited to comment on the advisability of multiple expected exceedances for determining attainment of the 24-hour standard and on the adjustment of the numerical level of the standard that would be appropriate if a multiple exceedance form were adopted after consideration of comments on this issue.

2. The Administrator proposes to change the form of the annual standard from the current annual geometric mean to a statistical form expressed as an expected annual arithmetic mean. The expected arithmetic mean form is more directly related to the available health effects information than is the current form of the standard. The change to an arithmetic mean was recommended by the staff and CASAC on this basis. The proposed interpretation of the statistical form of the standard is detailed in Appendix K to the proposed regulation.

Under the proposed statistical form, the standard would be expressed as an expected annual arithmetic average determined by averaging the annual arithmetic averages from three successive years of data. The current deterministic form of the standard does not adequately take into account the random nature of meteorological variations. In general, annual mean particulate matter concentrations will vary from one year to the next, even if emissions remain constant, due to the random nature of meteorological conditions that affect the formation and dispersion of particles in the atmosphere. This limitation means that compliance with the standard and, consequently, emission control requirements, may be determined on the basis of a year with unusually adverse weather conditions. The problem of year to year variability, is, however, much less significant for annual average concentration standards than for 24-hour standards.

In proposing the statistical form, EPA has considered the relative protection provided by a given standard level with this form as compared to the deterministic form, and has assessed the relationship between statistical and deterministic forms of an annual standard (Frank, 1982). Based on this analysis, the level of an annual statistical PM_{10} standard that would, on average, provide protection equivalent to a standard with a deterministic form, would be a factor of approximately 0.9 times the level of that deterministic standard.

3. The proposed interpretation of the statistical forms for both 24-hour and annual standards in Appendix K is conceptually similar to that proposed in Appendix I of the Carbon Monoxide Standard (45 FR 55066). However, specific adjustments have been made to the computations necessary for analyzing particulate matter data to account for the different averaging periods of the proposed standards and for non-scheduled sampling days as during episode periods.

The proposed appendix also specifies criteria for determining attainment of the proposed standards when less than 3 years of representative data are

available. The proposed criteria specify: (1) That two years of data representative of "normal" conditions would be sufficient to perform the calculation in order to show attainment of the annual standard; (2) that two years of representative data would be sufficient to perform the calculations for the 24-hour standard if the monitor samples every day and achieves an annual average data capture of 50 percent; and (3) that one year of representative data will be sufficient for both annual and 24-hour standards if the monitor samples every day and achieves 75 percent capture. In proposing these criteria, the Agency sought to minimize the likelihood of misclassifying areas due to incomplete data. Although data not meeting the criteria could also be used, such exceptions would have to be approved by the Regional Administrator. Comments are specifically requested on these criteria.

Provisions to minimize the influence of unusual events and trends in the computation of exceedances are also proposed. These are directed at: (1) Rare and unusual events that cannot be controlled through the State Implementation Plan process; and (2) situations in which trends in emissions and air quality are evident. The Agency is currently developing additional guidance on data requirements and treatment of both trends and unusual events. When completed, these guidelines will be made available for public comment.

The computational formulas for the 24-hour standard do not account for any seasonal differences in data capture and pollutant concentrations. Although normally small, in some cases they could affect the calculation of expected exceedances. Therefore, EPA requests comments on whether computational formulas that would address this question should be added to Appendix K.

The proposed attainment test for the 24-hour standard would compute an estimate for the expected annual exceedance rate and then compare this estimate to the allowable exceedance rate of once per year. An alternative approach would recognize the statistical variability associated with the estimated annual exceedance rate and develop a tolerance interval so that a site would not be classified as non-attainment unless the estimated annual exceedance rate exceeds the allowable exceedance rate by more than this tolerance interval. The magnitude of this tolerance interval could be determined by developing a statistical model to account for the underlying variability of the data and could incorporate factors such as autocorrelation. From a statistical viewpoint, this type of approach would have the advantage of controlling the "Type I" error, in this case the probability of misclassifying a site as non-attainment when it actually is attainment. However, by incorporating this tolerance interval fewer sites may, depending on the significance level chosen, be classified as non-attainment than with the attainment test proposed in this notice. The tolerance interval approach might also be applied in the other direction, so that a site would not be considered to have demonstrated attainment unless the estimated exceedance rate plus the tolerance limit is less than the allowable exceedance rate. Therefore, this alternative approach may, depending on the significance level chosen, make it more difficult for a site to be classified as either attainment or non-attainment. The concept of accounting for the underlying variability of the data is also applicable to the annual standard in which a tolerance interval could be determined for the annual mean. EPA solicits comments on such approaches for this and other ambient air quality standards, particularly with respect to the advisability of their use, the practical aspects of developing these tolerance intervals, an appropriate choice of a significance level used to develop the tolerance intervals, and how they might affect ongoing programs.

Level of the Standards

The staff paper and CASAC recommendations set forth a framework for considering the levels for the proposed particulate matter standards to ensure that they protect public health with an adequate margin of safety. The discussion that folllows on the levels of the standard relies heavily on that framework and on the supporting material in the staff paper and closure memorandum. The essential steps in this framework are summarized below.

1. Assessment of the more quantitative epidemiological studies of particulate matter. The criteria document identifies a small number of community epidemiological studies that are useful in developing quantitative conclusions regarding concentrations at which particulate matter is likely to produce health effects. The staff used these "quantitative" studies to examine concentration-response relationships for the various effects observed in the sensitive populations studied and developed numerical "ranges of interest" for possible PM_{10} standards.

A number of uncertainties associated with use of these studies must be considered in selecting an appropriate margin of safety. As discussed in the staff paper and the criteria document, epidemiological studies are generally subject to inherent difficulties involving confounding variables and somewhat limited sensitivity. Moreover, most of the quantitative studies were conducted in times and places where pollutant composition may have varied considerably from current U.S. atmospheres. Most also have used British Smoke* or TSP as particle indicators. None of the published studies used the proposed PM_{10} indicator. Thus, assumptions must be used to express the various results in common (PM_{10}) units (SP, pp. 96–100).

2. Evaluation of additional margin of safety considerations. The criteria document identifies a substantial body of scientific literature that, while not providing reliable concentration-response relationships for community exposure, does provide important qualitative insights into the health risks associated with human exposure to particles. The staff assessed this literature, including both quantitative and qualitative epidemiological studies, controlled human exposure experiments, and animal toxicological studies to identify additional factors and uncertainties that should be considered in selecting the most appropriate margin of safety (SP, pp. 100–101; 107–111).

3. Selection of the levels that might be considered to provide an adequate margin of safety for the sensitive populations of concern. The original intent of the margin of safety requirement was to direct the Administrator to set an air quality standard at some level below the pollution level at which adverse health effects have been found or might be anticipated to occur in sensitive groups. Experience with this requirement has shown that the scientific data are often so inconclusive that it is difficult to identify with confidence the lowest level at which an adverse effect is "likely" to occur. Even if such a level can be identified, available data may suggest that the effect is also "possible" at lower levels, or that other effects (not yet adequately studied) may occur at such levels. Thus, the Administrator must still decide how far below the "effects likely" level a standard must be set to provide a margin of safety that is "adequate."

* British Smoke (BS) is a pseudo-mass indicator related to small particle (size less than a nominal 4.5 μm) darkness. This particulate matter indicator was widely used in British and other European studies. See the more detailed treatment of BS in the criteria document (CD, pp. 1–88 to 1–90 and 14–8 to 14–11).

Assessments of risks can help guide this decision, but in the end cannot substitute for informed judgment. For example, if the health effect detected at low pollution levels is severe, a greater margin of safety would be called for then if it were less troubling. However, given the basic fact that determining what constitutes an adequate margin of safety always come into play below the pollution levels at which there is conclusive evidence of health effects, decision-making will necessarily involve value judgments made under a substantial degree of uncertainty. That is particularly true in a case such as the present one, where the health evidence suggests that both the severity of any potential harm from particulate pollution and the probability that this harm will in fact occur, decrease steadily, but do not necessarily vanish, as we move to lower and lower pollution levels.

For these reasons, EPA staff, with CASAC concurrence, recommended a range of potential standards for the Administrator's consideration. Any standard selected from these ranges can be said to provide some margin of safety. Because of the substantial uncertainties in the available effects information, the complex character of particulate matter exposures, and the importance of the decision, the Administrator wishes to solicit the fullest possible participation and comment by the public before deciding which standard levels should be adopted in the final standard. He is, therefore, proposing ranges from which the final standard is, in each case, to be selected. The rationales for the proposed ranges of levels for 24-hour and annual standards are discussed below.

24-Hour Standard.

The staff assessment of the short-term epidemiological data is summarized in Table 1; particulate matter levels are expressed in both the original and PM_{10} units. Based on these more quantitative studies, the staff has distinguished between concentration ranges where, in its judgment, the likelihood of effects occurring in sensitive populations is high and levels where the data indicate that such effects may be possible, but are less likely. Therefore, the "effects likely" row in Table 1 denotes concentration ranges derived from the criteria document at or above which there appears greatest certainty that the effects listed would occur. While these effects are much less likely to occur at levels below the lower end of the combined "effects likely" range, the data do not provide evidence of clear thresholds in exposed populations. Instead, they suggest a continuum of response for a given number of exposed individuals with both the likelihood (risk) of any effects occurring *and* the extent (incidence and severity) of any potential effect decreasing with concentration. Thus, effects may be "possible" at levels below those listed in the "effects likely" row, but, because the evidence is less clear, the nature and extent of risks at lower levels are much more uncertain. Following CASAC recommendations, the staff used the combined range listed in the "effects possible" row as a starting point for developing alternative standards.

TABLE 1.—STAFF ASSESSMENT OF SHORT-TERM EPIDEMIOLOGICAL STUDIES (AFTER TABLE 6-2, SP)

Effects[1]/study	Measured British smoke levels as $\mu g/m^3$			Equivalent PM_{10} Levels ($\mu g/m^3$)—Combined range[3]
	Daily mortality in London[1]	Aggravation of bronchitis[2]	Combined range	
Effects likely	500 to 1000	250* to 500*	250 to 500	350 to 600.
Effects possible	150* to 500	250*	150 to 250	150 to 350.

[1] Deviations in daily mortality from mean levels examined in 3 studies encompassing individual London winters of 1958–59 and 14 aggregate winters from 1958–72. Early winters were characterized by high smoke from coal combustion emissions and high SO_2 with frequent fogs (Martin and Bradley, 1960; Wicso et al., 1931, Mazumder et al., 1931).

[2] Examination of symptoms reported by bronchitis in London. Studies conducted from the mid-1950's to the early 1970's (Lawther et al., 1970).

[3] Conversion assumes that for London smoke conditions, BS < PM_{10} < TSP. Precise conversions are not possible. The lower bound assumption (BS = PM_{10}) incorporates some margins of safety and is used to estimate the lower bound in the effects possible range. The upper bound (PM_{10} = TSP = BS + 100 $\mu g/m^3$) likely overestimates PM_{10} levels and is used to provide estimates of levels where effects are most likely.

* Indicates levels used for upper or lower bound of range.

The "range of interest" derived from the staff analysis is, therefore, 150 to 350 $\mu g/m^3$ as PM_{10}, 24-hour average with no more than one expected exceedance per year. Under the conditions prevailing during the London studies, which were characterized by high SO_2, levels and smoke from open coal fires, PM_{10} concentrations near 350 $\mu g/m^3$ represent levels at which effects are considered likely in the sensitive populations studied. CASAC concluded that, considering the uncertainties in translating these results to current U.S. conditions and the seriousness of the potential health effects, the upper end of the original range of interest in the staff paper contains little or no margin of safety and should not be considered as an appropriate standard.

As indicated in Table 1, the study of Lawther et al. (1970) provides the lowest particulate matter level at which health effects are judged to be likely by the criteria document. The effects observed in this study (related to aggravation of bronchitis) are of concern both because of their immediate impact and because of the potential for inducing longer-term deterioration of health status in a significant sensitive group. There were approximately 6.5 million bronchitics in the U.S. in 1970 (DHEW, 1973). Based on the uncertain conversion between smoke and PM_{10} outlined in Table 1, the lowest "effects likely" level derived from the Lawther study (250 $\mu g/m^3$ as BS) should be in the range of 250 to 350 $\mu g/m^3$, in PM_{10} units.

Based on using this study alone, a PM_{10} standard of 250 $\mu g/m^3$ would contain some margin of safety, even for the sensitive bronchitics studied, because it incorporates the lower British Smoke/PM_{10} conversion factor and because of differences between exposure conditions in the British study and current U.S. air quality (SP, pp. 100–101). Because bronchitics are identified as a group particularly sensitive to particulate pollution, a standard of 250 $\mu g/m^3$ (as PM_{10}) also would provide a substantial margin of safety for other less sensitive groups in the population. This concentration is also a factor of two below the levels (500 to 750 $\mu g/m^3$ as BS) where the criteria document indicates excess mortality begins to be considered likely (CD, Table 14-7). The portions of the population at greatest risk of premature mortality associated with particulate matter exposures include the elderly and persons with pre-existing respiratory or cardiac disease. Although the extent of life shortening (days, weeks, or years) cannot be specified, the seriousness of this effect strongly justifies a margin of safety for it (below the "effects likely" levels) that is larger than that warranted for the effects on bronchitics.

Taken alone, then, this information would tend to support the choice of a standard level of 250 $\mu g/m^3$ as providing adequate health protection. Several

additional factors, however, suggest the need for considering a larger margin of safety than that provided by a standard with a level of 250 $\mu g/m^3$. These include:

(1) The staff assessment of London mortality studies suggests risks of premature mortality to sensitive individuals at concentrations lower than those at which such effects are considered likely. Although the risks to individuals may be small at 250 $\mu g/m^3$ and below, the number of people exposed to lower concentrations in substantially larger than the number exposed to higher levels (e.g., Biller, 1983). The increased number of sensitive individuals exposed increases the risk that effects will occur in the total population exposed.

(2) Information from qualitative studies assessed in the staff paper (SP, pp. 101–103) suggests risks for sensitive groups (children and asthmatics) and of potential effects (morbidity in adults) not demonstrated in the more quantitative epidemiological literature. The qualitative studies do not provide clear information on effects levels, but do justify consideration for standard-setting purposes of these particulate matter effects that have not been sufficiently investigated.

(3) Differences in composition of particles and gases among U.S. cities and between conditions in the U.S. and those in London at the time quantitative studies were conducted add to the complexity of assessing the risk associated with particulate matter exposures in the U.S.

These factors suggest the need to consider alternative standard levels that might extend from 250 $\mu g/m^3$ down to the lower bound of the staff range of interest (150 $\mu g/m^3$ or even below. In evaluating them, the Administrator is mindful of the uncertain and largely qualitative nature of the effects information when applied to assessing health risks of particulate matter in contemporary U.S. atmospheres. Although the CASAC has concurred with EPA's assessments of the key studies conducted in London, several of the early British investigators have continued to express substantial disagreement with the interpretations in the criteria document and staff paper (Lawther, 1982; Holland *et al.*, 1983). A diversity of opinion among scientists is to be expected when evaluating what constitutes an adequate margin of safety below consensus "likely" effects levels, but the range of uncertainty is particularly large in the case of particulate matter.

Because of the substantial uncertainties in the scientific and technical information available for use in assessing health risks below 250 $\mu g/m^3$, the complexities associated with applying available effects information uniformly to a variety of exposure conditions in different geographical areas, and the narrow range of factors that apparently may be reviewed in making this important public policy decision, the Administrator finds it difficult to choose a single standard level from a range of 150 to 250 $\mu g/m^3$. Given the relatively low health risks to individuals at levels below 250 $\mu g/m^3$, the Administrator feels that if consideration could be given to geographic variability in such factors as the number of people exposed, the nature and composition of pollution exposures and the costs and difficulties in attaining the standareds, different levels–spanning the entire range of 150 $\mu g/m^3$, to 250 $\mu g/m^3$—might be considered appropriate for different areas. The present Act, however, appears to proclude consideration of costs and feasibility in setting NAAQS and focuses the basis for a decision on national public health protection on "worst case" exposure situations.

Given the precautionary nature of section 109 and the factors the Act permits him to consider, the Administrator is inclined to select a 24-hour standard from the lower portion of he above range. Because of the wide uncertainties and the significance of this decision, however, he believes it is important to air the issues and uncertainties fully and to encourage broad public participation and comment before choosing a specific level for the standard. Therefore, the Administrator proposes to select a final standard level from a range of values between and including 150 to 250 $\mu g/m^3$, and solicits public comment on the standard level that provides an adequate margin of safety given the risk of effects suggested by the available scientific information.

In proposing this range for the 24-hour standard, the Administrator also invites public comment on an EPA analysis, developed subsequent to CASAC closure on the criteria document and staff paper, that is of some relevance to the final decision on the level of that standard. The analysis (Morgenstern, 1982), which has been placed in the rulemaking docket, is a further evaluation of the London mortality data and examines the issue of whether clear effects thresholds can be identified. The analysis adds to the evidence that would suggest some possibility of effects even at levels below 75 $\mu g/m^3$ BS (75 to 175 $\mu g/m^3$ as PM_{10}).

Although the analysis is relevant to the final decision on a standard level and should be considered during the public comment period, the Administrator did not consider it in developing the proposed standard range because it is an unpublished staff analysis that has not been considered by CASAC and because of possible limitations identified in initial public comment on it (Young, 1982). These comments have been placed in the rulemaking docket.

Annual Standard

The staff assessment of important long-term epidemiological data is summarized in Table 2. Long-term epidemiological studies are subject to additional confounding variables that reduce their sensitivity and make interpretation more difficult than for short-term studies. The "effects likely" levels are derived from the criteria document, but again, no clear thresholds can be identified in exposed populations for all indicators of health effects. Effects may occur at lower levels, but the evidence is inconclusive and effects are difficult to detect in the available epidemiological studies.

TABLE 2.—STAFF ASSESSMENT OF LONG-TERM EPIDEMIOLOGICAL STUDIES (AFTER TABLE 6-3, SP)

Effects/study	Measured BS levels (as $\mu g/m^3$)—increased respiratory disease, reduced lung function in children[1]	Measured TSP levels ($\mu g/m^3$)		Combined ranged	Equivalent PM_{10} levels ($\mu g/m^3$)—combined range[4]
		Increased respiratory disease symptoms, small reduction in lung function in adults[2]	Increased respiratory symptoms in adults[3]		
Effects likely	230 to 300 BS	180*		>180	90 to 110.
Effects possible	<230 BS	130 to 180*	60 to 150 (110*)	110 to 180	55 to 110.
No significant effects noted		80* to 130		80 to 110	40 to 55.

[1] Study conducted in 1963–65 in Sheffield, England (Lunn et al., 1967). BS levels (as $\mu g/m^3$) uncertain.
[2] Studies conducted in 1961–73 in Berlin, NH. Major source in community was pulp mill. Effects level (180 $\mu g/m^3$) based on 2-month average. Effects on lung function were relatively small (Ferris et al., 1973, 1976).

[3] Study conducted in 1973 (Bouhuys et al., 1978). Exposures reflect 1965-73 data in Ansonia, CT. Median value used as an indicator. Essentially negative study. No effects on lung function, but some suggestion of effects on respiratory symptoms.
[4] Conversion based on estimated ratio of PM_{10}/TSP for current (1980-81) U.S. atmospheres. The ratio estimated for use in the staff paper ranged between about 0.5 to 0.6. These numbers were used as lower and upper bounds for estimating PM_{10} equivalents from TSP values. More recent analyses suggest the median ratio may be as low as 0.45 to 0.5 (Pace, 1983).
*Indicates levels used for upper or lower bound of range.

Based on the staff assessment, the "range of interest" for examining potential PM_{10} standards was 55 to 110 $\mu g/m^3$, annual arithmetic mean. Because the original studies measured TSP, some uncertainty exists in deriving precise PM_{10} levels associated with possible effects.* Moreover, the upper end of this range overlaps the somewhat uncertain "effects levels" derived from these studies. CASAC felt that, due to these uncertainties, the upper end of the range (110 $\mu g/m^3$) may not include any margin of safety, and should not be considered as an appropriate standard alternative.

The lowest "effects likely" level identified in the assessment summarized in Table 2 is 90 $\mu g/m^3$ as PM_{10}, although effects are possible at lower concentrations. The effects of most concern relate to the possibility of long-term deterioration of the respiratory system in exposed populations, the potential for which is indicated by lung function (mechanical pulmonary) changes and increased incidence of respiratory disease. One set of studies (Ferris et al., 1973, 1976) provides some evidence for a "no observed effects" level at or below 60 to 65 $\mu g/m^3$ (130 $\mu g/m^3$ as TSP) while another, essentially negative study (Bouhuys et al., 1978), suggests some possibility of symptomatic responses at long-term median levels at or below about 50 to 55 $\mu g/m^3$ as PM_{10}. It is not clear whether these symptomatic responses, which were unaccompanied by lung function changes, represent adverse health effects.

A PM_{10} standard of 60 to 65 $\mu g/m^3$ would provide some margin of safety based on the studies of Ferris and co-workers, but would leave some small remaining risk of symptomatic responses. Because of associated uncertainties (SP, pp. 104–110) as well as the limited scope and number of these long-term quantitative studies, it is particularly important to examine the results of qualitative data from a number of epidemiological, animal, and air quality studies when evaluating what constitutes an adequate margin of safety for an annual standard. These studies justify concern for serious effects not directly evaluated in the studies listed in Table 2. Such effects include damage to lung tissues contributing to chronic respiratory disease, cancer, and premature mortality (SP, pp. 109–111). Substantial segments of the population may be susceptible to one or more of these effects (SP, p. 46). The available scientific data do not suggest major risks for these effects categories at current ambient particle levels in most U.S. areas. Nevertheless, the risk that both fine and coarse particles may produce these responses supports the need to limit long-term levels of PM_{10} for a variety of ambient aerosol compositions.

Although the qualitative data do not provide evidence for major risks of these effects categories at current annual particulate matter levels in most U.S. cities, the Administrator believes that the weight of the evidence, the seriousness of the potential effects, the large population at risk, and the recent information on converting TSP values to PM_{10} levels warrant caution in setting the standard, and suggest consideration of standards in a range of 50 to 65 $\mu g/m^3$. Given the precautionary nature of section 109 and the factors the Act permits him to consider, the Administrator favors a standard in the lower portion of this range. For reasons articulated in the discussion of the 24-hour standard, the Administrator has not selected a single level, but proposes that the level of the annual standard be selected from a range of 50 to 65 $\mu g/m^3$ (as PM_{10}), expected annual arithmetic mean. Public comment is solicited on what standard within this range that provides an adequate margin of safety against the risk of effects suggested by the available scientific information.

RATIONALE FOR THE SECONDARY STANDARDS

Introduction

Where secondary standards are concerned, the question of considering the costs and difficulties of attainment stands on a somewhat different footing. The Clean Air Act's legislative history contains a number of statements emphasizing that health must be the exclusive basis for setting primary standards, but no parallel language concerning secondary standards. To set a secondary standard that literally eliminated all welfare effects from air pollution could lead to very extreme control requirements. Indeed, since some regions are naturally dustier than others, and some have better natural visibility than others, a literal reading could compel those naturally dusty or low-visibility regions to clean up even beyond their natural background levels. Congress appeared to recognize some of these difficulties in that the Act allows the Administrator to use judgment in determining what constitutes an adverse welfare effect and the Act does not require the same stringent timetable for the secondary standards as for the primary standards.

If such a literal interpretation of the statute were truly intended, there would be no need for separate Clean Air Act programs to protect visibility or guard against significant deterioration. Yet Congress included these programs in the 1977 amendments to the Clean Air Act, and gave as one of its reasons that the secondary standards did not protect against all welfare effects, and that additional measures were therefore needed. See 1977 House Report pp. 201–05. Congress gave no indication that it expected revisions to the secondary standards that would change this situation.

Congress therefore seems to have assumed that the secondary standards would not literally protect against all welfare effects. But if the secondary standards are therefore not to be set based on a literal reading of the statute, that raises once again the question what factors may be considered in setting them.

In this regard, it is worth noting that striking anomalies arise in attempting to set welfare-based air quality standards according to some welfare effects but not others. For example, a tighter air quality standard might lead to a reduction in soiling and nuisance. However, such a standard could cause an increase in the price of electricity thus reducing the demand for air conditioning and increasing the discomfort factor. Both soiling and nuisance and personal well-being and comfort are welfare effects but in the case cited, a literal interpretation of the Act would allow one to be used but not the other in setting the secondary standards.

When the Agency first considered this issue in 1972, a staff memorandum (Schwartz, 1972) from the General Counsel's office argued that, though the

*As noted in Table 2, the original staff paper assessment assumed a PM_{10}/TSP ratio of 0.5 to 0.6. The discussion that follows also takes into account the results of more recent analyses suggesting that the median ratio may be as low as 0.45 to 0.5 (Pace, 1983). Applying this more recent information, the lower bound of the range of interest is reduced to 50 $\mu g/m^3$. Because this level represents a multi-year average in the original study, no adjustment is needed when considering this level as an expected annual mean.

better statutory reading was that costs and attainment problems could not be considered in setting secondary standards, the opposite conclusion could be supported by forceful arguments. As indicated previously, the D.C. Circuit has addressed the issue twice in the context of primary standards. *Lead Industries Association* v. *EPA*, supra, 647 F.2d at 1148–51; *American Petroleum Institute* v. *Costle*, supra, 665 F.2d at 1185, 1190. Neither case, however, involved a serious challenge to secondary standards on cost grounds. Although the opinions contain language that can be taken as hearing on the secondary standards issue, it is uncertain whether the court would have arrived at this conclusion in a case presenting issues of general welfare under secondary standards rather than public health under primary standards.

The Agency has not revised its position, based on the 1972 legal memorandum, that the better legal view is that attainment costs should not be considered in setting secondary standards. However, the Agency has not had occasion to face the issue directly since passage of the 1977 amendments. The issue remains a troubling one, worth further examination, particularly since this proposal sets forward a secondary standard that could have control impacts beyond those due to the primary standard. The Agency therefore invites comment on this issue.

The criteria document and staff paper examined the effects of particulate matter on such aspects of public welfare as visibility and climate, man-made materials, vegetation, and personal comfort and well-being. Each is discussed in some detail in the criteria document and staff paper. The following discussion of the rationale for the secondary standards focuses primarily on the considerations that were most influential in the Administrator's selection of a particular option, or that differ in some respects from or expand upon considerations that influenced the staff and/or CASAC recommendations.

Soiling and Nuisance

At high enough concentrations, both large and small particles may soil household and other surfaces, or otherwise become a nuisance. Both effects result in increased cost and decreased enjoyment of the environment (SP, p. 140). Efforts to control particulate matter in U.S. cities from 1970 to 1978 are estimated to have produced substantial economic benefits because of reduced soiling and nuisance (CD, p. 1–51). Based on these factors, the staff paper recommends consideration of soiling of materials and nuisance generated by dust and other particles in deciding upon a secondary standard (SP, p. 141).

In considering secondary standard(s) for particulate matter, the Administrator first determined whether the pollutant indicator (PM_{10}), averaging times and form, and range of levels of the proposed primary standards would provide adequate protection against the known or anticipated adverse welfare effects associated with soiling and nuisance. The decision with respect to each of these areas is discussed below.

Pollutant Indicator

Although both large and small particles can contribute to soiling and nuisance, the available scientific data do not provide quantitative information on the relative importance of various size fractions. The proposed indicator for the primary standards, PM_{10}, could also be considered as a useful indicator for a secondary standard based on soiling and nuisance because (1) small particles in the less than 10 μm size range are more likely to penetrate indoors and soil vertical surfaces (SP, pp. 136–137) and (2) due to the characteristic size distribution and origin of particles in the atmosphere (SP, pp. 14–19), control of particles less than 10 μm would also limit the concentration of large (coarse mode) particles, to some extent.

Nevertheless, the criteria document and everyday experience make it clear that particles larger than 10 μm, including visible dust and large soot, can soil horizontal and other surfaces outdoors and present a nuisance. A PM_{10} indicator would exclude the 50 percent or more of suspended particulate matter mass that is larger than 10 μm, and the ratio of PM_{10} to large particle levels can vary substantially from city to city. Therefore, PM_{10} would be an incomplete indicator for large particles and its use could result in a relatively large degree of variability in welfare protection among cities with differing PM_{10}/TSP ratios.

The current indicator for the secondary standard, TSP, incorporates a larger portion of the particles that can contribute to soiling and nuisance. Although TSP does not include some of the largest particles of concern nearest sources and the efficiency with which it collects such particles can vary with wind speed, control requirements for TSP would result in reductions in these larger particles as well. Most of the available information on such effects is related to TSP measurements, facilitating evaluation of alternative levels without the additional uncertainty added by converting to a different indicator. Given the lack of data permitting a clear distinction among particle size ranges with respect to soiling and nuisance, the more inclusive nature of TSP, and the use of TSP in available effects studies, the Administrator proposes to retain TSP as the indicator for a secondary standard designed to protect against soiling and nuisance.

While proposing to retain a TSP secondary standard, the Administrator solicits public comment on another option that is under consideration, that of making the secondary standard equivalent in all respects to the proposed primary standards for PM_{10}. As discussed above, both TSP and PM_{10} could be useful indicators for those particles responsible for soiling and nuisance. Based on the available scientific data, the choice between the two is difficult. Depending on the exact levels of primary standards chosen, the combined requirements for meeting both 24-hour and annual primary standards for PM_{10} might be considered adequate to protect against possible adverse welfare effects related to soiling and nuisance from all relevant particle sizes. This approach would also simplify monitoring and reporting requirements because information and control strategies would be required for only one pollutant.

Averaging Time and Form

Soiling and nuisance may result from both short-term dust episodes and longer-term accumulations of particles (SP, pp. 136–138). Most studies that indicate a relationship between particulate matter and these effects, however, have been based on annual average levels (SP, pp. 138–139). Moreover, strategies to prevent longer-term impacts appear to be more effective for protecting public welfare than those attempting to control temporary localized problems, such as a few days of windblown dust or pollen. Based on these considerations, an annual averaging time would appear to be more appropriate than a 24-hour standard. Therefore, the Administrator proposes to replace the current 24-hour secondary TSP standard with an annual standard.

For reasons presented in the discussion of proposed annual primary standards and for consistency in averaging and reporting between primary and secondary standards, the Administrator proposes an arithmetic mean and statistical form for the annual secondary standard. The proposed interpretation of this form is identical to

that for the primary particulate matter standard and is detailed in Appendix K of the proposed regulation.

Level

The available data base provides compelling evidence that elevated levels of particulate matter can produce adverse welfare effects, but provides little quantitative information on concentration-effects relationships. Physical damage and economic studies tend to show no obvious welfare effects "thresholds" for soiling. With time, particulate matter may accumulate on surfaces even at low concentrations. At very low concentrations, the amounts of particulate matter may be virtually invisible to the human eye or be so slight as to be ignored by most people (Carey, 1959; Hancock et al., 1976). Up to a point, the buildup of particles on surfaces may not be generally regarded as a social problem because it is removed by rain or routine cleaning and maintenance before substantial accumulation can occur. Thus, the critical judgment for selecting a standard level is to determine a particulate matter concentration at which the soiling effect is significant enough that it should be regarded as an "adverse" effect under section 109(b)(2) of the Act.

The available information suggests that the public makes a distinction between concentrations at which particulate pollution is noticeable and higher levels at which it is considered a nuisance. A study of the response of a panel of human subjects to dust on surfaces concluded that the level of dustiness that is found to be objectionable is higher than the level that can be perceived or discriminated (Hancock et al., 1976). No unique adverse particulate matter levels were, however, derived from this study. A more direct study of perception of air pollution as a nuisance (CD, pp. 9–67) suggests that the subjects began to consider air pollution a nuisance in areas where annual levels were at or somewhat above the level of the current annual primary TSP standard. Opinions expressed by some CASAC members (November, 1981 transcript, pp. 63–66) supported this suggestion. The committee as a whole did not, however, make any recommendations regarding a range of interest for a secondary TSP standard.

Several studies of economic effects associated with soiling by particulate matter are discussed in the criteria document. These studies suggest the possibility of substantial economic benefits in moving from TSP concentrations equivalent to the current primary annual standard to levels as low as the current annual guide for attaining the secondary standard (CD, pp. 10–54 to 10–69). The criteria document points out the tentative and largely qualitative nature of these studies, but uses them to provide a crude estimate of the magnitude and direction of benefits in reduced outdoor soiling associated with decreased TSP levels in U.S. cities. A 20 percent improvement in TSP from a starting point close to the current primary annual standard resulted in an estimated national economic benefit of $0.2 to $0.7 billion/yr in 1978 dollars (CD, p. 10–73). As discussed in the criteria document and the staff paper (SP, p. 139–140), the original studies are too uncertain to make this anything but a crude qualitative estimate.

The studies and information discussed above can be used to suggest a range for alternative annual secondary standards. Based on the study of perception and suggestions by individual CASAC members, a TSP standard at or near the current annual primary standard may protect public welfare against adverse effects related to soiling and nuisance by particles. Even though the available data are qualitative and uncertain, the weight of evidence would suggest that it is unwise to reverse the progress towards increasing benefits associated with implementing the current primary standard. Accounting for the change to arithmetic mean and statistical form, a level of 80 to 90 $\mu g/m^3$ expected annual arithmetic mean would be consistent with maintaining welfare protection equivalent or near to that provided by the present annual standard. These levels form the upper bound of the range of interest.

The rough economic estimates in the criteria document suggest the need to consider the possibility of more stringent standards, at levels approximately equivalent to the current annual guide for the secondary standard. Applying appropriate adjustments for form and averaging time, a standard of about 70 $\mu g/m^3$ annual arithmetic mean is approximately equivalent to the current annual guide. This level forms the lower bound for the range of interest.

The range of interest for the secondary standards developed above is thus 70 to 90 $\mu g/m^3$, expected annual arithmetic mean. Because CASAC and the public have not reviewed or commented on this range and because of the uncertainties in the information, the Administrator is proposing to select the final standard from within this range and has not decided upon a single standard level. Given the large uncertainties in the available information, the Administrator is inclined to continue the level of protection provided by the current annual TSP standard and select a level from the upper portion of the above range. The Administrator solicits public comment on the most appropriate level, and in particular seeks the guidance of knowledgeable State and local air pollution officials with respect to levels at which the public appears to consider particulate matter to be a nuisance.

Other Welfare Effects

The other welfare effects of particulate matter of principal interest include impairment of visibility, potential effects on climate, and contribution to acidic deposition. These potential effects are most strongly related to regional scale fine particle levels and any standards and controls would likely involve regional sulfur oxide emissions (SP, p. 147; Friedlander, 1982). The staff and CASAC pointed out the advantages of recognizing the interrelated aspects of the known and potential effects of fine particles on visibility and climate together with the acidic deposition phenomenon when considering a possible fine particle standard.

In view of these considerations, the Administrator has decided to defer a decision on a possible fine particle secondary standard until it is possible to link such a standard with a coherent, scientifically based strategy for these related regional air quality problems. EPA is continuing to evaluate alternative approaches to address acidic deposition. In parallel with this effort, the Agency is examining the implications of acidic deposition control strategies on visibility and other air quality values. The results of this examination together with other relevant information will be used in preparing an advance notice of proposed rulemaking soliciting public comment regarding a possible fine particle secondary standard.

The Administrator also concurs with the staff suggestions that a separate secondary particle standard is not needed to protect vegetation or to prevent adverse effects on personal comfort and well-being.

NEED FOR ADDITIONAL RESEARCH

A troublesome aspect of this standard decision is the large uncertainty in available scientific information. In this regard, CASAC transmitted to the Administrator its review of the scientific data base and assessment of research

needs for particulate matter as well as several other criteria pollutants (Lippmann, 1983). In this most recent assessment, the committee indicated that "the research needs for particulate matter (PM) are substantially greater than those for any of the other criteria pollutants discussed in this report" and that their "review also revealed a highly limited data base, particularly where quantitative studies were concerned, and a wide range of views about the effects of specific constituents of PM and the exposure levels at which adverse health or welfare effects are likely to, or may possibly, occur." While the report points out a number of specific areas where additional research is needed on both health and welfare effects, the main areas include:

1. The physicochemical properties of PM as they affect health;
2. The nature of health effects of PM and its major constituents;
3. Quantitative relationships between PM and health effects in sensitive population groups;
4. Effects on visibility; and
5. Soiling and nuisance effects.

The Agency is examining its research program in these areas and will, to the extent resources allow, incorporate the CASAC recommendations in its research planning process.

FEDERAL REFERENCE METHOD

Approach

The current appendices to 40 CFR Part 50 describe requirements for reference methods to be used for measuring each of the pollutants for which an NAAQS has been established. For each pollutant, a corresponding appendix specifies either (1) a complete, unique, manual reference method (e.g., TSP, SO_2, Pb) or (2) a measurement principle and calibration procedure applicable to automated reference methods, which must also meet performance requirements specified in 40 CFR Part 53 (e.g., CO, O_3, NO_2).

Accordingly, a new Appendix J is proposed today to describe the requirements for reference methods for PM_{10}. The proposed Appendix, however, would deviate somewhat from the established scheme in that the method described is considered a manual method even though the requirements resemble the measurement principle and performance requirements normally prescribed for automated methods. This approach would provide greater flexibility, allow the use of currently available particulate matter samplers and encourage continuing improvements and innovative sampler design.

Many of the concepts and approaches underlying the proposed PM_{10} reference method requirements have been established on the basis of extensive consultation, assistance, and general consensus among numerous particulate matter monitoring experts both within and outside EPA. In particular, EPA sponsored two workshops (October 1979 and November 1980) that brought together many of these experts to help formulate size-specific monitoring requirements (Kashdan and Ranade, 1982).

The proposal of PM_{10} as an indicator of particulate matter is discussed in an earlier section of this notice. The PM_{10} indicator is, in effect, defined by the sampling requirements, which in turn were designed to approximate particle penetration to the thoracic region of the human respiratory tract (as developed from studies using mouthpieces). In practice, however, the mass collected by ambient samplers is more dependent on the cut point than on matching other parameters of respiratory tract penetration (Rodes et al., 1981). Thus, samples with a 50 percent cut point of 10 μm that meet the size discrimination specifications in 40 CFR Part 53 will provide a reliable estimate of the total mass of suspended particulate matter less than or equal to 10 μm in aerodynamic diameter. The proposed requirements specify a 50 percent cut point of 10 ± 1 μm and designate total mass collection tolerances for typical atmospheric particle distributions.

The proposed reference method for PM_{10} is based on discrimination and selection of PM_{10} particles by inertial separation in a specially shaped inlet, followed by conventional filtration of a measured volume of sampled air and determination of the net weight gain of the filter. The normal sampling period would be 24 hours. The size discrimination characteristics of the sampler (or sampler inlet) would be required to meet specifications and be tested according to explicit test procedures prescribed in 40 CFR Part 53. Methods for PM_{10} that meet all requirements would be designated as PM_{10} reference methods according to the method identification, which in most cases would probably be the manufacturer and model of the sampler.

Wherever feasible, the requirements in Appendix J are prescribed as functional or performance specifications rather than design specifications to allow maximum flexibility in designing or configuring PM_{10} samplers. Sampler shape, inlet geometry, filter material and size, operational flow rate, degree of automation, and so forth are all specified in terms of required function or performance.

The proposed reference method prescribes no specific flow-rate for PM_{10} samplers. High flow-rate samplers, such as the existing high volume samplers equipped with a size-selective inlet, would be approved if they meet the other performance requirements. Medium- and low-flow samplers would also be allowed, provided enough mass is collected to meet the reproducibility specification. PM_{10} samplers would be required to minimize measurement errors resulting from filter handling operations such as conditioning, weighing, and installation in and removal from samplers. The alkalinity specification would disallow the use of excessively alkaline media that could lead to possible measurement errors from artifact formation on the filter. Filters meeting this specification should show little or no sulfate artifact but may be subject to errors due to nitrate artifact. However, for most sampling locations, PM_{10} mass concentration errors due to positive nitrate artifact or loss of nitrate by volatilization or chemical rection are expected to be small.

The proposed filter medium specifications are intended to be minimum requirements when measurement of PM_{10} mass concentration is of primary concern. Users would need to consider additional filter medium criteria if other sampling objectives were to be met.

Reference method samplers must have the capability of collecting valid samples at ambient concentration levels consistent with the proposed NAAQS. A filter's capability of withstanding high particle mass loadings under a variety of environmental conditions without overloading (clogging) is an important concern. Ideally, the pressure drop across the filter should be sufficiently low to minimize the potential for overloading. To further minimize this possibility, samplers should have the capability of maintaining normal flow rates over as wide a range of pressure drop as is practical.

Sampler manufacturers are encouraged to consider the potential for filter overloading in designing their samplers and in selecting their recommended filter media. Samplers that incorporate filter-changing mechanisms to automatically switch from a particle loaded filter to a fresh filter would be allowed, provided the reproducibility of the PM_{10} measurement met the required specification.

Sampler manufacturers would be required to provide sampler purchasers

with an operation or instruction manual containing detailed procedures for calibration and operation of the sampler, as well as recommendations regarding appropriate filter media and type of analytical balance required for mass determinations. Such a manual would be required by 40 CFR Part 53, which would require submission of the manual as part of the manufacturer's application for a reference method determination.

Technical Change to Appendix G

The high-volume method described in Appendix B will continue to be used for the proposed secondary standard and in conjunction with Appendix G ("Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air") and for other purposes that may be specified. Accordingly, EPA proposes to delete reference 10 in Appendix G and to revise section 5.1.1 of the Appendix to read as follows: "High Volume Sampler. Use and calibrate the sampler as described in Appendix B to this Part." The Appendix would also be revised to specify more directly that the high-volume method described in Appendix B is to be used in conjunction with the reference method for lead.

PREVENTION OF SIGNIFICANT DETERIORATION

Pursuant to a settlement with petitioners in *Chemical Manufacturers Association v. EPA*, D.C. Cir. No. 79-1112, EPA agreed to propose revision to certain requirements for the prevention of significant deterioration of air quality (PSD), if appropriate, at the time it proposed revisions to the particulate matter standards. Section 163 of the Act lists numerical increments for "particulate matter" that limit increases in ambient concentrations of that pollutant over established baseline values. The Act, however, does not define "particulate matter." EPA has traditionally defined this pollutant in terms of TSP, because the air quality standards have used that indicator. In a major decision in 1979, the D.C. Circuit indicated—though it was not essential to the resolution of the issues then at hand—that EPA has discretion to define particulate matter differently, provided that the definition encompassed all particles having a substantial health or welfare effect and excluded only those having no such impact. *Alabama Power Company v. Costle* 636 F.2d 323, 370 n. 134. Implicit in this view is that the Agency may not change to a definition of particulate matter that would exclude particles that are known to have adverse impacts on public health or welfare.

Various industries, especially the mining industry, have sought relief from the PSD increment based on TSP. In its litigation settlement with industry petitioners in *Chemical Manufacturers Ass'n v. EPA*, EPA agreed to propose certain regulatory changes, but only to the extent that they could be technically supported. In relevant part the settlement stated that "[w]hen EPA proposes a new size cutoff for purposes of the NAAQS, it shall also propose (a) a new size cutoff for PSD purposes that would remain in effect indefinitely (i.e., the 'permanent PSD cutoff') and (b) and iterim size cutoff for PSD purposes that would remain in effect until EPA takes final action on the permanent PSD cutoff. The interim cutoff will exclude only those particles which clearly appear not to pose substantial health and welfare risks and therefore are highly likely to be excluded permanently."[1]

As discussed in the rationale for the primary and secondary standards, although the Agency's review of the data suggests that particles larger than ten micrometers might be safely excluded from the primary standard, such particles can contribute to soiling and nuisance and therefore may have substantial welfare effects. The Administrator is proposing to retain TSP as the indicator for the secondary standard in large part because it includes most of these large particles and may therefore be a better indicator of all particles that produce soiling and nuisance. Thus, by the terms of the CMA agreement itself, there appears to be no appropriate cutoff below that for TSP for PSD purposes, and the contemplated interim and permanent relief is not available. Therefore, EPA proposes not to change how "particulate matter" is defined for purposes of the PSD increments. EPA solicits comments on this proposal.

As discussed above, EPA in response to comments conceivably might adopt a size cutoff below that for TSP for purposes of the secondary standard. Even if it does that, there is considerable question as to whether EPA could then also adopt the same cutoff for purposes of the PSD increments. EPA therefore solicits comment on this possible change to the increments and in particular on the merits of the position that EPA has some discretion to define particulate matter for PSD purposes.

EPA has established a separate docket for the review of the definition of particulate matter for purposes of the prevention of significant deterioration increments. Comments on this issue should be sent to this docket (Docket No. A-83-48) and not to the rulemaking dockets established for the proposed national ambient air quality standards.

REGULATORY AND ENVIRONMENTAL IMPACTS

Regulatory Impact Analysis

Under Executive Order 12291, EPA must judge whether a regulation is a "major" regulation for which a Regulatory Impact Analysis (RIA) is required. The Agency has judged the particulate matter NAAQS proposal to be a major action, and has prepared a draft RIA based on information developed by several EPA contractors (inter alia, Argonne, 1983; Mathtech, 1983). It includes estimates of costs, benefits, and net benefits associated with alternative standards. The draft analysis, entitled Regulatory Impact Analysis of the National Ambient Air Quality Standards for Particulate Matter-Draft (EPA, 1983), is available from the address given above (see Availability of Related Information section). A final RIA will be issued at the time of promulgation.

Neither the draft RIA nor the contractor reports have been considered in issuing this proposal. The Administrator has not seen these documents nor has he been briefed on their contents. As had been noted, several recent judicial decisions make clear that the economic and technological feasibility of attaining ambient standards are not to be considered in setting them, although such factors may be considered to a degree in the development of State plans to implement the standards. The Agency is currently considering the generic issue of the role, if any, of benefits analysis, or parts thereof, in setting ambient standards. If the Agency concludes that information from benefits analyses may be legally and technically relevant to standard setting, Agency staff will review the benefits information in the particulate matter RIA and contractor reports to determine whether or not any portions of if appear to be relevant in this rulemaking. Becuase the approaches used and the results have not been subject to extensive peer review, EPA would then submit the portions thought

[1] EPA also agreed to publish certain guidance regarding postponement of SIP revisions for correction of violations of PM increments and for issuance of basic State new source review permits (i.e., permits issued under State regulations meeting 40 CFR 51.18(a)-(i)) to sources that would cause a violation of a PM increment. That guidance was included in EPA's proposed rulemaking of August 25, 1983, 48 FR 38742.

to be relevant to CASAC and the public for comment on their scientific and technical adequacy and whether they should be considered in the final decision on the particulate matter standards.

The draft RIA has been submitted to the Office of Management and Budget (OMB) for review under Executive Order 12291. Any comments from OMB and any EPA responses to those comments are available for public inspection at EPA's Central Docket Section (Docket No. A–82–37), West Tower Lobby, Gallery I, Waterside Mall, 401 M Street, S.W., Washington, D.C.

Impact on Reporting Requirements

This proposed rule does not contain any information collection requirements subject to OMB review under the Paperwork Reduction Act of 1980 U.S.C. 3501 *et seq.*

Impact on Small Entities

Under the Regulatory Flexibility Act, 5 U.S.C. 600 et seq., the Agency must prepare a regulatory flexibility analysis assessing the impact of any proposed or final rule on small entities. Under 5 U.S.C. 605(b) this requirement may be waived if the Agency certifies that the rule will not have a significant economic effect on a substantial number of small entities. Small entities include small businesses, small not-for-profit enterprises, and governmental entities with jurisdiction over populations of less than 50,000. EPA has made an effort to assess the potential impacts on small entity groups as part of the economic impact analysis in Section V.F. of the RIA (EPA, 1983). The preliminary assessment based on selected industries does not suggest that the proposed revisions will significantly affect a substantial number of small entities for the group of potentially affected industries. For reasons outlined below, however, this analysis is limited and does not permit definitive findings with respect to all potentially affected small entities.

The major analytical difficulty results from the extremely large number of potentially affected industries (over 280 at the 4-digit SIC code level). This makes it impractical at present to gather and analyze all of the information on plant size and ownership that would be necessary to perform detailed economic impacts analyses on each small entity group. In an attempt to develop some of the information necessary for a regulatory flexibility analysis, a screening analysis was performed in Section V.D. of the RIA (EPA, 1983). This analysis selected 16 of the most affected industries (out of a total of 280 industries) for further examination. For the 16 industries as a group, the percentage of potentially affected plants (both large and small) was less than 20 percent, which would suggest that the percentage of small entities affected within the 280 industries would not be substantial (i.e., not greater than 20 percent). Nevertheless, this limited analysis does not permit a clear determination of whether significant impacts would be incurred by a substantial number of small entities.

Additionally, after promulgation of national ambient air quality standards, the control measures necessary to attain and maintain them are developed by the respective states as part of their state implementation plans. In selecting such measures, the states have considerable discretion so long as the mix of controls selected is adequate to attain and maintain the ambient standards. Whether a particular standard would have a significant effect on a substantial number of small entities then depends to some extent on how the states would choose to implement it. For these reasons, any assessment performed by EPA at this time is necessarily somewhat speculative. Moreover, although the proposed standards may impact some small entities when they are implemented by the states, it appears that this factor, like other economic and technological feasibility factors, cannot affect the Agency's decision.

OTHER REVIEWS

This proposed rule was submitted to the Office of Management and Budget (OMB) for review. Any comments from OMB and any EPA responses to these comments are available for public inspection at EPA's Central Docket Section (Docket No. A–82–37), West Tower Lobby, Gallery I, Waterside Mall, 401 M Street, S.W., Washington, D.C.

List of Subjects in 40 CFR Part 50

Air pollution control, Carbon monoxide, Ozone, Sulfur oxides, Particulate matter, Nitrogen dioxide, Lead.

Dated: March 8, 1984.

William D. Ruckelshaus,

Administrator.

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Addendum I—Executive Summary—Review of the National Ambient Air Quality Standards for Particulate Matter: Assessment of Scientific and Technical Information—OAQPS Staff Paper (EPA, 1982)

EXECUTIVE SUMMARY

This paper evaluates and interprets the available scientific and technical information that the EPA staff believes is most relevant to the review of primary (health) and secondary (welfare) National Ambient Air Quality Standards (NAAQS) for particulate matter and presents staff recommendations on alternative approaches to revising the standards. Review of the NAAQS is a periodic process instituted to ensure the scientific adequacy of air quality standards and is required by Section 109 of the 1977 Clean Air Act Amendments. The assessment in this staff paper is intended to help bridge the gap between the scientific review contained in the EPA criteria document "Air Quality Criteria for Particulate Matter and Sulfur Oxides" and the judgments required of the Administrator in setting ambient standards for particulate matter. The staff paper is, therefore, an important element in the standards review process and provides an opportunity for public comment on proposed staff recommendations before they are presented to the Administrator.

Particulate matter represents a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) ranging in size from molecular clusters of about 0.005 micrometers (μm) to coarse dusts on the order of 100 μm. Particles originate from a variety of stationary and mobile sources and may be emitted directly or formed in the atmosphere by transformations of gaseous emissions such as SO_2. The major chemical and physical properties of particulate matter vary greatly with time, region, meteorology and source category, complicating the assessment of health and welfare effects as related to various indicators of particulate pollution. Typical particle distributions reveal differences in origin and composition for fine particles (<2.5 μm) and coarse particles (>2.5 μm). The reference method for the current standards for particulate matter is the "hi volume" sampler which collects particulate matter of particle sizes up to 25–45 μm (so called "Total Suspended Particulate" or TSP).

At elevated concentrations, particulate matter can adversely affect human health, visibility, climate, materials, economic values, personal

comfort and well-being, and vegetation. Components of particulate matter (e.g., sulfuric acid) also contribute to acid deposition. Typical long-term average levels of TSP range from 20–40 $\mu g/m^3$ in rural areas to over 150 $\mu g/m^3$ in the most polluted urban industrial areas. Maximum 24-hour TSP concentrations exceed 500 $\mu g/m^3$. Long-term fine particle (<2.5 μm) levels range from 2 to 5 $\mu g/m^3$ in isolated arid western areas to 20–50 $\mu g/m^3$ in the rural East. The highest annual fine particle levels, on the order of 50 $\mu g/m^3$, occur in the most polluted urban industrial areas.

Primary Standards

The staff has reviewed scientific and technical information on the known and potential health effects of particulate matter cited in the criteria document. The information includes studies of respiratory tract deposition of particles, studies of mechanisms of toxicity, effects of high exposures to various particulate substances in controlled human and animal studies, epidemiological studies, and air quality information. Based on this review, the staff derives the following conclusions.

(1) The mechanisms by which inhaled particles may pose health risks involve (a) penetration into and deposition of particles in the various regions of the respiratory tract, and (b) the biological responses to the deposited materials.

(2) The risks of adverse effects associated with deposition of ambient fine and coarse particles in the thorax (tracheobronchial and alvelor regions of the respiratory tract) are markedly greater than for deposition in the extrathoracic (head) region. Maximum particle penetration to the thoracic regions occurs during oronasal or mouth breathing.

(3) The major effects categories of concern associated with high exposures to particulate matter include: (a) Effects on respiratory mechanics and symptoms, (b) aggravation of existing respiratory and cardiovascular disease, (c) effects on clearance and other host defense mechanisms, (d) morphological alterations, (e) carcinogenesis, and (f) mortality.

(4) The major subgroups of the population that appear likely to be most sensitive to the effects of particulate matter include: (a) Individuals with chronic obstructive pulmonary or cardiovascular disease, (b) individuals with influenza, (c) asthmatics, (d) the elderly, (e) children, (f) smokers, and (g) mouth or oronasal breathers.

(5) Although controlled animal and human studies, and qualitative epidemiological results can provide important insights into the health risks from particles, the most useful concentration-response information comes from a limited set of community epidemiological studies conducted over the last 25 years in Great Britain and the United States.

Based on the scientific and technical reviews as well as policy considerations, the staff makes the follows recommendations with respect to primary particulate matter standards.

(1) Despite the variability in the composition of ambient particles with time and space, the available data suggest that reductions in ambient particulate matter in Great Britain and the U.S. have benefited public health and reduced the need for separate control programs for many of the more innately toxic components of particulate matter. Elevated particulate matter exposures in current U.S. settings most frequently occur without concomitant high SO_2 levels. Considering these observations, a separate general particulate matter standard remains a reasonable public health policy choice.

(2) The current TSP standard directs control efforts towards particles of lower risk to health because of its inclusion of larger particles which can dominate the measured mass concentration, but which are deposited only in the extrathoracic region. A new particle indicator representing those particles capable of penetrating the thoracic regions (thoracic particles, TP) is recommended. Protection of sensitive individuals breathing oronasally or by mouth, sampler reliability, and the convention recently adopted by the International Standards Organization (ISO) suggest that the particle size range include those particles less than a nominal 10 μm (D_{50}). Sampler performance criteria should be related to respiratory tract deposition data. Prototype samplers meeting these criteria are being field tested; reliable commercially available models must await test results.

(3) Both short-term (24-hour) and annual arithmetic mean standards are recommended. The short-term standard should be expressed in statistical form with the decision on the allowable number of exceedances made in conjunction with establishing a level for the Standard.

(4) Selecting a level for a particulate standard with an adequate margin of safety will involve a number of uncertainties in addition to those involved in making judgments on health risks associated with specific substances such as CO or SO_2. Quantitative assessments must be based on limited epidemiological studies conducted in times and places where pollutant composition may have varied considerably from current U.S. atmospheres. Epidemiological studies are generally subject to a number of inherent difficulties involving confounding variables and somewhat limited sensitivity. Most studies have used British smoke (a pseudo mass indicator related to small particle (<4.5 μm) darkness) or TSP as particle indicators. None of the published studies have used the recommended TP (<10 μm) indicator. Thus, appropriate assumptions must be used to express available results in common units.

The staff assessment of short-term epidemiological data is summarized in Table 1; levels are expressed in both the original and TP units. The "effects likely" row denotes concentration ranges derived from the criteria document at or above which there appears greatest certainty that effects would occur. The data do not, however, show evidence of clear population thresholds but suggest a continuum of response with both the risk of effects occurring *and* the magnitude of any potential effect decreasing with concentration. Thus, effects may be possible at levels below those listed in the "effects likely" row, but the evidence and risks at lower levels are much less certain.

TABLE 1.—STAFF ASSESSMENT OF SHORT-TERM EPIDEMIOLOGICAL STUDIES

Effects/study	Measured British smoke levels (as $\mu g/m^3$)			Equivalent TP (<10 μg) levels ($\mu g/m^3$)—Combined range[3]
	Daily mortality in London [1]	Aggravation of bronchitis [2]	Combined range	
Effects likely	500 to 1000	250* to 500*	250 to 500	350 to 600.
Effects possible	150* to 500	<250*	150 to 250	150 to 350.

[1] Deviations in daily mortality from mean levels examined in 3 studies encompassing individual London winters of 1958–59 and 14 aggregate winters from 1958–72. Early winters were dominated by high smoke dominated by coal combustion emissions and high SO_2 with frequent fogs.

[2] Examination of symptoms reported by bronchitics in London. Studies conducted from the mid-1950's to the early 1970's.
[3] Conversion assumes that for London smoke conditions, BS< TP < TSP. Precise conversions are not possible. The lower bound assumption (BS = TP) incorporates some margin of safety and is used to estimate the lower bound in the effects possible range. The upper bound (TP = TSP = BS + 100 μg/m³) likely overestimates TP levels and is used to provide estimates of levels where effects are most likely.
* Indicates levels used for upper or lower bound of range.

Based on this staff assessment, the range of 24-hour TP levels of interest are 150 to 350 μg/m³. Under the conditions prevailing during the London studies, the upper end of the range represents levels at which effects are likely in the sensitive populations studied. Given the uncertainties in translating these results to U.S. conditions and the seriousness of the potential health effects, the upper end of the above range contains no identifiable margin of safety and should not be considered as an appropriate standard alternative. The uncertainties and the nature of the potential effects are important margin-of-safety considerations. Neither the studies summarized above nor more qualitative studies of effects in other sensitive population groups (e.g., asthmatics, children), or effects in controlled human or animal studies provide scientific support for health risks of consequence below 150 μg/m³. These qualitative data as well as factors such as aerosol composition and exposure characteristics should also be considered in evaluating margins of safety associated with alternative standards in the range of 150 μg/m³ to something below 350 μg/m³.

The staff assessment of important long-term epidemiological data is summarized in Table 2. Long-term epidemiological studies are subject to additional confounding variables that reduce their sensitivity and make interpretation more difficult. The "effects likely" levels are derived from the criteria document, but again, no clear population thresholds exist for all effects indicators. Some risk of effects are possible at lower levels, but these are uncertain and difficult to detect in these studies.

Based on this staff assessment, the range of annual TP levels of interest are 55 to 110 μg/m³. The upper end of this range overlaps the somewhat uncertain "effects levels" derived from these studies. Due to these uncertainties, the upper end of the range (110 μg/m³) may not include any margin of safety, and should not be considered as an appropriate standard alternative. The lower end (55 μg/m³) represents a level where some risk of symptomatic effects might remain but no detectable differences in plumonary function or marked increases in respiratory diseases are expected. Increases in symptomatic effects at the lower levels are uncertain and small in comparison to baseline rates.

TABLE 2.—STAFF ASSESSMENT OF LONG-TERM EPIDEMIOLOGICAL STUDIES

Effects/study	Measured BS levels (as μg/m³)—increased respiratory disease, reduced lung function in children [1]	Measured TSP levels		Combined range	Equivalent TP levels (μg/m³) combined range [4]
		Increased respiratory disease symptoms, small reduction in lung function in adults [2]	Increased respiratory symptoms in adults [3]		
Effects likely	230 to 300 BS	180*		>180	90 to 110.
Effects possible	<230 BS	130 to 180*	60 to 150 (110*)	110 to 180	55 to 110.
No significant effects noted		60* to 130		60 to 110	40 to 55.

[1] Study conducted in 1963–65 in Sheffield, England. BS level's (μg/m³) uncertain.
[2] Studies conducted in 1961–73 in Berlin, NH. Major source in community was pulp mill. Effects level (180 μg/m³) based on 2 month average. Effects on lung function were relatively small.
[3] Study conducted in 1973. Exposures reflect 1965–73 data in Ansonia, CT. Median value used as an indicator. Essentially negative study. No effects on lung function, but some suggestion of effects on respiratory symptoms.
[4] Conversion based on estimated ratio of TP/TSP for current (1960–81) U.S. atmospheres. The ratio ranges between about 0.5 to 0.6. These numbers are used as lower and upper bounds for estimating TP equivalents from TSP values.
* Indicates levels used for upper or lower bound of range.

When evaluating margins of safety for an annual standard, it is particularly important to examine the results of qualitative data from a number of epidemiological, animal, and air quality studies. These suggest concern for effects not directly evaluated in the studies listed in Table 2. Such effects include damage to lung tissues contributing to chronic respiratory disease, cancer, and premature mortality. The available scientific data do not suggest major risks for these effects categories at current ambient particle levels in most U.S. areas. Nevertheless, the risk that both fine and coarse particles may produce these responses supports the need to limit long-term levels of TP for a variety of aerosol compositions.

Because of different form, averaging procedure and size range, precise comparisions between the above range of TP standards and the current primary TSP standards are not possible.* The lower bounds, taken together, result in standards roughly equivalent in stringency to the current standards. In general, the rest of the ranges represent increasing degrees of relaxation as compared with the current standards. At the lower concentrations in the ranges, much of the relaxation would result because only smaller particle sizes would be collected. Thus, a city where exceedance of the TSP standard was largely dominated by coarse mode dust (with substantial mass of particles greater than 10 μm) would be less likely to violate a comparable TP standard than would an area where exceedance of the TSP standard was dominated by particles smaller than 10 μm. At higher concentrations in the above ranges, standards would permit increased levels for TP as well as for larger particles.

*By applying observed TP/TSP ratios and other factors, crude comparisons can be made. The current annual TSP standard (75 μg/m³ geometric mean) is roughly equivalent to an arithmetic mean of 50 μg/m³ as TP. The numerical value of the 24 hr TSP standard (260 μg/m³) is roughly equivalent to 140 μg/m³ TP, but this does not account for differences between the deterministic (current standard) and recommended statistical form.

Secondary Standards

The staff examined information in the criteria document relevant to the review of the secondary standards. Categories of welfare effects examined include visibility and climate, man-made materials, vegetation, and personal comfort and well-being. Major staff conclusions and recommendations are summarized below.

(1)(a) Impairment of visibility by fine particles over urban to multistate regions clearly affects public welfare. Fine particles or major constituents thereof also are implicated in climatic effects, materials damage, soiling, and acid deposition. Neither the current secondary TSP standard nor the recommended ranges of TP standards

will protect visibility in an effective manner. The staff, therefore, recommends consideration of a fine particle secondary standard, based primarily on the relatively well-defined quantitative relationships between fine mass and visibility.

(b) If a fine particle standard is selected, a seasonal (calendar quarter) averaging time could provide a statistically stable target and yet achieve most short or long-term visibility goals. Consideration should be given to specifying a spatial average of three or more monitors placed at distances on the order of 16–50 km.

(c) Despite the fact that the public is concerned about visibility and is willing to pay something for clean air, quantitative bases for evaluating visibility goals have not been established. Therefore, the level of any standard must be based on the judgment of the Administrator after consideration of aesthetics and transportation, as well as non-visibility related effects. The staff recommends that any national standards focus on welfare effects associated with multistate eastern regional (and western urban) haze. Such standards would not of themselves protect sensitive scenic areas of the West, but these areas are directly and indirectly addressed by other provisions of the Clean Air Act.

(d) Empirical ranges for standards can be derived from approximate estimates of eastern natural background and current summertime fine particle levels. The range thus derived is 8–25 $\mu g/m^3$, seasonal and spatial average. The upper portion of the range would tend to maintain the *status quo* in the East. Current summertime visual range in much of the East is about 9–15 miles. Because the lower portion of the range approaches natural background levels, standards set at the lower levels would be, in all practicality, unattainable in most of the eastern U.S. Estimated summertime visibility under eastern natural background conditions is on the order of 3 to 5 times greater than under current conditions.

(e) Because regional fine particles in the East appear to be influenced most strongly by sulfates, adoption of a fine particle standard would trigger a substantial departure from current approaches to particle control strategies. The evidence suggests that multistate control of regional sulfur oxide emissions might be needed to reduce fine particle levels. Thus, fine particle/visibility-climate effects are linked to acid deposition, and these problems would likely be ameliorated by similar control strategies. Addressing these welfare effects with a common standard or control strategy is likely to be more efficient than establishing separate control approaches for each. Appropriate scientifically based targets and control strategies for acid deposition are not yet available.

(2) Although poetntial effects on climate support the consideration of a fine particle standard, quantitative relationships are not well enough developed to provide the principal basis for selecting the level of the standard.

(3) Consideration should be given to soiling and nuisance effects in determining whether a secondary standard for TP or for TSP or some other large particle indicator is desirable to supplement the primary health and secondary fine particle standards. The available data base on such effects is, however, largely qualitative. Therefore, the basis for selecting a particular level for a secondary TP or TSP standard is a matter of judgment.

(4) While chemically active fine mode and hygroscopic coarse mode particles have been qualitatively associated with materials damage, the available data do not clearly suggest major effects of particles on materials for concentrations at or below the ranges recommended for the primary health and secondary visibility standards. Therefore, a secondary standard based solely on materials damage is not recommended.

(5) The staff concludes that a secondary particle standard is not needed to protect vegetation.

(6) The acid deposition issue will not be addressed directly in the review of the particulate matter standards.

Addendum II—Casac Review and Closure of the Criteria Document for Sulfur Oxides/Particulate Matter

January 29, 1982.

Subject: CASAC Review and Closure of the Criteria Document for Sulfur Oxides/Particulate Matter

From: Sheldon K. Friendlander, Chairman, Clean Air Scientific Advisory Committee (CASAC)

To: Anne M. Gorsuch, Administrator

On November 16, 1981, the Clean Air Scientific Advisory Committee of the Science Advisory Board completed its third review of the air quality criteria document for sulfur oxides/particulate matters (SO_x/PM). The Committee notes with satisfaction the improvements made in the quality of the document during the course of previous CASAC reviews on August 20–22, 1980 and July 7–9, 1981. The staff of the Environmental Criteria and Assessment Office, directed by Dr. Lester Grant, have proven responsive to Committee advice as well as to comments provided by the general public, and deserve to be commended for the high quality of the document.

The purpose in writing you is to summarize the Committee's major conclusions to assist you in reviewing the scientific data and associated studies relevant to the establishment of revised ambient air quality standards for sulfur dioxide and particulate matters as required by law. This letter further advises you of the Committee's conclusion that the criteria document fulfills the requirements set forth in Section 108 of the Clean Air Act as amended, which requires that the document "shall accurately reflect the latest scientific knowledge useful in indicating the kind and extent of all indentifiable effects on public health or welfare" from suflur oxides and particulates in the ambient air.

The Committee is preparing a separate letter to you summarizing the conclusions of its reviews of the Draft Staff Paper for Particulate Matter. In addition, CASAC will prepare a similar report on the Draft Staff Paper for Sulfur Oxides once that document becomes available and its review is completed.

MAJOR SCIENTIFIC ISSUES AND CASAC CONCLUSIONS IN THE SOx/PM CRITERIA DOCUMENT REVIEW

Chapter 1: Executive Summary

In general, the revised draft Executive Summary critically synthesizes the key points of information discussed at length in the individual chapters. Its conclusions and interpretations of scientific data, studies, and issues are consistent with those presented in each chapter. Relationships among individual chapters are clearly defined; redundancies that do appear are reasonable given the complexity of the subject.

The quality of the Executive Summary would be further improved if more specific statements and/or tables were added to clarify certain important interrelationships. These include the differences in chemical composition associated with each of the several significant size ranges of particulate matter; and the health effects associated with the respiratory tract deposition patterns of particulate matter in the several size ranges and different chemical compositions. Quantitative health effects information useful in defining specific concerntrations or ranges of concentrations of size-specific and/or chemical specific PM associated with the occurrence of health effects should also be highlighted. In view of evidence that total thoracic (tracheobronchial and alveolar) particle

deposition is of public health concern, it would also be helpful to include a discussion of the likely equivalencies among British Smokeshade (BS), Total Suspended Particles (TSP), and size selective particle aerometric measurements that would sample or index atmospheric concentrations of those sized particles identified with tracheobronchial or alveolar deposition.

Chapter 2: Physical and Chemical Properties of SOx/PM

This chapter is well written and addresses the important issues relevant to a criteria document. It presents a good summary of current knowledge of the factors affecting the physics and chemistry of sulfur dioxide and the pathways and kinetics of its transformation into sulfuric acid. It also provides a good summary of particle characteristics, dynamics, and hygroscopic growth.

Chapter 3: Techniques for the Collection and Analysis of SOx/PM

The revised chapter provides an excellent summary of the measurement of sulfur oxides and particulates. Especially important is the discussion of the capabilities of the various measurement techniques and the profile of pollutants in the ambient air which these measurements yield. The chapter correctly notes that British Smoke (BS), Coefficient of Haze (COHS), and Total Suspended Particulate (TSP) measurements do not adequately reflect key physical or chemical properties of particulate matter in the contemporary ambient air. Precise interconversion among units of BS, COHS, and TSP is not possible. In the context of a particulate standard, British Smoke is applicable only to a "sooty" smoke aerosol. It may not be a valid health effects indicator for the aerosol compositions observed in recent summertime episodes in the United States and Europe. Thus, it is unlikely that BS can provide a sensitive index of hazard for today's air pollution.

Chapter 4: Sources and Emissions

Both natural and man-made sources emit sulfur dioxide and particulate matter into the ambient air. Given the limitations of our ability to derive reliable estimates from both types of sources, the criteria document presents an adequate discussion of current knowledge.

Chapter 5: Environmental Concentrations and Exposure

This chapter is largely acceptable in its present form. Most of the comments and suggestions which were made for previous drafts have been effectively incorporated. The most important omission from the chapter is information related to chemical composition with respect to particle size. Abundant information of this type is available for sulfates and some trace metals. Given the strong dependence of deposition rates and light scattering on particle size, it might have been worthwhile to refer to this literature in Chapter 5 or to direct attention to other document chapters (e.g., Chapter 2) where such relationships are discussed.

Chapter 6: Atmospheric Transport, Transformation and Deposition

This chapter is concise, well-written, and effective in communicating information related to the current status of mathematical models for air pollution. The utility of various models is clearly discussed, and the inadequacy of current models for quantitative extrapolation is pointed out. Topics which had been omitted from the previous draft of this chapter have been added to other chapters with overlapping content. The chapter is now acceptable as written.

Chapter 7: Acidic Deposition

The Commitee has recognized the desirability of incorporating existing information on acidic deposition in the present criteria document. Chapter 7 provides an abbreviated but adequate summary of the contribution of sulfur oxides and particulates to the formation, transport, and effects of acidic deposition. The Committee has concluded that Chapter 7 is a scientifically adequate summary with the conditional understanding that EPA is preparing a Critical Assessment Document for Acidic Deposition for its review that recognizes and incorporates information on causes, effects, and data bases for all of the various pollutants relevant to acidic deposition. CASAC has been briefed several times by Agency officials regarding the status of this document. The Committee looks forward to the submission of this integrated assessment for its critical review.

Chapter 8: Effects on Vegetation

In response to CASAC recommendations and public comments, this chapter on vegetation effects has been greatly improved compared to earlier drafts reviewed by the Committee. It now includes a more concise and interpretive critical evaluation of those few key studies yielding quantitative dose-effect or dose-response information of most use for criteria development and standard-setting purposes. It also reasonably includes tables in the appendices which summarize studies of particulates and sulfur dioxide related vegetation effects that are of less utility for criteria development and standard setting.

The Committee concurs with Chapter 8 evaluations which point to the lack of dose-response data to establish quantitative evidence of deleterious effects on vegetation from particulates at presently encountered U.S. ambient air concentrations. In contrast to particulates, much clearer evidence exists by which to define quantitative exposure-effect relationships for sulfur dioxide effects on vegetation. Laboratory experiments in particular have demonstrated the greater relative toxicity to vegetation from high short-term exposures of sulfur dioxide. This is especially important in view of the fact that ambient air concentrations of sulfur dioxide from point sources often fluctuate widely and result in high intermittent short-term exposures of plants to sulfur dioxide concentrations against a background of longer-term but much lower annual average sulfur dioxide levels. Also of much importance are differences in the relative sensitivity of various plant species to sulfur dioxide exposures. The degree of sensitivity depends in part on factors such as phase of growth at time of exposure, ambient temperature and humidity levels, and plant water content. Among studies judged to be most useful for quantitative criteria development and standard setting are those of Dreisinger (1965, 1967) and Dreisinger and McGovern (1970) which demonstrate visible injury to white pine (a commercially important species in some U.S. areas) when natural stands of the tree in southern Canada were exposed for 4 hours to 0.30 ppm or for 8 hours to 0.25 ppm sulfur dioxide emitted from a nearby smelter. Roughly similar exposure-effect relationships were observed in studies reported by Jones et al. (1974) and McLaughlin (1981) on the effects of sulfur dioxide from a southeastern U.S. power plant on a wide variety of natural species in the vicinity of the point source. In these studies some crop and garden species showed visible injury effects with 3 hours exposures to 0.6–0.8 ppm sulfur dioxide, while certain other crop species (potato, cotton, corn, peach) did not show visible injury at levels below 0.8 ppm. In contrast, a chamber study by Hill et al. (1974) suggests that plants common to the southwestern U.S., with markedly lower moisture content and under generally lower ambient air humidity levels, may be able to withstand much higher

ambient sulfur dioxide concentrations (up to 11 ppm for two hours) without visible injury.

Chapter 9: Effects on Visibility and Climate

The technical aspects of this difficult problem are well characterized. The chapter does a good job of discussing the physics and public awareness of visibility. The relationship between fine particle mass concentrations and visibility has been well established. The criteria document thus provides an excellent technical basis for Agency decision-making on these issues.

This chapter adequately discusses the currently available scientific information concerning the effects of particulate matter and sulfur oxides on man-made materials. This includes critical assessments of available data concerning pertinent materials damage functions, uncertainties associated with existing characterizations of such functions, and limitations regarding estimation of monetary costs and/or benefits associated with the occurrence or control of such damage.

Chapter 11: Respiratory Deposition and Biological Fate of Inhaled Aerosols and Sulfur Dioxide

This chapter is very much improved compared to earlier drafts reviewed by CASAC and is now a comprehensive and more informative summary of existing knowledge relevant to a criteria document. The existing knowledge in this area is, in many cases, incomplete. For example, a potentially very important factor is the influence of the integrity of lung epithelial barriers (both airway and alveolar) on deposition and clearance. To enhance the chapter's comprehensiveness, this issue should be discussed more sufficiently in the criteria document, despite the paucity of available data.

Chapter 12: Toxicological Studies

This chapter is quite comprehensive as it describes essentially all toxicological studies relevant to a criteria document on sulfur oxides and particulates. Also, it provides commentary on many studies and the significance of their findings to potential human health effects. In addition, the presentation of the information is more polished than the previous draft because of improved editing.

Chapter 13: Controlled Human Studies

This is a chapter which thoroughly discusses the published material on controlled human experiments. The scientific criteria for good studies discussed at the beginning of the chapter cannot be overemphasized. While not all studies meet these criteria, the Committee recognizes that EPA must take account of the available literature and believes the studies cited in the chapter have been appropriately selected and discussed. Overall the chapter is well-written and directed toward addressing those questions to which answers are needed. One of the most important criteria for good human clinical studies is that they be double-blind. Unfortunately, most of the studies in the literature were not so performed. This factor is especially significant when sensitive population groups, such as asthmatics, are under study.

The chapter is also improved by the discussion of exposures administered through the nose and mouth during controlled studies. It appropriately notes that caution should be used in any attempted extrapolation of observed quantitative exposure/effects resulting from such protocols, particularly when compared to results that might be expected under ambient exposure conditions. The chapter identifies additional research results from studies using either face mask or open chamber oronasal breathing that would better resolve this issue, and it discusses existing studies in a balanced and thorough fashion.

Chapter 14: Epidemiological Studies

The current draft of this chapter represents considerable change and improvement over previous drafts reviewed by CASAC. Following discussion with the Committee, EPA has applied a set of guidelines for deciding with epidemiological studies are most appropriate for use in revising ambient air quality standards.

More specific comments on the chapter include the following: (1) The integration of Chapter 14 with Chapter 3 has advanced the "real world" understanding concerning the application of epidemiological methods; (2) the epidemiological studies providing the most useful quantitative concentration/response information for revising the 24-hour ambient particulate standard include: Lawther et al, 1958 and 1970; Martin and Bradley 1960; Martin 1964; Ware et al, 1981; and Mazumdar el al, 1981; (3) the epidemiological studies providing the most useful quantitative concentration/response information for revising the annual ambient particulate standard include: Ferris and Anderson 1962; Lunn et al, 1967; Ferris et al, 1971 and 1976; and Bouhuys et al, 1978; and (4) the studies by Lave and Seskin, 1970, and Mendelsohn and Orcutt, 1979 suggest an association between chronic exposure to high concentrations of sulfates and increases in the level of mortality, but they do not indicate any threshold or safe level from such exposures, and they are not refined enough to provide estimates of the quantitative effect of sulfate concentrations on mortality.

SUMMARY

The Committee made numerous comments of an editorial nature. These remarks, as well as a more detailed discussion of the recommendations and review provided above, are included in the transcripts of the three CASAC meetings held to review this document. With the understanding that the advised changes will be incorporated in the final criteria document, the Committee is satisfied that the air quality criteria document for sulfur oxides/particulate matter is scientifically adequate for use in standard setting.

Addendum III—CASAC Review and Closure of the OAQPS Staff Paper for Particulate Matter

January 29, 1982.

Subject: CASAC Review and Closure of the OAQPS Staff Paper for Particulate Matter

From: Sheldon K. Friedlander, Chairman, Clean Air Scientific Advisory Committee

To: Anne M. Gorsuch, Administrator

The Clean Air Scientific Advisory Committee (CASAC) recently completed its second and final review of the document entitled *Review of the National Ambient Air Quality Standards for Particulate Matter: Assessment of Scientific and Technical Information, OAQPS Staff Paper.* The Committee notes with satisfaction the improvements made in the scientific quality and the completeness of the staff paper. It has been modified in accordance with the recommendations made by CASAC in July and November 1981. This document is also consistent in all significant respects with the scientific evidence presented and interpreted in the combined criteria document for sulfur oxides and particulate matter. It has organized the data relevant to the establishment of particulate primary and secondary ambient air quality standards in a logical and compelling way, and the Committee believes that it provides you with the kind and amount of technical guidance that will be needed to make appropriate revisions to the standards.

CASAC has prepared this closure memorandum to inform you more specifically of its major findings and conclusions concerning the various scientific issues and studies discussed in

the staff paper. In addition, the Committee's review of the scientific evidence leading to the particulate standard revision leads to a discussion of its own role in the process for setting the standard.

CASAC Conclusions and Recommendations on Major Scientific Issues and Studies Associated With the Development of Revised NAAQS for Particulates

1. Based upon the review of available scientific evidence, a separate general particulate standard remains a reasonable public health policy choice.

2. CASAC reaffirms its initial recommendation on July 1981 to establish a 10 micrometer cut point for a revised primary particulate standard. This recommendation is based upon a recognition of the periodic, and sometimes frequent, tendency of both healthy and sensitive populations to breathe through their mouths and/or oronasally. This practice increases the amount of particulate matter that can penetrate into the thorax because the larger particles are not filtered in the oronasal passages. Deposition of particulates into this region is of special concern to those individuals with pre-existing respiratory problems and children. In addition, the collection of particles of less than 10 micrometer diameter size more closely resembles particles passing into the thoractic region of the human body than the collection of larger sized particles. Furthermore, monitors equipped for a 10 micrometer cut are less wind dependent and can provide a more accurate profile of the contemporary ambient air than samplers which measure total suspended particles.

CASAC's recommended size cut is also similar to proposals of other scientific associations. For example, 88% of the national members of the Air Quality Committee of the International Standards Organization recently voted for a particulate cut point at 10 micrometers for sampling particles which can deposit in the lungs.

The CASAC recommendation is based upon available scientific data. Other individuals and groups have discussed the possibility of establishing a revised particulate standard at a size cut considerably less than 10 micrometers. However, for the current revision of the standard, the scientific data more readily support a 10 micrometer size cut.

3. CASAC reached several major conclusions concerning the revision of the 24-hour and annual particulate standards. At the upper bound of the proposed ranges of 150–350 $\mu g/m^3$ for the 24-hour and 55–110 $\mu g/m^3$ for the annual averages, detectable health effects occur in the populations evaluated in the epidemiological studies. Since the upper end of these ranges contain little or no margin of safety, it would be appropriate to consider lower values for revising the 24-hour and annual standards. In addition, the stated ranges are based solely on quantitative evidence reported in epidemiological studies. A final decision on a revised standard should also incorporate information generated through controlled human, animal toxicology, and from other less quantitative epidemiological studies discussed in the criteria document.

There is an absence of a clearly definable exposure-response relationship for particles, as amply discussed in the criteria document and the staff paper. In addition, because airborne particles are heterogeneous in composition, the potential toxic effects of individual constituents should be considered in setting the standard. Thus, compared to margins of safety set for pollutants such as ozone and carbon monoxide, where exposure-response relationships are better established and small margins of safety are more justifiable, CASAC believes you should consider a revised standard with a wider margin of safety.

4. The Committee reached general agreement that the annual particulate standard should consist of an arithmetic mean. It is recommended that the 24-hour standard include a statistical form and that the number of exceedances is set in relation to the revised standard level.

5. During the past decade, the link between visibility and fine particle mass concentrations has been convincingly documented. Visibility is a sensitive indicator of accumulated man-made pollutants in the ambient air. The public cares about visibility and is willing to pay something for clean air. However, the quantitative basis for establishing a psychological, economic, transportation or any other welfare cost associated with visibility impairment has not been established. In addition, controls required to achieve a given visibility standard are not known due to the complexities of pollutant transport and transformation.

Defining acceptable levels of visibility is a social/policy judgment as well as a scientific decision, but science can provide some guidance. The upper end of the 8–25 $\mu g/m^3$ range for fine particles (those particles with a diameter size of less than 2.5 micrometers) would tend to maintain the status quo for the eastern United States and some western urban areas, but would permit air quality degradation for large areas in the west including national parks. Also, it is highly uncertain that the recommended thoracic particle ranges for the primary standard will protect visibility. The 8–25 $\mu g/m^3$ range for fine particles suggested for visibility protection is a seasonal and spatial average, unlike peak values which will be recommended for the primary standard.

The strongest case for a visibility related standard is one that links emissions of nitrogen oxides and sulfur dioxide with the interrelated aspects of acidic deposition, possible climatological effects, and visibility. Each of these three air quality issues is related to the fine particles which originate both as primary particulate emissions and as secondary aerosols from atmospheric conversions of sulfur dioxide and nitrogen oxides emitted as vapors. In terms of a control strategy to protect public welfare, it may be more efficient to consider a common standard linked to fine particles than to establish a separate set of controls for each of these problems and pollutants.

6. The Committee's evaluation of scientific data and studies in the criteria document and the staff paper lead it to conclude that there is no scientific justification for the establishment of a particulate standard for the specific protection of vegetation.

7. The Committee discussed what effect elimination of a Total Suspended Particulate (TSP) standard would have on the environment. The soiling and nuisance aspects of TSP are essentially local air quality problems because such coarse particles are not transported great distances. This contrasts with visibility or oxidant related problems which are distinctly issues of long range pollution transport. Individuals who serve on the Committee made various recommendations regarding retention or elimination of a secondary standard for TSP, but no clear consensus evolved.

The Process for Setting the Ambient Particulate Standard

In its report of September 21, 1981, CASAC made several major recommendations relating to the process for setting ambient air standards. The Committee is aware that your staff is analyzing its report and is awaiting a response.

A major underlying assumption of the Committee's recommendations was the need to make more explicit the relationship between the scientific evidence in the criteria document and the staff paper and the eventual selection of a numerical level for individual standards. The Committee

strongly believes in the need to clarify the standard setting process by identifying the key studies that will shape the determination of a standard. Intensive evaluation of such studies by CASAC and the public will considerably increase your ability to set a scientifically supportable standard.

The Committee is greatly encouraged by your decision to improve the format and content of OAQPS scientific issue staff papers. In the Draft Staff Paper for Particulate Matter key studies are identified and their implications for setting primary and secondary standards are discussed. More importantly, the inclusion of numerical ranges and their supporting rationale enabled the Committee and the public to critically examine the staff's proposed use of the studies. This led to a marked improvement in the quality of the public dialogue concerning the scientific basis for revising the standard. CASAC commends your effort and recommends that all staff papers developed for ambient air standards contain numerical ranges.

CASAC recognizes that your statutory responsibility to set standards requires public health policy judgments in addition to determinations of a strictly scientific nature. While the Committee is willing to further advise you on the particulate standard, we see no need, in view of the already extensive comments provided, to review the proposed particulate standards prior to their publication in the Federal Register. In this instance, the public comment period will provide sufficient opportunity for the Committee to provide any additional comment or review that may be necessary.

PART 50—NATIONAL PRIMARY AND SECONDARY AMBIENT AIR QUALITY STANDARDS

For reasons set forth in the preamble, EPA proposes to amend Part 50, Chapter 1 of Title 40 of the *Code of Federal Regulations* as follows:

1. The table of contents for Part 50 is amended by adding new entries for Appendix J and Appendix K as follows:

* * * * *

Appendix J—Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere

Appendix K—Interpretation of the National Ambient Air Quality Standards for Particulate Matter

* * * * *

2. Section 50.6 is revised to read as follows:

§ 50.6 National primary ambient air quality standards for particulate matter.

(a) The level of the national primary 24-hour ambient air quality standard for particulate matter is [value to be selected from range of 150 to 250] micrograms per cubic meter ($\mu g/m^3$), 24-hour average concentration. The standard is attained when the expected number of days per calendar year with a 24-hour average concentration above the standard level is equal to or less than one, as determined by Appendix K.

(b) The level of the national primary annual standard for particulate matter is [value to be selected from range of 50 to 65] micrograms per cubic meter ($\mu g/m^3$), annual arithmetic mean. The standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard level, as determined by Appendix K.

(c) For purposes of the primary standards, particulate matter shall be measured in the ambient air as PM_{10} (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers) by:

(1) A reference method based on Appendix J and designated in accordance with Part 53 of this chapter, or

(2) An equivalent method designated in accordance with Part 53 of this chapter.

3. Section 50.7 is revised to read as follows:

§ 50.7 National secondary ambient air quality standard for particulate matter.

(a) The level of the national secondary standard for particulate matter is [value to be selected from range of 70 to 90] micrograms per cubic meter ($\mu g/m^3$), annual arithmetic mean. The standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard level, as determined by Appendix K.

(b) For purposes of the secondary standard, particulate matter shall be measured in the ambient air by the method described in Appendix B of Part 50 of this Chapter.

4. In Appendix G, reference 10 is removed and section 5.1.1 is revised to read as follows:

* * * * *

5.1.1 *High-Volume Sampler.* Use and calibrate the sampler as described in Appendix B to this part.

5. Appendix J is added as follows:

Appendix J—Reference Method for the Determination of Particulate Matter as PM_{10} In The Atmosphere

1.0 *Applicability.*

This method provides for the measurement of the mass concentration of particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}) in ambient air over a 24-hour period for purposes of determining attainment and maintenance of the primary national ambient air quality standards for particulate matter specified in § 50.6 of this chapter. The measurement process is nondestrucative, and the PM_{10} sample can be subjected to subsequent physical and chemical analyses. Quality assurance procedures and guidance are provided in Part 58, Appendices A and B, of this chapter and in References (*1*) and (*2*).

2.0 *Principle.*

2.1 An air sampler draws a measured quanity of ambient air at a constant flow rate into a specially shaped inlet where the suspensed particulate matter is inertially separated into one or more size fractions within the PM_{10} size range. Each size fraction in the PM_{10} size range is then collected on a separated filter over the specified sampling period. The particle size discrimination characteristics (sampling effectiveness and 50 percent cutpoint) of the sampler inlet over the PM_{10} size range are functional specifications described in Part 53 of this chapter.

2.2 Each filer is weighed (after moisture equilibration) before and after use to determine the net weight (mass) gain due to collected PM_{10}. The total volume of air sampled, corrected to EPA reference conditions (25°C, 101.3 kPa), is determined from the measured volumetric flow rate and the sampling time. The concentration of PM_{10} in the ambient air is computed as the total mass of collected particles in the PM_{10} size range divided by the volume of air sampled, corrected to reference conditions, and is expressed in micrograms per standard cubic meter ($\mu g/std\ m^3$). For samples collected at temperatures and pressures significantly different from EPA reference conditions, these corrected concentrations sometimes differ substantially from actual concentrations (in micrograms per actual cubic meter), particularly at high elevations. Although not required, the actual PM_{10} concentration can be calculated from the corrected concentration, using the actual temperature and pressure during the sampling period.

2.3 A method based on this principle will be considered a reference method only if (a) the associated sampler meets the requirements specified in this appendix and those in Part 53 of this chapter and, (b) the method has been designated as a reference method in accordance with Part 53 of this chapter.

3.0 *Range.*

The lower limit of the mass concentration range is limited by the repeatability of filter tare weights, assuming the nominal air sample volume for the sampler. The upper limit of the concentration range cannot be specified. For samplers having a filter-changing mechanism, there may be no upper limit. For samplers that do not have a filter-changing mechanism, the upper limit is determined by the point at which the sampler no longer maintains the specified operating flow rate due to increased pressure drop

across the loaded filter(s). This limit cannot be specified because it is a complex and undetermined function of particle size distribution and type, humidity, filter type, and perhaps other factors.

4.0 *Precision.*

The reproducibility of PM_{10} samplers must be 15 percent or better as required by Part 53 of this chapter, which prescribes a reproducibility test procedure that determines the variation in the PM_{10} concentration measurements of identical samplers under typical sampling conditions. Other specifications are provided in Part 53 for the particle size discrimination characteristics and the flow rate stability of the sampler. Continual assessment of the precision via collocated samplers is required by Part 58 of this chapter for PM_{10} samplers used in certain monitoring networks.

5.0 *Accuracy.*

Because the sizes of the particles making up ambient particulate matter vary over a wide range and the concentration of particles varies with particle size, it is difficult to define the absolute accuraacy of PM_{10} samplers. Part 53 of this chapter provides a specification for the sampling effectiveness of PM_{10} samplers. This sampling effectiveness specification requires that the expected mass concentration measurement calculated for a candidate PM_{10} sampler, when sampling a specified typical ambient particle distribution, be within ±10 percent of that calculated for an ideal sampler whose sampling effectiveness is explicitly specified. Also, the particle size for 50 perent sampling effectiveness is required to by 10±1 micrometers (μm). Other specifications related to accuracy apply to flow measurement and calibration, filter media, analytical (weighing) procedures, loss of volatiles, and artifact and nonsampled particulate matter. The flow rate accuracy of PM_{10} samplers used in certain monitoring networks is required by Part 58 of this chapter to be assessed periodically via flow rate audits.

6.0 *Potential Sources of Error.*

6.1 *Loss of Volatile Particles.* Volatile particles collected on filters are often lost during shipment and/or storage of the filters prior to the postsampling weighing (*3*). Although shipment and storage of loaded filters are sometimes unavoidable, filters should be reweighed as soon as practical to minimize these losses.

6.2 *Artifact Particulate Matter.* Positive errors in particle mass measurements may result from retention of gaseous species on filters (*4, 5*). Such errors include the retention of sulfur dioxide and nitric acid. Retention of sulfur dioxide on filters, followed by oxidation to sulfate is referred to as artifact particulate sulfate formation, a phenomenon which increases with increasing filter alkalinity (*6*). Artifact particulate nitrate, resulting primarily from retention of nitric acid, occurs to varying degrees on many filter types, including glass fiber, cellulose ester, and many quartz fiber filters, (*5, 7, 8, 9, 10*). Filters that meet the alkalinity specification (section 7.2.4) should show little or no artifact sulfate. Negative artifact is the loss of collected particulate matter during sampling by volatilization or chemical reaction (*11*). Loss of true atmospheric particulate nitrate has been observed on Teflon® filters (*8*) and inferred for quartz fiber filters (*11*). The significance of this problem for PM_{10} mass measurements will vary with location and ambient temperature. However, for most sampling locations, PM_{10} mass concentration errors due to nitrate artifact are expected to be small.

6.3 *Nonsampled Particulate Matter.* Particulate matter is sometimes deposited on filters during periods when the sampler is inoperative (*12*). Timely installation and retrieval of filters prior to and following the sampling period should help to minimize this problem.

6.4 *Humidity.* The effects of ambient humidity on the sample are unavoidable. The moisture conditioning procedure in section 9.0 is designed to minimize the effects of moisture on the filter medium.

6.5 *Filter Handling.* Careful handling of filters betwen presampling and postsampling weighing is necessary to avoid errors due to damaged filters or loss of particles from the filters. Use of a filter cartridge or cassette may reduce the magnitude of these errors.

6.6 *Flow Rate Variation.* Variations in the sampler's operating flow rate may alter the particle size discrimination characteristics of the sampler inlet. The magnitude of this error will depend on the sensitivity of the inlet to variations in flow rate and on the particle distribution in the atmosphere during the sampling period. The use of an automatic flow controller (section 7.1.4) is required to minimize this error.

6.7 *Air Volume Determination.* Errors in the air volume determination can result from errors in the flow rate and/or sampling time measurements. The automatic flow controller also serves to minimize errors in the average flow rate determination. The use of an elapsed time meter (section 7.1.5) is required to minimize the error in sampling time.

7.0 *Apparatus.*

7.1 PM_{10} Sampler.

7.1.1 The sampler shall be designed to:

a. Draw the air sample, via reduced internal pressure, into the sampler inlet and through the filter(s) at a uniform face velocity.

b. Hold and seal the filter(s) in a horizontal position so that sample air is drawn downward through the filter(s).

c. Allow the filter(s) to be installed and removed conveniently.

d. Protect the filter(s) and sampler from precipitation and prevent insects and other debris from being sampled.

e. Minimize leaks that would cause error in the measurement of the air volume passing through the filter(s).

f. Discharge exhaust air at a sufficient distance from the sampler inlet to minimize the sampling of exhaust air.

g. Minimize the collection of dust from the supporting surface.

7.1.2 The sampler shall operate at a controlled flow rate specified by its designer or manufacturer, and it shall have an inlet system that provides particle size discrimination characteristics meeting all of the applicable performance specifications prescribed in Part 53 of this chapter. The sampler inlet shall show no significant wind direction dependence. This requirement can generally be satisfied by an inlet shape that is circularly symmetrical about a vertical axis.

7.1.3 The sampler shall provide a means to measure the total flow rate during the sampling period. A continuous flow recorder is recommended. The sampler may be equipped with additional flow measurement devices if it is designed to collect more than one particle size fraction.

7.1.4 The sampler shall have an automatic flow control device capable of adjusting and maintaining the sample flow rate within the limits specified for the sampler inlet over normal variations in line voltage and filter pressure drop. A convenient means must be provided to temporarily disable the automatic flow control device to allow calibration of the sampler's flow measurement device.

7.1.5 A timing/control device capable of starting and stopping the sampler shall be used to obtain an elapsed run-time of 24 ±1 hr (1,440 ±60 min). An elapsed time meter, accurate to within 15 minutes, shall be used to measure sampling time. This meter is optional for samplers with continuous flow recorders if the sampling time measurement obtained by means of the recorder meets the ±15 minute accuracy specification.

7.1.6 The sampler shall have an associated operation or instruction manual as required by § 53.4 of this chapter and which includes either the text or a reproduction of this appendix.

7.2 *Filters*

7.2.1 *Filter Medium.* No commercially available filter medium is ideal in all respects for all samplers. The user's goals in sampling determine the relative importance of various filter evaluation criteria (e.g., cost, ease of handling, physical and chemical characteristics, etc.) and, consequently, determine the choice among acceptable filters. Furthermore, certain types of filters may not be suitable for use with some samplers, particularly under heavy loading conditions (high mass concentrations), because of high or rapid increase in the filter flow resistance that would exceed the capability of the sampler's automatic flow controller. However, samplers equipped with automatic filter-changing mechanisms may allow use of these types of filters. The specifications given below are minimum requirements to insure acceptability of the filter medium for measurement of PM_{10} mass concentrations. Other filter evaluation criteria should be considered to meet individual sampling and analysis objectives.

7.2.2 *Collection Efficiency.* >99 percent as measured by DOP test (ASTM–2986) with 0.3 μm particles at the sampler's operating face velocity.

7.2.3 *Integrity.* ±5 $\mu g/m^3$ (assuming sampler's nominal 24-hour air sample volume), measured as the concentration equivalent corresponding to the difference between the initial and final weights of the filter when weighed and handled under simulated sampling conditions (equilibration, initial weighing, placement on inoperative sampler, removal from sampler, re-equilibration, and final weighting).

7.2.4 *Alkalinity.* <0.005 milliequivalents/gram of filter as measured by ASTM-D202 following at least two months storage at ambient temperature and relative humidity.

7.3 *Flow Rate Transfer Standard*

7.3.1 A flow rate transfer standard, suitable for the flow rate of the sampler and calibrated against a primary standard that is traceable to NBS, must be used to calibrate the sampler's flow measurement device.

7.3.2 The reproducibility and resolution of the transfer standard must be 2 percent or less of the sampler's operating flow rate.

7.3.3 The flow rate transfer standard must include a means to vary the sampler flow rate during calibration of the sampler's flow measurement device.

7.4 *Filter Conditioning Environment*

7.4.1 Temperature range: 15 to 30° C.

7.4.2 Temperature control: ±3° C.

7.4.3 Humidity: 45 ±5 percent relative humidity.

7.5 *Analytical Balance*

7.5.1 The analytical balance must be suitable for weighting the type and size of filters required by the sampler. The range and sensitivity required will depend on the filter tare weight and mass loading. Typically, an analytical balance with a sensitivity of 0.1 mg is required for high volume samplers (flow rates >0.5 m^3/min). Lower volume samplers (flow rates <0.5 m^3/min) will require a more sensitive balance.

8.0 *CALIBRATION.*

8.1 *General Requirements*

8.1.1 Calibration of the sampler's flow measurement device is required to establish traceability of the flow measurement to a primary standard. A flow rate transfer standard calibrated against a primary flow or volume standard shall be used to calibrate the sampler's flow measurement device at the field site.

8.1.2 The particle size separation characteristics of PM_{10} samplers usually require that specific air velocities be maintained in the separation system. Therefore, the sampler must be set to operate at and maintain the specified volumetric flow rate, measured under the actual ambient conditions of use (Q_a). In contrast, the mass concentration of PM_{10} must be computed using the flow rate based on the standard volume at EPA reference conditions (Q_{std}).

8.2 *Flow Rate Calibration Procedures*

8.2.1 The calibration procedure given here is based on flow rates at ambient conditions (Q_a) and serves to illustrate the steps involved in the calibration process. Alternative procedures based on other measures of flow rate (e.g., Q_{std}) may be used provided the requirements of section 8.1 are met. Consult the sampler manufacturer's instruction manual for specific guidance on calibration. Reference (*13*) provides additional information on the use of the commonly used measures of flow rate and their interrelationships.

8.2.2 Calibrate the flow rate tranfer standard against a primary flow or volume standard traceable to NBS. Establish a calibration relationship (e.g., and equation or family of curves) such that traceability to the primary standard is accurate over the expected range of ambient conditions (i.e., temperatures and pressures) under which the transfer standard will be used. Recalibrate the transfer standard periodically (minimum of once per year).

8.2.3 Disable the sampler's flow controller during calibration of the sampler's flow measurement device.

8.2.4 Install a clean filter (or filters) in the sampler. Remove the sampler inlet and connect the transfer standard to the sampler such that the transfer standard accurately measures the sampler's flow rate. Make sure there are no leaks between the transfer standard and the sampler.

8.2.5 Choose three flow rates evenly spaced over a range of ± 10 percent of the sampler's specified operating flow rate (actual m^3/min), and by suitable adjustment of the sampler flow rate, obtain a calibration curve of flow rate (actual m^3/min) versus the sampler's flow indicator reading. Record the barometric pressure and ambient temperature. Daily or seasonal temperature and daily or average pressure corrections for subsequent flow indicator readings may be required for certain types of flow measurement devices (see Note following step 9.6).

8.2.6 Re-enable the flow controller, adjust the flow rate (actual m^3/min) to the manufacturer's specified operating set point, and use the transfer standard to verify that the flow rate is correct with a clean filter (or filters) in place.

8.2.7 Replace the sampler inlet.

9.0 *Procedure.*

9.1 The sampler shall be operated in accordance with the general instructions given here and with the specific instructions provided in the sampler manufacturer's instruction manual. Note.—This procedure assumes that the sampler's flow rate calibration was performed using flow rates at ambient conditions (Q_a).

9.2 Inspect each filter for pinholes, particles, and other imperfections; establish a filter information record and assign an identification number to each filter.

9.3 Equilibrate each filter in the conditioning environment for at least 24-hours.

9.4 Following equilibration, weigh each filter, and record the presampling weight with the filter identification number.

9.5 Install a preweighed filter (or filters) in the sampler following the instructions provided in the sampler manufacturer's instructional manual.

9.6 Turn on the sampler and adjust (if necessary) the automatic flow controller to the manufacturer's specified operating set point. Run the sampler for at least 5 minutes to establish run-temperature conditions. Record the flow indicator reading and, if needed, the barometric pressure and ambient temperature. Determine the sampler flow rate (in actual m^3/min) using the sampler's flow rate calibration curve.

Note.—No onsite pressure of temperature measurements are necessary if the sampler flow indicator does not require pressure or temperature corrections or if average barometric pressure and seasonal average temperature for the site are incorporated into the sampler calibration (see step 8.2.5). For individual pressure and temperature corrections, the ambient pressure and temperature can be obtained by onsite measurements or from a nearby weather station. Barometric pressure readings obtained from airports must be station pressure, not corrected to sea level, and may need to be corrected for differences in elevation between the sampler site and the airport.

9.7 If the sampler flow rate (actual m^3/min) is outside the acceptable range specified by the sampler manufacturer, check the sampler for leaks and, if necessary, adjust the automatic flow controller set point. Stop the sampler.

9.8 For samplers without continuous flow recorders, record the initial flow rate (in actual m^3/min) as $Q_{a(init.)}$.

9.9 Set the timer to start and stop the sampler at appropriate times. Set the elapsed time meter to zero.

9.10 Record the sample information (filter identification number(s), site location or identification number, sample date, and starting time).

9.11 Sample for 24 ±1 hours.

9.12 For samplers without continuous flow recorders, as soon as practical following the sampling period, run the sampler for 5 minutes to again establish run-temperature conditions. Record the flow indicator reading and, it needed, the barometric pressure and ambient temperature. Stop the sampler. Determine the final flow rate (in actual m^3/min) using the sampler's flow rate calibration curve and record as $Q_{a(final)}$ (see Note following step 9.6). If $Q_{a(final)}$ is outside the sampler manufacturer's specified operating range, the sample must be invalidated. For valid samples, calculate the average flow rate (in actual m^3/min), and record as $\bar{Q}_a$.

9.13 For samplers with continuous flow recorders, examine the flow record. If $\bar{Q}_a$ is outside the sampler manufacturer's specified operating range for more than 6 hours of the 24-hour sampling period, the sample must be invalidated. For valid samples, record the average flow recorder reading during the sampling period. If needed, estimate the average temperature and pressure at the site *during the sampling period* from weather bureau or other available data. Determine the average flow rate (in actual m^3/min using the sampler's flow rate calibration curve and record as $\bar{Q}_a$ (see NOTE following step 9.6).

9.14 Carefully remove the filter (or filters) from the sampler following the sampler manufacturer's instructions. Touch only the outer edges of the filter.

9.15 Place the filter(s) in a protective holder or container (e.g., petri dish, glassine envelope, or manila folder).

9.16 Record the elapsed time on the filter information record and any other factors, such as meteorological conditions, construction activity, fires or dust storms, etc., that might be pertinent to the measurement. If the sample is known to be defective, void it at this time.

9.17 Transport the exposed sample filter (or filters) to the filter conditioning environment as soon as possible for equilibration and subsequent weighing.

9.18 Equilibrate the exposed filter(s) in the conditioning environment for 24-hours.

9.19 Immediately after equilibration, reweigh the filter(s) and record the weight(s) with the filter identification number(s).

10.0 *Calculations.*

10.1 Calculate the average flow rate over the sampling period corrected to EPA reference conditions as $\overline{Q}_{std}$. When the sampler's flow rate calibration and operation is based on flow rates at ambient conditions, Q_{std} is calculated as:

$$\overline{Q}_{std} = \overline{Q}_a \times \frac{P_b}{T_a} \times \frac{T_{std}}{P_{std}}$$

where:

$\overline{Q}_{std}$=average flow rate at EPA reference conditions, std m^3/min;

$\overline{Q}_a$=average flow rate at ambient conditions, m^3/min;

P_b=average barometric pressure for the site or average barometric pressure during the sampling period, kPa;

T_a=seasonal average ambient temperature for the site or average ambient temperature during the sampling period, K;

P_{std}=standard pressure, defined as 101.3 kPa;

T_{std}=standard temperature, defined as 298 K.

10.2 Calculate the total volume of air sampled as:

$V = \overline{Q}_{std} \times t$

where:

V=total air sampled in standard volume units, std m^3;

t=sampling time, min.

10.3 Calculate the PM_{10} concentration as:

$$PM_{10} = \frac{\Sigma (W_f - W_i) \times 10^6}{V}$$

where:

PM_{10}=mass concentration of PM_{10}, μg/std m^3;

W_f, W_i=final and initial weights of filter(s) collecting PM_{10} particles, g;

10^6=conversion of g to μg.

11.0 *References.*

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(12) Chahal, H. S., and D. J. Romano. High-Volume Sampling Effect of Windborne Particulate Matter Deposited During Idle Periods. J. Air Pollut. Control Assoc., 26:885, 1976.

(13) Smith, F., P. S. Wohlschlegel, R. S. C. Rogers, and D. J. Mulligan. Investigation of Flow Rate Calibration Procedures Associated with the High Volume Method for Determination of Suspended Particulates. EPA-600/4-78-047, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, 1978.

6. Appendix K is added as follows:

Appendix K—Interpretation of the National Ambient Air Quality Standards for Particulate Matter

1.0 *General.*

This appendix explains the computations necessary for analyzing particulate matter data to determine attainment of the 24-hour and annual standards specified in 40 CFR §§ 50.6 and 50.7. For the primary standards, particulate matter is measured in the ambient air as PM_{10} (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers) by a reference method based on Appendix J of this part and designated in accordance with Part 53 of this chapter or an equivalent method designated in accordance with Part 53 of this chapter. For the secondary standard, particulate matter is measured in the ambient air by the method described in Appendix B of this part, hereafter referred to as Total Suspended Particulate Matter (TSP).

Several terms used throughout the appendix must be defined. A "daily value" for PM_{10} refers to the 24-hour concentration of PM_{10} calculated or measured from midnight to midnight (local time). The term "exceedance" means a daily value that is above the level of the 24-hour standard after rounding to the nearest 10 $\mu g/m^3$ (i.e., values ending in or greater than 5 are to be rounded up). The term "average" refers to an arithmetic mean. All particulate matter standards are expressed in terms of expected annual values: expected number of exceedances per year for the 24-hour standard and expected annual arithmetic mean for the annual standards. The "expected annual value" is the number approached when the annual values from an increasing number of years are averaged, assuming no long-term trends in emissions or meteorological conditions.

Although the discussion in this appendix focuses on monitored data, the same principles apply to modeling data.

2.0 *Attainment Determinations.*

2.1 *24-Hour Primary Standard.*

Under 40 CFR § 50.6(a) the 24-hour primary standard is attained when the expected number of exceedances per year is less than or equal to one. In the simplest situation, this determination is to be made by recording the number of exceedances at a monitoring site for each calendar year and then averaging them over the past 3 calendar years, to determine whether the average is less than or equal to one. Situations in which 3 years of data are not available and possible adjustments for unusual events or trends are discussed in Sections 2.4 and 2.5. Moreover, because of the potential for incomplete data during a year, it may also be necessary first to compute an estimated number of exceedances for a given year by adjusting the observed number of exceedances. This is described in Section 3. The expected number of exceedances is then estimated on the basis of the average of the individual annual estimates for the past 3 years.

The comparison with the allowable expected exceedance rate of one per year is made in terms of a number rounded to the nearest tenth (fractional values equal to or greater than 0.05 are to be rounded up; e.g., an exceedance rate of 1.05 would be rounded to 1.1, which is the lowest rate for nonattainment).

2.2 *Annual Primary Standard.*

Under 40 CFR 50.6(b) the annual primary standard is attained when the expected annual arithmetic mean PM_{10} concentration is less than or equal to the level of the standard. In the simplest case, the arithmetic annual mean PM_{10} concentration for each calendar year would be averaged over the past 3 calendar years to estimate whether this value is less than or equal to the level of the annual primary standard. Due to the potential for incomplete data and the possible seasonality in the PM_{10} concentrations, the annual mean shall be calculated in terms of the four quarterly means of PM_{10} concentrations within the calendar year. The formulas for calculating the annual arithmetic mean are given in Section 4. The expected annual arithmetic means shall be estimated as the arithmetic mean of the individual annual arithmetic means for the past 3 years. Situations in which 3 years of data are not available and other possible adjustments for unusual events or trends are discussed in Sections 2.4 and 2.5. Comparisons with the level of the annual primary standard are made in terms of integers (fractional values equal to or greater than 0.5 are to be rounded up).

2.3 *Annual Secondary Standard.*

Under 40 CFR 50.7(a), the annual secondary standard is attained when the expected annual arithmetic mean TSP concentration is less than or equal to the level of the standard. In the simplest case, the arithmetic annual

mean TSP concentrations for each calendar year would be averaged over the past 3 calendar years to estimate whether this value is less than or equal to the level of the annual secondary standard. Due to the potential for incomplete data and the possible seasonality in the TSP concentrations, the annual arithmetic mean shall be calculated in terms of the four quarterly arithmetic means of TSP concentrations within each calendar year. The formulas for calculating the annual arithmetic mean are given in Section 4. The expected annual arithmetic mean shall be estimated as the arithmetic means of these individual annual arithmetic means for the past 3 years. Situations in which 3 years of data are not available and other possible adjustments for unusual events or trends are discussed in Sections 2.4 and 2.5. Comparisons with the level of the standard are made in terms of integers (fractional values equal to or greater than 0.5 are to be rounded up).

2.4 *Data Requirements.*

40 CFR 58.13 specifies the required minimum frequency of sampling for PM_{10} and TSP. For the purposes of making comparisons with the particulate matter standards, all National Air Monitoring Stations (NAMS) and State and Local Air Monitoring Stations (SLAMS) data submitted to EPA in accordance with the Part 58 requirements must be used and in minimum of 12 TSP or PM_{10} samples per quarter are required. For a one in six-day sampling schedule, this requirement corresponds to a 75 percent data capture.

To demonstrate attainment of either the annual or 24-hour primary standard or the annual secondary standard at a particular location, the monitoring site must provide sufficient data in order to perform the required calculations of Sections 3 and 4. The amount of data required varies with the sampling frequency, data capture and the number or years of record. In all cases, 3 years of monitoring data that meet the minimum data completeness criterion of the previous paragraph and are representative of "normal" conditions (defined below) would suffice. In the event that 3 years of monitoring data are not available, then 2 years of representative data will be sufficient to perform the calculations in order to show attainment of annual standards and 2 years of representative data will also be sufficient to perform the calculations for the 24-hour standard if the monitor samples every day and achieves an annual average data capture of 50 percent. If only 1 year of representative data is available, then 1 year of data will be sufficient for both annual and 24-hour standards if the monitor samples every day and achieves a 75 percent data capture. Furthermore, the calculations for estimated exceedances will not be necessary if the monitor samples every day and achieves a 75 percent data capture for the first year of monitoring; in other words, no more than one observed exceedance would demonstrate attainment under this condition. Data not meeting these criteria may also suffice to show attainment; however, such exceptions will have to be approved by the Regional Administrator in accordance with established guidelines (currently under development).

There are less stringent data requirements for showing that a monitor has failed an attainment test and thus has recorded a violation of the particulate matter standards. A single observed exceedance from 1 year of representative data may be sufficient to demonstrate nonattainment of the 24-hour standard as illustrated in example 1 of Section 3.1 and an annual mean from an individual representative year may be sufficient to demonstrate nonattainment of the annual standards. Although it is necessary to meet the minimum data completeness requirement of 12 TSP or PM_{10} samples per quarter to use the computational formulas described in Sections 3 and 4, this criterion does not apply when there are obvious nonattainment situations. For example, when a site fails to meet the completeness criteria, nonattainment of the 24-hour primary standard can still be established on the basis of the observed annual number of exceedances. Nonattainment of the annual standards can be demonstrated on the basis of quarterly mean concentrations developed from observed data combined with zeros substituted for missing values.

Normal conditions, associated with representative air quality data, are defined as usual emission levels and typical meteorology and are conditions which would be expected to continue to occur in the future. Departures from normal conditions would have to be substantiated on the basis of historical emissions or meterological data and may require treatment as described in Section 2.5. The designation of air quality data as representative, for judging attainment or non-attainment, is subject to the review of the Regional Administrator.

2.5. *Considerations for Unusual Events and Trends.*

In some cases it is possible for a rare or unsual event to result in a PM_{10} or TSP measurement which either is not expected to occur in the future or cannot be controlled through the State Implementation Plan process. Inclusion of such a value in the computation of exceedances or averages could result in inappropriate estimates of their respective expected annual values. To reduce the effect of unusual events, more than 3 years of data may be used if these data are representative of normal conditions. If 3 or more years of data are not available to minimize the influence of such events, other techniques, such as the use of statistical models or the use of historical data could be considered. For example the use of historical meteorological data may be used to establish the frequency of occurrence of an unusual event, so that the event may be discounted or weighted according to the likelihood it will reoccur, subject to the approval of the Regional Administrator in accordance with established guidelines (currently under development).

In cases where long-term trends in emissions and air quality are evident, mathematical techniques should be applied to account for the trends to ensure that the expected annual values are not inappropriately biased by data that are not representative of normal conditions. In the simplest case, if 3 years of data are available under stable emission conditions, this data should be used. In the event of a trend or shift in emission patterns, either the most current representative year(s) could be used or statistical techniques or models could be used in conjunction with previous years of data to adjust for trends, subject to the approval of the Regional Administrator in accordance with established guidelines (currently under development).

3.0. *Computation Formulas for the 24-Hour Standard.*

3.1. *Estimating Exceedances for a Year.*

Because of practical considertions, a PM_{10} value may not be available for each day of the year. To account for the possible effect of incomplete data, an adjustment must be made to the data collected at a particular monitoring location to estimate the number of exceedances in a calendar year. In this adjustment, the assumption is made that the fraction of missing values that would have exceeded the standard level is identical to the fraction of measured values above this level. This computation is to be made for all NAMS, SLAMS, and all other sites that are scheduled to monitor consistently throughout the entire year and meet the minimum data requirements of Section 2.4. Because of possible seasonal imbalance, this adjustment is not intended for short-term monitoring. The estimate of the expected number of exceedances for the year is equal to the observed number of exceedances plus an increment associated with the missing data.

The following formula must be used for these computations:

[Formula 1]

$$e = v + [(v/n) \times (N-n)] = v \times N/n$$

where

e = the estimated number of exceedances for the year,

v = the observed number of exceedances,

N = the number of days in the year, and

n = the number of days with PM_{10} data.

This adjustment for incomplete data will not be necessary for monitoring or modeling data which results in a complete record, i.e., 365 days per year. Other exceptions of the adjustment for incomplete data are discussed in Section 2.4.

If the sampling schedule changes within a calendar year, formula [1] may be applied quarterly and the annual number of exceedances may be estimated as the sum of the quarterly estimates.

The estimated number of exceedances for a single year must be rounded to one decimal place (fractional values equal to or greater than 0.05 are to be rounded up).

Example 1

During the most recent calendar year, 61 out of a possible 365 samples were recorded, with one observed exceedance of the applicable 24-hour standard. Using formula [1], the estimated number of exceedances for the year is

$$e = 1 \times 365/61 = 6.0$$

If the estimated exceedances for the two previous years were both 0.0 then the expected number of exceedances is estimated by $(\frac{1}{3}) \times (6.0+0+0) = 2.0$. Since 2.0 is greater than the allowable

number of expected exceedances, this monitoring site would fail the attainment test.

Example 2

The sampling frequency at this monitoring site is once every two days. In the most recent year, 183 days were sampled and one exceedance was recorded. Using formula [1], the estimated number of exceedances is

$e = 1 \times {}^{365}/_{183} = 2.0$

In each of the two previous years the estimated number of exceedances was 0.0. Therefore, the expected number of exceedances is estimated by (⅓) × (2.0 + 0 + 0) = 0.7. Since 0.7 is less than the allowable number of expected exceedances, this monitoring site would pass the attainment test.

3.2 *Adjustments for Non-Scheduled Sampling Days.*

If a systematic sampling schedule is used and sampling is performed on days in addition to the days specified by the systematic sampling schedule, e.g., episode conditions, then an adjustment must be made in the formula for the estimation of exceedances. This is intended to eliminate any bias in the estimate of the annual number of exceedances, which could occur if the chance of an exceedance is different between scheduled and non-scheduled days, as would be the case with episode sampling.

This approach effectively treats the systematic sampling schedules as a stratified sampling plan. If the period from one scheduled sample until the day preceding the next scheduled sample is defined as a sampling stratum, then there is one stratum for each scheduled sampling day. An average number of observed exceedances is computed for each of these sampling stratum, allowing for differences in exceedance rates that may exist during periods of unscheduled samples, such as episode conditions. With nonscheduled sampling days, the estimated number of exceedances is defined as

[Formula 2]

$$e = (N/m) \times \sum_{j=1}^{m} (v_j/k_j)$$

where

e = the estimated number of exceedances for the year,

N = the number of days in the year,

m = the number of strata with samples during the year,

v_j = the number of observed exceedances in stratum j, and

k_j = the number of actual samples in stratum j.

Note that if only one sample value is recorded in each stratum, then formula [2] reduces to formula [1].

Example 3

A monitoring site samples according to a systematic sampling schedule of once every 6 days for a total of 61 samples in a year. During one 6-day period, potential episode levels of PM_{10} were suspected, so 3 additional samples were taken. Five of the regularly scheduled samples were not recorded, so a total of 59 samples in 56 sampling strata were measured. The one 6-day sampling stratum with 4 samples recorded 2 exceedances. The remainder of the year with one sample per stratum recorded a single exceedance. Using formula [2], the estimated number of exceedances for the year is

$e = (365/56) \times (2/4 + 1) = 9.8$

If formula [1] were used instead of the revised formula [2], then the estimated number of exceedances for the year would have been

$e = 3 \times 365/59 = 18.6.$

This computation would have produced an estimate for exceedances that is roughly twice as high as that produced by the revised formula.

4.0 *Computational Formula for Annual Standards.*

4.1 *Calculation of the Annual Arithmetic Mean.*

The annual arithmetic means for PM_{10} and TSP shall be based on the average of the quarterly means for each calendar quarter for the most recent representative calendar years of data at a particular monitoring site. The following formula is to be used for calculation of mean for a calendar quarter:

[Formual 3]

$$\bar{x}_q = (1/n_q) \times \sum_{i=1}^{n_q} x_i$$

where

$\bar{x}_q$ = the quarterly mean concentration for quarter q, q = 1, 2, 3, or 4,

n_q = the number of samples in the quarter, and

x_i = the ith concentration value recorded in the quarter.

The average of quarterly means must be rounded to the nearest integer (fractional values of 0.5 should be rounded up). The annual mean is calculated by using the following formula:

[Formula 4]

$$\bar{x} = (1/4) \times \sum_{q=1}^{4} \bar{x}_q$$

where

$\bar{x}$ = the annual mean, and

x_q = the mean for calendar quarter q.

The use of quarterly averages to compute the annual average will not be necessary for monitoring or modeling data which results in a complete record, i.e., 365 days per year.

Example 4

Using formula [3], the quarterly means are calculated for each calendar quarter. If the quarterly means are 52.4, 75.3, 82.1, and 63.2 $\mu g/m^3$, then the annual mean is

$\bar{x} = (1/4) \times (52.4 + 75.3 + 82.1 + 63.2) = 68.3$ or 68

4.2 *Adjustments for Non-Scheduled Sampling Days.*

An adjustment in the calculation of the annual mean is needed if sampling is performed on days in addition to the days specified by the systematic sampling schedule. Using the notation and rationale described for estimated exceedances (Section 3.2), the quarterly averages would be calculated by using the following formula:

[Formula 5]

$$\bar{x}_q = (1/m_q) \times \sum_{j=1}^{m_q} \sum_{i=1}^{k_j} (x_{ij}/k_j)$$

where

$\bar{x}_q$ = the quarterly mean concentration for quarter q, q = 1, 2, 3, or 4,

x_{ij} = the ith concentration value recorded in stratum j,

k_j = the number of actual samples in stratum j, and

m_q = the number of strata with data in the quarter.

If one sample value is recorded in each stratum, formula [5] reduces to a simple arithmetic average of the observed values as described by formula [3].

Example 5

During one calendar quarter, 9 observations were recorded. These samples were distributed among 7 sampling strata, with 3 observations in one stratum. The concentrations of the 3 observations in the single stratum were 202, 242, and 180 $\mu g/m^3$. The remaining 6 observed concentrations were 55, 68, 73, 92, 120, and 155 $\mu g/m^3$. Applying the weighting factors specified in formula [5], the quarterly mean is

$\bar{x}_q = (1/4) \times [(1/3) \times (202 + 242 + 180) + 55 + 68 + 73 + 92 + 120 + 155] = 110.1$

Although 24-hour measurements are rounded to the nearest 10 $\mu g/m^3$ for determinations of exceedances of the 24-hour standard, note that these values are treated as integers for the calculation of means.

(42 U.S.C. 7403 and 7409)

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40 CFR Part 58

[AD-FRL 2491-6]

Ambient Air Quality Surveillance for Particulate Matter

AGENCY: Environmental Protection Agency.

ACTION: Proposed rule.

SUMMARY: EPA proposes to amend provisions of Part 58 of Chapter I of Title 40 of the *Code of Federal Regulations* (CFR) to account for revisions to the National Ambient Air Quality Standards (NAAQS) for particulate matter (PM) that are being proposed elsewhere in today's Federal Register. Under the proposed revisions to the primary ambient standard, particulate matter would be measured in the ambient air as PM_{10} (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers). Under the proposed revision to the secondary ambient standard, particulate matter would continue to be measured in the ambient air by the method described in Appendix B (40 CFR Part 50) hereinafter referred to as Total Suspended Particulate Matter (TSP). This necessitates proposed revisions to Part 58 that would establish ambient air quality monitoring requirements for PM_{10} as measured by a new reference method being proposed as Appendix J (40 CFR Part 50) elsewhere in today's Federal Register or an equivalent method. In addition new network design and monitoring siting requirements are being proposed for the secondary TSP standard. The proposed requirements are comparable to those already established for the other pollutants (criteria pollutants) for which NAAQS have been set. These include requirements for reporting and assuring the quality of ambient PM_{10} data, for the design of monitoring networks and the siting of samplers for both TSP and PM_{10}. Also proposed are revisions to the lead (Pb) and sulfur dioxide (SO_2) lower limits for precision estimates contained in Section 4.2 of Appendix A. Finally several clarifying changes are proposed in each of the appendices. Proposed revisions to EPA's regulations concerning Requirements for Preparation, Adoption, and Submittal of Implemention Plans (40 CFR Part 51) with associated guidelines, will be published later. Following the publication of these notices, the Agency will announce a supplementary review period for the limited purpose of taking comments on the implications of the proposed Part 51 implementation requirements and guidelines on the Part 58 regulations proposed today.

DATES: Comments must be submitted on or before June 18, 1984, for the proposals herein.

ADDRESSES: In conjunction with the monitoring requirements for PM_{10}, two draft guideline documents have been prepared and are included in Docket No. A–83–13 for public comment. These two draft documents are entitled:

- Guideline for Particulate Episode Monitoring Methods.
- Optimum Network Design and Site Exposure Criteria for Particulate Matter.

These documents are available for inspection and copying at:

- The Central Docket Section.
- State Air Programs Branch, U.S. EPA, Region I, JFK Federal Building, Boston, MA 02203.
- Air Programs Branch, U.S. EPA, Region II, 26 Federal Plaza, New York, NY 10278.
- Air Programs and Energy Branch, U.S. EPA Region III, Curtis Building, 6th and Walnut Streets, Philadelphia, PA 19106.
- Air Management Branch, U.S. EPA, Region IV, 345 Courtland Street, NE, Atlanta, GA 30365.
- Air Programs Branch, U.S. EPA, Region V, 230 S. Dearborn Street, Chicago, IL 60604.
- Air Programs Branch, U.S. Region VI, First International Building, 1201 Elm Street, Dallas, TX 75270.
- Air Programs Branch, U.S. EPA, Region VII, 324 East 11th Street, Kansas City, MO 64106.
- Air Programs Branch, U.S. EPA, Region VIII, 1860 Lincoln Street, Denver, CO 80295.
- Air Programs Branch, U.S. EPA, Region IX, 215 Fremont Street, San Francisco, CAS 94105.
- Air Programs Branch, U.S. EPA, Region X, 1200 6th Avenue, Seattle, WA 98101.

Submit comments (duplicate copies are preferred) to: Central Docket Section, U.S. Environmental Protection Agency, Attn: Docket No. *A–83–13*, 401 M Street, S.W., Washington, DC 20460. Docket No. *A–83–13* is located in the Central Docket Section of the Environmental Protection Agency, West Tower Lobby Gallery I, 401 M St., S.W. Washington, D.C. The docket may be inspected between 8:00 a.m. and 4:00 p.m. on week days and a reasonable fee may be charged for copying.

FOR FURTHER INFORMATION CONTACT: Neil Berg or Stanley Sleva, Monitoring and Data Analysis Division (MD–14), Office of Air Quality Planning and Standards, Environmental Protection Agency, Research Triangle Park, N.C. 27711, phone: 919–541–5651 or (FTS) 629–5651.

SUPPLEMENTARY INFORMATION:

Background

Elsewhere in today's Federal Register 40 CFR Part 50, EPA is proposing revised national ambient air quality standards (NAAQS) for particulate matter and a new reference method for the determination of ambient concentrations of particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}). Corresponding revisions are also being proposed elsewhere in today's Federal Register to the regulations in 40 CFR Part 53, Ambient Air Monitoring Reference and Equivalent Methods. The method discussed in Appendix B of 40 CFR Part 50 will continue to be used to measure particulate matter in the ambient air for purposes of determining attainment of the proposed revisions to the secondary standard hereinafter referred to as Total Suspended Particulate Matter (TSP). The Appendix B method will also be used in conjunction with Appendix G of Part 50 (Reference Method for the Determination of Lead in Suspended Particulate Matter Collected from Ambient Air) as well as for other purposes as specified in the proposed revisions to this Part. Additional information on these proposed actions can be found in the respective notices and comments on them should be sent to the addresses provided therein.

Section 110(a)(2)(C) of the Clean Air Act requires ambient air quality monitoring for purposes of the State Implementation Plans (SIP's) and for reporting air quality data to EPA. Criteria to be followed when measuring air quality and provisions for daily air pollution index reporting are required by Section 313 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 ambient air quality standards have been established (criteria pollutants) except lead. On September 3, 1981 (44 FR 27558), similar rules were promulgated for lead. The regulations in this notice deal with the ambient air quality monitoring, data reporting, and surveillance requirements associated with today's proposed revisions of the particulate matter standards. Comments sent to Docket No. *A–83–13*, therefore, should concern only the regulations being proposed in this notice, and the two previously mentioned guideline documents, Guideline for Particulate Episode Monitoring Methods, and Optimum Network Design and Site Exposure Criteria for Particulate Matter.

Proposed Revisions to Part 58—Ambient Air Quality Surveillance

Section 58.1, Definitions.

The revisions proposed today would add definitions of the terms "TSP" (total

suspended particulates), "Pb" (lead), and "PM_{10}" (particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers). The definition for Pb is added at this time because it was inadvertently left out in the promulgation of the Pb monitoring regulations.

Section 58.13, Operating Schedules

The current monitoring regulations specify that, "for manual methods, at least one 24-hour sample (is required) every 6 days except during periods or seasons exempted by the Regional Administrator." The revision proposed for this section would require the States to conduct more frequent sampling for PM_{10} by manual methods in order to provide for more accurate SIP design values and more correct attainment/nonattainment determinations. These revisions will apply only to the site with expected maximum concentration in each monitoring area. It is recognized that the probability of detecting exceedances of the 24-hour standard is dependent upon the frequency of monitoring, therefore, more frequent sampling is required to overcome the deficiency of the current monitoring requirements in detecting exceedances of the 24-hour standard. While every sixth day monitoring is adequate for estimating annual average concentrations, more frequent monitoring is considered necessary to assess status with respect to the 24-hour standard.

The operating schedule proposed for the measurement of PM_{10} will consist of a short-term and long-term monitoring plan. The short-term monitoring schedule will be based on a probability assigned to areas characterizing the likelihood that they are not attaining the PM_{10} standards. The use of PM_{10} nonattainment probabilities is necessary since most areas of the country do not have PM_{10} ambient monitoring data. These probabilities will be developed according to "Procedures for Estimating Probability of Nonattainment of a PM_{10} NAAQS Using Total Suspended Particulate or Inhalable Particulate Data." OAQPS, U.S. Environmental Protection Agency, Research Triangle Park, N.C. February 1984. These probabilities will be classified into three categories: low (<20 percent), medium (≥20 to <95 percent) and high (≥95 percent). A low probability, defined as a probability less than 20 percent, was chosen as a reasonable cutpoint in order to identify areas which are unlikely to be nonattainment. Such areas would have less than a one-in-five chance of being nonattainment. A medium probability, defined as a probability greater than or equal to 20 but less than 95 percent was chosen to identify areas which are more likely to be nonattainment and includes areas which would be expected to be near the standards. A high probability, defined as a probability greater than or equal to 95 percent was chosen as a reasonable cutpoint to identify areas which are most likely to be nonattainment; such areas would have a less than one-in-twenty chance of being attainment.

Data collection requirements for the first year of monitoring (short term) shall be based on the estimated probabilities of not attaining the PM_{10} standards and the associated importance of additional PM_{10} ambient data. For the areas with a low probability of not attaining the PM_{10} standards, the value of collecting more than a minimum of PM_{10} data is relatively low. Such areas are likely to be attainment, and intensified PM_{10} data collection is not warranted. Due to the small chance for being nonattainment, however, a minimum sampling program is still required. Accordingly, a minimum sampling schedule of one in 6 days would be required.

Areas with a medium probability of not attaining the PM_{10} standards are likely to either be near or in exceedance of the level of the standard. For such areas, the chance of misclassifying current attainment status is high, especially with respect to the 24-hour standard. Moreover, the value of additional PM_{10} information is important if it is found that a State Implementation Plan (SIP) must be prepared. Consequently, a more intensified sampling schedule of once in 2 days would be required.

For areas with a high probability of not attaining the PM_{10} standards, the value of a first year intensified PM_{10} data collection is most important. This is because these areas are most likely to be required to develop a SIP. Consequently, everyday sampling for a minimum of 1 year is being proposed for these areas in order to confirm a probable nonattainment status, as well as the degree. Although the specific details of EPA policy for PM_{10} control strategy development will be proposed at a later date with revisions to Part 51 "Requirements for Preparation, Adoption, and Submittal of Implementation Plans" and associated guidelines, this monitoring requirement will facilitate the determination of correct air quality status so that appropriate action can be made in a timely fashion. The short-term strategy also contains provisions for monitoring to be intensified to everyday at the site of expected maximum concentration in medium and low probability areas, if exceedances of the 24-hour standard are measured during the first year of monitoring.

The long-term selective sampling schedule is based on an analysis of the ratio of measured PM_{10} concentrations to the controlling PM_{10} standard. Depending upon the ratio, the sampling frequency could be either everyday, every other day, or every sixth day. The long-term monitoring strategy is designed to optimize monitoring resources and maximize information concerning attainment status. Similar to the short-term strategy, the increased sampling frequency provisions only apply to the site with expected maximum concentration in each monitoring area.

For those areas wherein the annual standard is controlling, 1 in 6 day monitoring would be required; this frequency is adequate for assessing status with respect to this standard. For those areas wherein the 24-hour standard is controlling, the required minimum sampling frequency, for the calendar year, will vary according to the relative level of the most current maximum concentration site to the level of the standard. In other words, the sampling requirement applies to the site which drives attainment/nonattainment status for the monitoring area. The least frequent monitoring (1 in 6 days) would be required for those areas wherein the maximum concentration site is clearly above the standard (>40% above) or clearly below the standard (<20% below). For such sites a minimum amount of data collection would be adequate to verify correct attainment/nonattainment status. As the area approaches the standard, the monitoring frequency for the maximum concentration site would increase so that the misclassification of correct attainment/nonattainment status can be minimized. If the area is either 10–20 percent below or 20–40 percent above the 24-hour standard, 1 in 2 day monitoring would be required. When the area is close to the standard, i.e. 10 percent below to 20 percent above, everyday sampling would be required in order to maximize the stability of the attainment/nonattaiment classification. Modification to the sampling schedule will be based on the SLAMS network annual data review, in which the most recent calendar year of air quality data would generally be used to determine current air quality status. Although the most recent year of measured data would be considered first in determining which site would operate at the more frequent sampling schedule, other

factors should also be considered. For example, the most recent three years of data might be used to provide stability to the network. In addition, an appropriate adjustment for trends could be made when a change in air quality status is shown to correspond to a commensurate change in underlying particulate matter emissions. Finally, major changes in sources of PM_{10} emissions or in sampling site characteristics could possibly influence the location of the expected maximum concentration area PM_{10} site. If the location of expected maximum concentration varies annually, EPA suggests that the recommended monitoring schedule be used at more than one site.

The annual operating costs associated with the sampling schedules of this proposed regulation are approximately 5 million dollars for the most stringent standard described in Part 50. This is comparable to the operating costs for the other criteria pollutants. The costs for the other sampling options considered are presented in "PM_{10} Monitoring Costs for Three Sampling Options," (October 26, 1983). A more detailed discussion of the rationale for the selected sampling options is currently being developed and will be available for public comment as a paper entitled, "Revising the NAAQS for Particulate Matter—A Selective Sampling Monitoring Strategy."

Section 58.20, Air Quality Surveillance: Plan Content

The revisions proposed today would require the States to have their revised air quality network descriptions for TSP and their new air quality network descriptions for PM_{10} available for submission to the appropriate Regional Administrators by 6 months afer promulgation. Since most PM_{10} monitoring stations are expected to be chosen from existing TSP or Pb monitoring stations, EPA believes it is reasonable to require States to submit their PM_{10} State and local air monitoring station (SLAMS) network descriptions within 6 months of promulgation of these regulations. Although some TSP monitors may need to be relocated to fulfill the micro/middle scale TSP secondary requirements, the 6 month deadline also applies to SLAMS TSP network descriptions since the new TSP SLAMS network will, in most cases, be a modification of the existing TSP SLAMS network.

As described in the proposed revisions to section 2.2 of Appendix C, EPA would allow the continued use of TSP high volume samplers in PM_{10} SLAMS as a substitute for PM_{10} samplers as long as measured 24-hour TSP concentrations and annual TSP levels remain below the PM_{10} standards. Such substitute TSP samplers would have to be identified and included in the initial SLAMS PM_{10} network descriptions. Should a TSP sampler record TSP levels that exceed the PM_{10} NAAQS, the substitute TSP sampler would be considered for replacement by a PM_{10} sampler during the annual SLAMS network review required by § 58.20(d).

Section 58.23, Monitoring Network Completion

Two dates, 1 year and 2 years after promulgation are proposed for completion of the PM_{10} SLAMS network. By 1 year after promulgation, each area within the approved SLAMS network for which a probability of PM_{10} NAAQS nonattainment is greater than or equal to twenty percent, must have at least one PM_{10} sampler which is located in the area of expected maximum concentration in operation, be sited in accordance with Appendix E, be located as described on the station's SAROAD identification form and meet all of the quality assurance requirements pertinent to PM_{10} contained in Appendix A. The remaining PM_{10} samplers have until 2 years after promulgation to be fully operational and to meet the siting and quality assurance requirements. This latter date would also be applicable to the relocated TSP samplers required by the secondary NAAQS monitoring requirements.

The SLAMS network design and probe requirements being proposed today (as revisions to Appendices D and E respectively) would be similar to those required for TSP in the current Appendices D and E; the major difference would be the addition of a microscale to the applicable spatial scale for monitoring TSP and PM_{10}. (Definitions of monitoring scales of representativeness and SLAMS monitoring objectives and spatial scale are found in section 1 of Appendix D.) Since the expected size of the revised TSP SLAMS network and the PM_{10} SLAMS network would be approximately the same or smaller than the current TSP SLAMS network, complying with the revised requirements of Appendices A, D and E should not pose unmanageable resource burdens. Although the Agency does not anticipate any major problem in SLAMS network design, siting, or quality assurance, it does recognize that because of the potential lack of sufficient commercially available PM_{10} reference or equivalent samplers the States may have difficulties in completing their entire planned SLAMS PM_{10} network. Because of this situation, and based on the time required to complete SLAMS for the other criteria pollutants, the Agency proposes to allow a two year time period for SLAMS TSP and a two year phased approach for PM_{10} network completion.

Section 58.26, Annual SLAMS Summary Report, and § 58.27, Compliance Data for Air Quality Data Reporting

These sections, which remain unchanged, specify when the SLAMS annual reporting procedures were to begin. Under these procedures the data from each particulate matter SLAMS are currently summarized and submitted in the annual report as TSP data. After the new NAAQS are promulgated, there would be a requirement to report PM_{10} data in the annual report. However, as discussed more fully in a later part of this preamble, the revision proposed to Appendix C of Part 58 would allow high volume samplers to be used under certain circumstances as substitute samplers for PM_{10} samplers, and the revisions being proposed to Appendix F would provide for reporting of both TSP and PM_{10} data. Accordingly, EPA would expect States to continue reporting TSP data from each TSP slams until that station is taken out of service. Also, as each PM_{10} SLAMS is put into operation, the PM_{10} data would be included in the annual report as required by § 58.26. There would, therefore, be a gradual transition in the data reporting process and no revision is needed to § 58.26 or § 58.27 to establish an initial reporting date for PM_{10} annual summary data.

Section 58.30, NAMS Network Establishment

The revision proposed today would designate 6 months after promulgation as the date by which the National Air Monitoring Station (NAMS) network portion of each State's SLAMS network must be fully described and documented in a submittal to the Administrator (through the appropriate Regional Office). Since the number of PM_{10} NAMS required would be less than the number of existing TSP NAMS, EPA believes that the design of the PM_{10} NAMS network can reasonably be accomplished and submitted within six months after the promulgation of these regulations. Also, since the new TSP secondary NAAQS NAMS network will likely be smaller than the existing TSP primary NAAQS NAMS Network, six months is a reasonable time to design and submit a description of the new TSP network as well.

Section 58.34, NAMS Network Completion

The revision proposed today would designate 1 year after promulgation as the date by which the State must have all PM_{10} and TSP NAMS in operation. Specifically, each PM_{10} and TSP NAMS would have to be sited in accordance with the criteria in Appendix E, be located as described in the station's SAROAD site identification form and be operating under the quality assurance requirements of Appendix A. The Agency believes this shorter period for completion of the NAMS portion of the SLAMS network is reasonable in view of the smaller number of TSP and PM_{10} NAMS versus the entire TSP and PM_{10} SLAMS network. EPA also anticipates that an adequate number of PM_{10} reference or equivalent samplers will be available within 12 months after promulgation of these regulations.

Section 58.35, NAMS Data Submittal

Today's proposed revisions would designate 90 days after the first quarter of operation as the date by which data collected during the first quarterly period after PM_{10} NAMS network completion must be reported. The purpose of this revision would be to establish a date for the submission of the initial quarterly report of data from PM_{10} NAMS and the relocated or newly established TSP NAMS. States having PM_{10} NAMS operating according to all Part 58 criteria prior to 1 year after promulgation would be encouraged to submit data from those stations in the earliest NAMS report possible.

Revisions to Appendix A

Appendix A sets forth quality assurance and quality assessment requirements for ambient air monitoring data. Revisions to various sections are proposed to include appropriate data quality assessment procedures for PM_{10} monitoring. The proposed accuracy and precision assessment procedures for PM_{10} would be very similar to the current requirements for TSP. Accuracy would be assessed with rotating flow audits each quarter, and precision would be assessed with collocated samplers.

A minor change in section 4.2.1(a) would eliminate, from the precision calculations, paired measurements from collocated samplers where either measurements is below a specified lower limit. This would avoid exaggerated estimates of precision that often result from very low measurements. The specified lower limit for PM_{10} would be 20 $\mu g/m^3$, and the lower limits for SO_2 and Pb would be changed slightly to provide more meaningful precision estimates: SO_2 from 40 to 45 $\mu g/m^3$, and Pb from 0.15 to 0.25 $\mu g/m^3$.

The data assessment report form (Form 1, Figure 1, Back) would be revised to add data blocks from PM_{10} data, and the instructions for the form in Appendix A, Section 5.3 would be revised accordingly.

Revisions to Appendix B

Appendix B contains quality assurance requirements for PSD monitoring. Appropriate amendments to extend the data quality assessment requirements explicitly to PM_{10} monitoring are proposed. As in Appendix A, a new provision for excluding from the precision caclulation any paired measurements from collocated samplers below specified limits would be added to apply to TSP, Pb, and PM_{10}.

Revisions to Appendix C

Because TSP high volume samplers measure a larger particle size fraction of suspended particulate matter than PM_{10} samplers, EPA believes that after this promulgation there would be no need to require the high volume sampler to be replaced with PM_{10} sampler in the SLAMS network in stations where measured TSP ambient concentration levels are below the PM_{10} ambient standards. State or local agencies would be allowed to continue to operate the high volume sampler to demonstrate compliance with ambient PM_{10} standards as long as measured TSP levels remain below those standards. As soon as a TSP sampler measures a single value which is higher than the PM_{10} 24-hour standard or has an annual average greater than the PM_{10} annual standard, it would be necessary to replace the high volume samplers designated as substitute PM_{10} samplers with PM_{10} samplers. This is because the PM_{10} portion of TSP varies from area to area and could possibly be close to 100 percent of the TSP during air stagnation periods in some areas. This correction must be reflected in the SLAMS annual network review.

This proposed revision to Appendix C would be added as section 2.2, and the existing material in section 2.2 would be deleted because it involves requirements that are now out of date.

In addition to allowing the continued use of the high volume (TSP) method as a substitute for a PM_{10} sampler in certain areas, EPA believes that there is a strong need to require a limited amount of TSP and PM_{10} air quality sampling (at least one year of collocated sampling) at those existing TSP NAMS which will be designataed as PM_{10} NAMS. This requirement would provide supporting data to determine possible relationships between TSP and PM_{10} air quality data so that historical trends and patterns for ambient particulate matter can be continued. Because the TSP/PM_{10} relationships may vary geographically and seasonally, the proposed rule would require that States continue to operate a TSP sampler for one year at all PM_{10} NAMS that were previously TSP NAMS. The year would begin for each station at the time the PM_{10} sampler in the PM_{10} NAMS is put into operation.

The requirements in section 4.0 for episode monitoring would be revised to replace "TSP" with "PM_{10}" and all references to the high volume method would be changed to reflect the new reference method for PM_{10} since episodes would be based upon PM_{10} rather than TSP.

Also, the reference in section 5.0 pertaining to selecting TSP episode monitoring methods would be replaced with a reference to the document, Guideline for Particulate Episode Monitoring Methods, which provides guidance on selecting PM_{10} episode monitoring methods. EPA solicits comments on this guideline document.

Revisions to Appendix D

The revisions to Appendix D proposed today would revise sections 2.2 and 3.1 to incorporate changes necessitated by the revised TSP secondary NAAQS, add new sections 2.8 and 3.7 dealing with considerations necessary in the design of PM_{10} SLAMS and NAMS networks and revise section 3.2 to delete references to TSP in the SO_2 section. Also added are references to guidelines to be used in siting PM_{10} stations and references for calculating PM_{10} NAAQS nonattainment probability.

The revisions to section 2.2 would allow micro scale TSP SLAMS to be used to monitor for compliance with the revised TSP secondary NAAQS.

The revisions to section 3.1 would revise the range for the number of TSP NAMS required in urban areas.

Section 2.8 is a new section that describes the criteria that would be used in designing the SLAMS network and specifies situations where the PM_{10} monitoring requirements could be met by TSP samplers (in accordance with the proposed revision to Appendix C). This section also includes descriptions of applicable PM_{10} spatial scales.

Section 3.2 specifies SO_2 design criteria for NAMS and makes comparisons to TSP monitoring. Because of the proposed revisions to the TSP monitoring criteria it is appropriate to

eliminate comparisons to TSP in the SO_2 section at this time.

Section 3.7 is a new section. It would establish design criteria for determining the number of NAMS based on PM_{10} NAAQS nonattainment probability, source types, and urban area population. Consistent with design criteria for other pollutants, one of the NAMS would be a category (a) maximum concentration station, and the other a category (b) population exposure station. For PM_{10}, category (a) stations would be micro or middle scale and category (b) stations would be neighborhood scale. As noted in Appendix C, all PM_{10} NAMS that were previously designated as TSP NAMS would be required to collect both ambient TSP and PM_{10} data for a one-year period starting at the time the PM_{10} sampler in the PM_{10} NAMS is put into operations.

Revisions to Appendix E

Today's proposed revisions to Appendix E would revise section 2 to include revised TSP siting requirements, and add a new section 8 to cover the specific PM_{10} sampler siting requirements.

The proposed changes consist of siting parameters that would specify spacing distances from roadways and minimum separation distances from buildings, trees and other obstructions. Vertical and horizontal sampler distances are also proposed so that sampling can be conducted representative of the breathing zone while preventing vandalism to the sampler.

For microscale sites, a height of 2–7 meters is proposed while for larger scale sites, a height of 2–15 meters is proposed. A horizontal roadway setback distance of 5–15 meters is proposed for a microscale roadway site and a range of distances is proposed for larger scales. EPA welcomes further comments on this subject, as well as comments on the guideline document, Optimum Network Design and Site Exposure Criteria for Particulate Matter, mentioned earlier under the heading, AVAILABILITY OF RELATED INFORMATION. The other siting provisions being proposed are consistent with those currently required for the other criteria pollutants.

Revisions to Appendix F

As a result of the revisions proposed for the particulate matter standards, revisions would be necessary to the data reporting requirements of Appendix F. A new section 2.7 is proposed to be added to Appendix F that would specify the ambient PM_{10} information that would be required in the annual air quality data report. As discussed under Appendix C, States could operate high volume samplers in their PM_{10} SLAMS network where measured TSP levels were below the PM_{10} ambient standards. This TSP data would be reported as such in the annual SLAMS report. The annual TSP arithmetic mean is required in order to estimate PM_{10} levels in those cases where TSP is measured as a substitute for PM_{10}. Also, the annual TSP artithmetic mean is required in order to determine compliance with the proposed secondary TSP standard. Section 2.2, therefore, would be retained to address TSP reporting but modified to be consistent with Section 2.7.

New concentration ranges related to the proposed PM standards are proposed in section 2.7 for compiling PM_{10} data. For consistency, in section 2.2, compatible ranges are also proposed for compiling TSP data. Also, the TSP annual mean would be changed from a geometric mean to an arithmetic mean. In order to calculate the expected number of exceedances of the 24-hour PM_{10} ambient standard (40 CFR Part 50, Appendix K, section 2.2), all exceedances of the standard would be reported as well as the sampling frequency. The proposal, therefore, contains the requirement to report all 24-hour values exceeding the 24-hour PM_{10} ambient standard, their dates of occurence, and the sampling schedule.

According to the procedures of Appendix K, Part 50, the calculations to determine attainment/nonattainment of the PM_{10} ambient standards also must take into account episode statistics. If episode occurrences are not taken into account, an overestimate of the number of exceedances, as well as the level of the annual arithmetic mean could result.

In section 2.2.2, only the ten highest TSP values above the PM_{10} standards are proposed to be reported. Since only TSP data would be available until PM_{10} samplers are installed, the ten highest values would be sufficient for statistical purposes.

Revisions to Appendix G

The proposed requirements in Appendix G for air quality index reporting are to eliminate provisions related to TSP or TSP x SO_2 and to add provisions for PM_{10}. A number of proposed revisions involve removing TSP provisions (including the example calculation) in section 7.2, and replacing them with PM_{10}. The pollutant standard index (PSI) function in Figure 2 and the second column in Table 1 are proposed to be renamed "PM_{10}" and revised to reflect breakpoints which coincide with the proposed episode and significant harm levels for PM_{10}. This is consistent with the provisions for other pollutants. The proposed action also includes removing the breakpoints and PSI function figure for TSP x SO_2.

A minor proposed change involves a typographical error in the fifth column of Table 1. The correct term for the column is mg/m^3 instead of umg/m^3.

Impact on Small Entities

The Regulator Flexibility Act requires that all federal agencies consider the impacts of final regulations on small entities, which are defined to be small business, small organizations, and small governmental jurisdictions (5 U.S.C. 601 *et seq.*). EPA's consideration pursuant to this Act indicates that no small entity group would be significantly affected in an adverse way by the proposal. Therefore, pursuant to 5 U.S.C. 605(b), the Administrator certifies that this regulation will not have a significant economic impact on a substantial number of small entities.

Other Reviews

The regulatory impact of the proposed revisions to Part 58 is addressed within the Regulatory Impact Analysis (RIA) referenced under the Proposed Revisions to the National Ambient Air Quality Standards for Particulate Matter Published elsewhere in today's Federal Register.

The proposed revisions to Part 58 were submitted to the Office of Management and Budget (OMB) for review (under Executive Order 12291). This is not a "major" rule under E.O. 12291 because it does not meet any of the criteria defined in the Executive Order.

The reporting and recordkeeping provisions addressed in this notice, however, have been submitted separately for review by OMB under section 3504(b) of the Paperwork Reduction Act of 1980 U.S.C. 3501 et seq. Any OMB comments and EPA responses to those comments are available for public inspection at EPA's Central Docket Section (Docket No. *A–83–13*), West Tower Lobby, Gallery, I, Waterside Mall, 401 M Street SW., Washington, D.C.

List of Subjects in 40 CFR Part 58

Air Pollution Control, Intergovernmental relations, Reporting and recordkeeping requirements, Pollutant standard index, Ambient air quality monitoring network.

(Secs. 110, 301(a) and 319, Clean Air Act, 42 USC 7410, 7601(a), 7619)

Dated: March 8, 1984.
William D. Ruckelshaus,
Administrator.

PART 58—AMBIENT AIR QUALITY SURVEILLANCE

For the reasons set out in the preamble, Part 58 of Chapter I of Title 40 of the *Code of Federal Regulations* is proposed to be amended as follows:

1. Section 58.1 is amended by adding new paragraphs (t), (u), and (v) as follows:

§ 58.1 Definitions.

* * * * *

(t) "TSP" (total suspended particulates) means particulate matter as measured by the method described in Appendix B of Part 50 of this chapter.

(u) "PM_{10}" means particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers as measured by a reference method based on Appendix J of Part 50 of this chapter and designated in accordance with Part 53 of this chapter or by an equivalent method designated in accordance with Part 53 of this chapter.

(v) "Pb" means lead.

* * * * *

2. Section 58.13 is amended by revising paragraph (b) and adding paragraph (c) to read as follows:

§ 58.13 Operating Schedule.

* * * * *

(b) For manual methods (excluding PM_{10} samplers)—at least one 24-hour sample every six days except during periods or seasons exempted by the Regional Administrator.

(c) For PM_{10} samplers—a 24-hour sample must be taken from midnight to midnight (local time) to ensure national consistecy. The sampling shall be conducted on the following schedules which are based on either the first year of PM^{10} monitoring or a long-term selective PM^{10} monitoring plan:

(1) First year PM_{10} monitoring. The sampling frequency for the first year (12 consecutive months) of ambient PM_{10} monitoring shall be based on a described area's probability of nonattainment of the PM_{10} NAAQS using total suspended particulate data. Procedures to develop these probabilities are found in Frank, N. and T. Pace. "Procedures for Estimating Probability of Nonattainment of a PM_{10} NAAQS Using Total Suspended Particulate or Inhalable Particulate Data." OAQPS, U.S. Environmental Protection Agency, Research Triangle Park, N.C. September 1983. The most recent 3 calendar years of air quality data must be used in this determination. The probabilities are divided into three categories: (i) High—greater than or equal to 95 percent probability; (ii) medium—greater than or equal to 20 percent to less than 95 percent probability, and (iii) low—less than 20 percent probability. A described area could be: An urbanized area; a city or town and; a rural area. The starting date for this first year of PM_{10} monitoring may begin prior to the effective date (promulgation date) of this regulation.

(i) For high probability areas, everyday PM_{10} sampling is required for at least one PM_{10} site which must be located in the area of expected maximum concentration. The remainder require every sixth day sampling.

(ii) For medium probability areas, every other day sampling is required for at least one PM_{10} site which must be located in the area of expected maximum concentration. The remainder require every sixth day sampling.

(iii) For low probability areas, a minimum of one in six day sampling is required.

If a monitoring site in a medium or low probability area later records levels exceeding the short term (24-hour) PM_{10} NAAQS, as described in Part 50 Appendix K, and the monitoring frequency was less than everyday, then everyday sampling must be initiated in the area of expected maximum concentration no later than 90 days following the end of the calendar quarter in which the exceedance occurred and continue for the subsequent four calendar quarters.

(2) Long term monitoring selective sampling. After one year of PM_{10} monitoring has been obtained, the minimum monitoring schedule for the site in the area of expected maximum concentration shall be based on the relative level of that monitoring site concentration with respect to the level of the controlling standard. For those areas in which the short-term (24-hour) standard is controlling i.e., has the highest ratio, the selective sampling requirements are illustrated in Figure 1. The minimum sampling schedule for all other sites in the area would be once every six days. For those areas in which the annual standard is the controlling standard, the minimum sampling schedule for all monitors in the area would be once every six days.

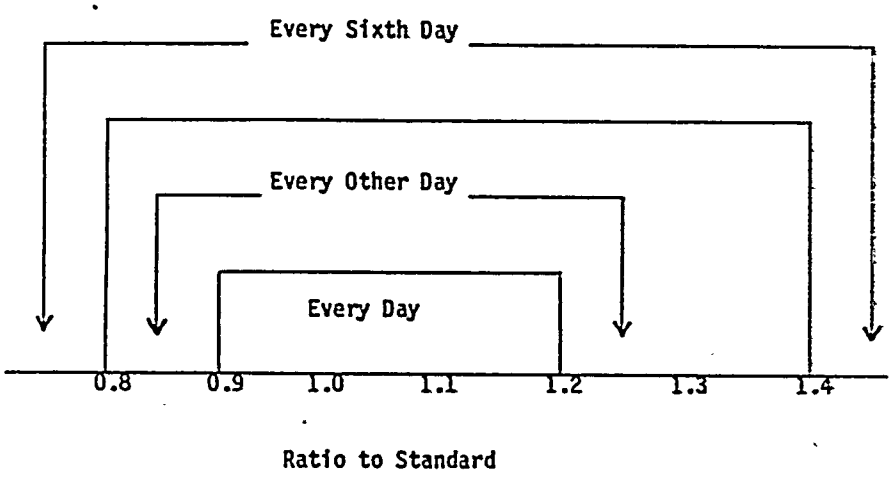

Figure 1. Selective Sampling Requirements

During the annual review of the SLAMS network, the most recent year of data must be considered to estimate the air quality status for the controlling air quality standard (24-hour or annual). Statistical models such as analysis of concentration frequency distributions as described in "Guideline for the Interpretation of Ozone Air Quality Standards," EPA-450/479-003, U.S. Environmental Protection Agency, Research Triangle Park, N.C., January 1979, should be used. Adjustments to the monitoring schedule must be made on the basis of the annual review. The site having the concentration in the most current year must be given first consideration when selecting the site for more frequent sampling schedule. Other factors such as major change in sources of PM_{10} emissions or in sampling site characteristics could influence the location of the expected maximum concentration site. Also, the use of the most recent three years of data might in some cases, be justified in order to

provide a more representative data base from which to estimate current air quality status and to provide stability to the network. If the maximum concentration site based on the most current year is not selected for the more frequent operating schedule, documentation of the justification for selection of an alternate site must be submitted to the Regional Office for approval during the annual review process. It should be noted that minimum data completeness criteria, number of years of data and sampling frequency for judging attainment of the NAAQS are discussed in Appendix K of Part 50.

§ 58.20 [Amended]

3. Paragraph (e) of § 58.20 is amended by adding "and for PM_{10} and relocated TSP monitors which must be available by 6 months after promulgation" after "by December 1, 1981."

§ 58.23 [Amended]

4. Section 58.23 is amended by adding "with the exception of PM_{10} samplers whose probability of nonattainment of the PM_{10} ambient standard is greater than or equal to 20 percent which shall be by 1 year after promulgation and the remaining PM_{10} and relocated TSP samplers which shall be by 2 years after promulgation" after "January 1, 1983," in the introductory sentence.

§ 58.30 [Amended]

5. Section 58.30 is amended by adding "and PM_{10} and relocated TSP samplers, which shall be by 6 months after promulgation," after "by December 1, 1981" in paragraph (a).

§ 58.34 [Amended]

6. Section 58.34 is amended by adding "and PM_{10} and relocated TSP samplers, which shall be by 1 year after promulgation" after "by July 1, 1982" in the introductory sentence.

7. Section 58.35 is amended by adding a new sentence after the last sentence in paragraph (d) as follows:

§ 58.35 NAMS data submittal.

* * * * *

(d) * * *. For PM_{10} and relocated or newly established TSP samplers, the first quarterly report will be due 90 days after the first quarter of operation.

Appendix A—[Amended]

8. In Appendix A, sections 3, 4, and 5 are amended as follows:

a. The fourth sentence in section 3.2.1 is changed by replacing the phrase "high volume" with the phrase "high volume and PM_{10}."

b. Section 3.2.2 is amended by replacing the phrase "For TSP" with the phrase "For TSP and PM_{10}," in the second sentence and by adding paragraph (e) to read as follows:

* * * * *

(e) *PM_{10} Methods.* Each calendar quarter, audit the flow rate of at least 25 percent of the PM_{10} samplers such that each sampler is audited at least once per year. If there are fewer than four PM_{10} samplers within a reporting organization, reaudit one or more randomly selected samplers so that one sampler is audited each calendar quarter.

Audit the flow rate of the sampler at its specified operating flow rate, using a certified flow transfer standard (see reference 2). The flow transfer standard used for the audit must not be the same one used to calibrate the flow of the sampler being audited, although both transfer standards may be referenced to the same primary flow of volume standard. The difference between the audit flow measurement and the flow indicated by the sampler's flow indicator is used to calculate accuracy, as described in section 4.2.2.

c. In section 4.2.1, paragraph (a) is revised to read as follows:

* * * * *

(a) *Single Instrument Precision.* For the paired measured obtained as described in section 3.2.1, select all pairs in which both measurements are above the concentrations given at the end of paragraph (a). For each selected measurement pair, calculate the percent difference (d_i) using equation 1, where Y_i is the concentration of pollutant measured by the duplicate sampler and X_i is the concentration measured by the sampler reporting air quality for the site. For each site, calculate the quarterly average percent difference (d_j), equation 2, and the standard deviation (S_j), equation 3.

At low concentrations, agreement between the measurements of collocated samples, expressed as 95 Percent Probability Limits, may be poor. For this reason a separate count is made of the occurrence of pollutant measurements below specified levels. Count the number of data pairs from all collocated sites that indicate a measurement from either of the collocated samplers (see section 3.2.1) below the following limits:

* * * * *

TSP: 20 $\mu g/m^3$,
SO_2: 45 $\mu g/m^3$,
NO_2: 30 $\mu g/m^3$,
Pb: 0.25 $\mu g/m^3$, and
PM_{10}: 20 $\mu g/m^3$.

Report the counts in columns 20–23 of Form 12 (Back).

d. In section 4.2.2, paragraphs (a) and (b) are revised to read as follows:

(a) *Single Sampler Accuracy (TSP and PM_{10}).* For the flow rate audit described in sections 3.2.2(a) and 3.2.2(e), let X_i represent the known flow rate and Y_i represent the indicated flow rate. Calculate the percent difference (d_i) for each audit, using equation 1.

(b) *Accuracy for Reporting Organization (TSP and PM_{10}).* Using equation 8, calculate the averages (D) of the individual percent differences for all TSP or PM_{10} samplers audited during the calendar quarter. Compute the standard deviation (S_a) of all the percent differences for all of the samplers audited during the calendar quarter, using equation 9.

Calculate the 95 Percent Probability Limit for the accuracy of a reporting organization, using equations 6 and 7, and record these limits on the back of Form 1 under blocks 46–51. Note that since the audit is conducted at only one level, blocks 40–45 and 52–57 are not used. For reporting organizations having four or fewer TSP or PM_{10} samplers, 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, semi-annual (instead of quarterly) reporting of probability limits is required.

* * * * *

e. In the introduction to section 5, "Environmental Monitoring and Support Laboratory" is changed to "Environmental Monitoring Systems Laboratory."

f. In section 5.1, delete the phrase "with a copy to EMSL/RTP".

g. In section 5.3, the instructions for Form 1, Back, are revised as follows:

5.3 *Instructions for Form 1.*

* * * * * * * *

Block No.	Description
* * * * * * *	
	Manual Methods (Form 1, Back)
9–14	*Pollutant Identifiers:* (Precoded).
15–17	*Number of Samplers:* Count only those samplers for each pollutant that are associated with an approved method and from which monitoring data are reported as part of a SLAMS network.
18–19	*Number of Collocated Sites:* Number of sites having collocated samplers. The minimum number is 2
20–23	*Number of Collocated Data Pairs Below the Limit:* Count the number of data pairs from the collocated sites where a measurement from either of the collocated samplers (see section 3.2.1) is below the following limits: TSP: 20 μg TSP/m^3 SO_2: 45 μg SO_2/m^3 NO_2: 30 μg NO_2/m^3 Pb: 0.25 μg Pb/m^3 PM_{10}: 20 μg PM_{10}/m^3
24–26	*Lower Probability Limit, Precision:* Block 24 is either "+" or "–". Blocks 25–26 contain the percentage obtained from equation 11.

Block No.	Description
27–29	*Upper Probability Limit, Precision:* Block 27 is either "+" or "−". Blocks 28–29 contain the percentage obtained from equation 10. Note: If precision limits exceed two digits, e.g., 103% report as 99.
30–35	*Pollutant Identifiers:* (Precoded).
36	Not used.
37–39	*Number of Audits:* Count the total number of audits performed on the entire network for the pollutants. A single audit may consist of several audit level checks, but count only once for each audit. For example, although an audit conducted for NO_2 or SO_2 consists of checks at three different concentration levels, count this as one audit, not three.
40–57	*Probability Limits, Accuracy:* The lower and upper probability limits for each level of the accuracy audits are entered in blocks 40–57. Audit levels, their corresponding flow or concentration ranges and the appropriate blocks for this information are given in the following table:

Blocks	Audit level	Flow audit			Analytical audit	
		TSP	Pb	PM_{10}	Pb µg/strip [1]	SO_2, NO_2, µg/ml
40–45	1				100 to 300	0.2 to 0.3.
46–51	2	Normal sampler flow.		Normal sampler flow.	600 to 1,000	0.5 to 0.6.
52–57	3		Normal sampler flow [2].			0.8 to 0.9.

[1] Audit ranges apply only to the Pb reference method. Audit ranges for an equivalent Pb method must be compatible with the specific requirements of the equivalent method.
[2] Applies to Pb equivalent methods which do not use the high volume sampler.

Block	Description
40–42, 46–48, 52–54	*Lower Probability Limits, Accuracy:* Blocks 40, 46, and 52 are either "+" or "−". Blocks 41–42, 47–48 and 53–54 contain the percentage obtained from equation 7.
43–45, 49–51, 55–57	*Upper Probability Limits, Accuracy:* Blocks 43, 49 and 55 are either "+" or "−". Blocks 44–45, 50–51 and 56–57 contain the percentage obtained from equation 6. Note: If accuracy limits exceed two digits, e.g., 103%, report as 99. Report, as required, all pollutants (TSP, Pb, PM_{10}, SO_2, and NO_2) determined by manual methods. Note that only blocks 46–51 are used for TSP and PM_{10}. NOTE: If only one audit is performed during a given quarter for a given pollutant, it is not possible to calculate probability limits for that quarter. In that case, blocks 40–57 are left blank for the first such quarter and the number 001 is reported in blocks 37–39. Probability limits are then computed and reported on a semi-annual basis (i.e., after the next quarter) from the audit data obtained during the two consecutive quarters.
58–60	*Number of Valid Collocated Data Pairs:* Enter the total number of data pairs from all the collocated sites.

h. The Data Assessment Report Form (back), Figure 1, is revised to read as follows:

DATA ASSESSMENT REPORT — MANUAL METHODS

OMB No. 2000-0003
Expires 10-31-86

STATE | REPORTING ORGANIZATION | YEAR | QUARTER | SEND COMPLETED FORM TO REGIONAL OFFICE

(1 2 3 4 5 | 6 7 | 8)

NAME OF REPORTING ORGANIZATION _____

DATE SUBMITTED _____ ORIGINAL _____ REVISION _____

PRECISION

		NO. OF SAMPLERS[1] (15-17)	NO OF COLLOCATED SITES (18-19)	NO. OF COLLOCATED SAMPLES < LIMIT (20-23)	PROBABILITY LIMITS LOWER (24-29)	PROBABILITY LIMITS UPPER (24-29)	NO OF VALID COLLOCATED DATA PAIRS (58-60)
A. TSP	111101 (9-14)						
B SO_2	142401 (9-14)						
C. NO_2	142602 (9-14)						
D Pb	112128 (9-14)						
E PM_{10}	181102 (9-14)						

LIMITS APPLICABLE TO BLOCKS 20-23

TSP: 20 μg TSP/m^3

SO_2: 45 μg SO_2/m^3

NO_2: 30 μg NO_2/m^3

Pb: 0.25 μg Pb/m^3

PM_{10}: 20 μg PM_{10}/m^3

ACCURACY

			NO OF AUDITS	PROBABILITY LIMITS LEVEL 1 LOWER (40-45)	LEVEL 1 UPPER (40-45)	LEVEL 2 LOWER (46-51)	LEVEL 2 UPPER (46-51)	LEVEL 3 LOWER (52-57)	LEVEL 3 UPPER (52-57)
A. TSP	111101 (30-35)	A (36)	(37-39)						
B SO_2	142401 (30-35)	B (36)	(37-39)						
C. NO_2	142602 (30-35)	C (36)	(37-39)						
D Pb	112128 (30-35)	D (36)	(37-39)						
E PM_{10}	181102 (30-35)	E (36)	(37-39)						

[1] COUNT ONLY REFERENCE OR EQUIVALENT MONITORING METHODS.

FIGURE 1 FORM 1 (BACK)

Appendix B—[Amended]

9. Appendix B is amended as follows:

a. The heading of paragraph 3.3.1 is revised to read as follows:

3.3.1 *TSP and PM_{10} Methods.* * * *

b. The first paragraph of 3.4.1 is revised to read as follows:

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

* * * * *

c. Section 5.1 is revised to read as follows:

5.1 *Single Instrument Precision for TSP, Pb and PM_{10}.* Estimates of precision for ambient air quality particulate measurements are calculated from results obtained from

collocated samplers as described in section 3.3. At the end of each sampling quarter, calculate and report a precision probability interval, using weekly results from the collocated samplers. Directions for calculations are given below, and directions for reporting are given in section 6.

For the paired measurements obtained as described in section 3.3.1 and 3.3.2, select all pairs in which both measurements are above 20 $\mu g/m^3$ for TSP, 0.25 $\mu g/m^3$ for Pb, or 20 $\mu g/m^3$ for PM_{10}. For each selected pair, calculate the percent difference (d_i) using equation 1, where Y_i is the concentration of pollutant measured by the duplicate sampler, and X_i is the concentration measured by the sampler reporting air quality for the site. Calculate the quarterly average percent difference (dj), equation 2; standard deviation (Sj), equation 3; and upper and lower 95 percent probability limits for precision, equations 6 and 7.

Upper 95 Percent Probability
Limit=dj+1.96 Sj 2 (6)

Lower 95 Percent Probability
Limit=dj−1.96 Sj 2 (7)

d. In paragraph 5.2, revise the heading to read *"Single Instrument Accuracy for TSP and PM_{10},"* and replace the phrase "each high volume sampler" with the phrase "each high-volume or PM_{10} sampler."

Appendix C—[Amended]

10. In Appendix C, sections 2.0, 4.0, and 5.0 are amended as follows:

a. In section 2.0, paragraphs 2.2.1 and 2.2.2 are removed and paragraph 2.2 is revised to read as follows:

* * * * *

2.2 For purposes of showing compliance with the NAAQS for particulate matter, the high volume sampler described in Appendix B of Part 50 of this chapter may be used in a SLAMS as long as the ambient concentration of particles measured by the high volume sampler is below the PM_{10} NAAQS.

As soon as the TSP sampler measures a single value which is higher than the PM_{10} 24-hour standard or has an annual average greater than the PM_{10} annual standard, it would be necessary to replace the high volume sampler designated as a substitute PM_{10} sampler with a PM_{10} sampler.

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 concurrently operated with the PM_{10} sampler for a one-year period beginning with the PM_{10} NAMS start up date.

* * * * *

B. Section 4.0 is revised to read as follows:

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

4.1.1 Either the "Staggered PM_{10}" method or the "PM_{10} Sampling Over Short Sampling Times" method, both of which are based on the reference method for PM_{10} and are described in reference 1: or

4.1.2 Any other method for measuring PM_{10}:

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

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

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

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

c. Section 5.1 is revised to read as follows:

5.1 Pelton, D.J. Guideline for Particulate Episode Monitoring Methods, GEOMET Technologies, Inc., Rockville, MD. Prepared for U.S. Environmental Protection Agency, Research Triangle Park, NC. EPA Contract No. 68-02-3584. (February 1983 Draft.)

Appendix D—[Amended]

11. Appendix D is amended as follows:

a. In the Table of Contents, sections 2.8 and 3.7 are added in the appropriate places as follows:

* * * * *

2.8 PM_{10} Design Criteria for SLAMS

* * * * *

3.7 PM_{10} Design Criteria for NAMS

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b. In section 2, in the second paragraph of section 2.2 in the second sentence, the words "one of four scales" are revised to read "one of five scales", and the word "micro" is inserted in the parenthetical expression immediately before the word "middle." In the third paragraph, the word "four" is replaced by the word "five." Following the third paragraph and before the discussion of "middle scale" the following is inserted:

"• *Microscale*"—This scale would typify areas such as downtown street canyons, traffic corridors, unpaved roads, haul roads, track out dirt from construction sites, dust from storage piles and fugitive emissions. Because of the very steep ambient TSP gradients resulting from these sources, the dimensions of the microscale for TSP generally would not extend beyond 15 meters. In the case of roadway sources, the microscale could continue the length of the roadway, which may be several kilometers. Microscale TSP sites should be located near inhabited buildings where property can be expected to be exposed to high ambient particulate concentrations. Emissions from stationary sources such as primary and secondary smelters, power plants, steel mills 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.

The first 3 sentences of the "• middlescale"—discussion are deleted and replaced by "the previously mentioned sources also have an impact at the middlescale level."

In the "• neighborhood scale"—discussion, the remainder of the 4th sentence after the word "conditions" is deleted and replaced by "to which a large part of the city is subjected."

* * * * *

c. In section 2, a new section 2.8 is added as follows:

2. SLAMS Network Design Procedure

* * * * *

2.8 *PM_{10} Design criteria for SLAMS.*

As with other pollutants measured in the SLAMS network, the first step in designing the PM_{10} network is to collect the necessary background information. Various studies 11, 12, 13, 14, 15 have documented the major source categories of particulate matter and their contribution to ambient levels in various locations throughout the country. Because the sources for PM_{10} are similar to those for TSP, the procedures for collecting the necessary background information for PM_{10} are similar to those described in section 2.2 for Total Suspended Particulates. After completing the first step, existing TSP SLAMS or other particulate matter stations should be evaluated to determine their potential as candidates for SLAMS designation. Stations meeting one or more of the four 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 sitting and classifying PM_{10} stations, the procedures described in reference 16 should be used.

If existing TSP samplers meet the quality assurance requirements of Appendix A, the siting requirements of Appensix E, and are located in areas of suspected maximum concentrations as discribed in section 3 of Appendix D, and if the TSP Levels are below the ambient PM_{10} standards, TSP samplers may continue to be used as substitutes for PM_{10} SLAMS samplers under the provisions of Section 2.2 of Appendix C.

The most important spatial scales to effectively characterize the emissions of PM_{10} from both mobile and stationary sources are the micro, middle and neighborhood scales. For purposes of estabishing monitoring stations to represent large homogenous areas other than the above scales of representativeness, urban or regional scale stations would also be needed.

• *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. Because of the very steep ambient PM_{10} gradients resulting from mobile sources, the dimensions of the microscale for PM_{10} generally would not extend beyond 15 meters from the roadway, but could continue the length of the roadway which could be several kilometers. Microscale PM_{10} 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 "hotspot" control measures.

• *Middle Scale*—Much of the measurement of short-term public exposure to PM_{10} is on this scale. People moving through downtown areas, or living near major roadways, encounter particles that would be adequately characterized by measurements of this spatial scale. Thus, measurements of this type would be appropriate for the evaluation of possible short-term 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.

• *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 PM_{10} concentrations, as well as the land use and land surface characteristics. 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 period comparable to those specified in the NAAQS. This category also includes industrial and commercial neighborhoods, as well as residential.

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 emissions 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.

• *Urban Scale*—This class of measurement would be made to characterize the PM_{10} concentration over an entire metropolitan area. Such measurements would be useful for assessing trends in city-wide air quality, and hence, the effectiveness of large scale air pollution control strategies.

• *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 PM_{10} emissions, losses and transport.

d. In section 3, the third paragraph is revised 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 TSP, Pb and PM_{10}, neighborhood scale for SO_2, and NO_2, and urban scale for O_3.

* * * * *

e. In Section 3.1 in the second sentence, "500,000" is replaced by "1,000,000", the word "primary" is replaced by the word "secondary," and the number "8" is replaced by the number "10." Table 2 is revised as follows:

In the first sentence after Table 2, the phrase "600 to 700" is replaced by "300 to 450."

The rest of the first paragraph after Table 2 and the second and third paragraphs after Table 2 are removed and are replaced by "this range of monitors is believed to be sufficient to provide a national overview with respect to the welfare effects associated with the secondary TSP NAAQS in urban areas of 100,000 population or greater."

f. In Section 3.2, the phrase "As with TSP monitoring" at the beginning of the first paragraph is removed and the sentence begins with the next word "It." The second, third, fourth and fifth sentences in the second paragraph are removed and replaced with "This number of NAMS SO_2 monitors is sufficient for national trend purposes due to the low background SO_2 levels, and the fact that air quality is very sensitive to SO_2 emission changes.

g. A new Section 3.7 is added as set forth below.

3.7 *PM_{10}* Design Criteria for NAMS.

Table 4 indicates the approximate number of permanent stations required in urban areas to characterize national and regional PM_{10} air quality trends and geographical patterns. The number of stations in areas where urban 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.

TABLE 2.—TSP NATIONAL AIR MONITORING STATION CRITERIA

[APPROXIMATE NUMBER OF STATIONS PER AREA][a]

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

[a] Selection of urban and actual number of stations per area will be jointly determined by EPA and the State agency.
[b] High concentration—exceeding level of the secondary NAAQS by 20 percent or more.
[c] Medium concentration—exceeding secondary NAAQS.
[d] Low concentration—less than secondary NAAQS.

It is recognized that no PM_{10} samplers will be designated as PM_{10} reference or equivalent methods until, at the earliest, approximately six months after promulgation of PM_{10} NAAQS and the reference and equivalent method requirements. Even though non-designated PM_{10} samplers will have been commercially available, and a small number of samplers will have been in use by EPA, other agencies, and industry, there will not be enough ambient PM_{10} data to determine ambient PM_{10} levels for all areas of the country. Accordingly, EPA has provided guidance [17] on converting ambient IP_{15} data to ambient PM_{10} data. Ambient IP_{15} data are data from high volume samplers utilizing quartz filters or dichotomous samplers, both with inlets designed to collect particles nominally 15 μm and below. Also included in the guidance are procedures for calculating from ambient TSP data the probability that an area will be nonattainment for PM_{10}. For determining the appropriate number of NAMS per area, the converted IP_{15} data or the probabilities of PM_{10} nonattainment are used in Table 4, unless ambient PM_{10} data are available. If only one monitor is required in an urbanized area, it must be a category (a) type. If an evaluation of the sources of PM_{10} as described in section 2.8 indicates that the maximum concentration area is predominantly influenced by roadway emissions, then the category (a) station should be located adjacent to a major road and should be a microscale or middle scale. A microscale is preferable but a middle scale

is also acceptable if a suitable microscale location cannot be found. However, if the predominant influence in the suspected maximum concentration area is expected to be industrial emissions, and/or combustion products (from other than an isolated single source), the category (a) station should be a middle scale or neighborhood scale. A middle scale exposure is preferable to a neighborhood scale in representing the maximum concentration impact from multiple sources, other than vehicular, but a neighborhood scale is acceptable, especially in large residential areas that burn oil, wood, and/or coal for space heating.

For those cases where more than one station is required for an urban area; these should be at least one station for category (a) and one station for category (b) neighborhood scale objectives as discussed in Section 3. Where three or more stations are required, the mix of category (a) and (b) stations is to be determined on a case-by-case basis. The actual number of NAMS and their locations must be determined by EPA Regional Offices and the State agencies, subject to the approval of the Administrator as required by § 58.32. The Administrator's approval is necessary to 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. As required under the provisions of section 2.2 of Appendix C, all PM_{10} NAMS that were previously designated as TSP NAMS must concurrently collect ambient TSP and PM_{10} data for a one-year period beginning when each NAMS PM_{10} sampler is put into operation.

TABLE 4.—PM_{10} National Air Monitoring Station Criteria

[Approximate number of stations per area] [a]

Population category	High concentration [b]	Medium concentration [c]	Low concentration [d]
>1,000,000	6-10	4-8	2-4
500,000 to 1,000,000	4-8	2-4	1-2
250,000 to 500,000	3-4	1-2	0-1
100,000 to 250,000	1-2	0-1	0

[a] Selection of urban areas and actual number of stations per area will be jointly determined by EPA and the State agency.
[b] High concentration areas are those for which: Ambient PM_{10} data or ambient IP_{15} data converted to PM_{10} show ambient concentrations exceeding either PM_{10} NAAQS by 20 percent or more; or the probability of PM_{10} nonattainment, calculated from TSP data, is 95 percent or greater.
[c] Medium concentration areas are those for which: Ambient PM_{10} data or ambient IP_{15} data converted to PM_{10} show ambient concentrations exceeding either 80 percent of the PM_{10} NAAQS; or the probability of PM_{10} nonattainment, calculated from TSP data, is >20 percent and <95 percent.
[d] Low concentration areas are those for which: Ambient PM_{10} data or ambient IP_{15} data converted to PM_{10} show ambient concentrations less than 80 percent of the PM_{10} NAAQS; or the probability of PM_{10} nonattainment, calculated from TSP data, is less than 20 percent.
[e] Procedures for estimating ambient PM_{10} concentrations from IP_{15} ambient air measurements or for estimating the probability of nonattainment for PM_{10} given observed TSP data are provided in reference 17.

h. In section 4, Table 4 is renumbered Table 5 and is revised to include TSP and PM_{10} as follows:

TABLE 5.—SUMMARY OF SPATIAL SCALES FOR SLAMS AND REQUIRED SCALES FOR NAMS.

Spatial scale	Scales applicable for SLAMS							Scales required for NAMS						
	TSP	SO_2	CO	O_3	NO_2	Pb	PM_{10}	TSP	SO_2	CO	O_3	NO_2	Pb	PM_{10}
Micro	√		√			√	√	√		√			√	√
Middle	√	√	√	√	√	√	√	√					√	√
Neighborhood	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Urban	√	√		√	√	√	√				√	√		
Regional	√	√		√		√	√							

* * * * *

i. In section 5, the list of references is amended by adding references 11 through 17 as follows:

5. References.

* * * * *

11. Cooper, J.A., et al. Summary of the Portland Aerosol Characterization Study. (Presented at the 1979 Annual Air Pollution Association Meeting, Cincinnati, OH. APCA #79-24.4).

12. Bradway, R.M. and F.A. Record. National Assessment of the Urban Particulate Problem. GCA Technology Division, Bedford, MA. Prepared for U.S. Environmental Protection Agency, Research Triangle Park, NC. EPA Publication No. EPA-450/3-76-035. July 1976.

13. U.S. Environmental Protection Agency, Air Quality Criteria for Particulate Matter and Sulfur Oxides, Volume 2. Environmental Criteria and Assessment Office, Research Triangle Park, NC. December 1981.

14. Watson, J.G., J.C. Chow, and J.J. Shaw. Analysis of Inhalable and Fine Particulate Matter Measurements. Environmental Research and Technology, Inc., Concord, MA. Prepared for U.S. Environmental Protection Agency, Research Triangle Part, NC. EPA Contract No. 68-02-2542. March 1982 draft.

15. Record, F.A. and L.A. Baci. Evaluation of Contribution of Wind Blown Dust from the Desert Levels of Particulate Matter in Desert Communities. GCA Technology Division, Bedford, MA. Prepared for U.S. Environmental Protection Agency, Research Triangle Park, NC. EPA Publication No. EPA-450/2-80-078. August 1980.

16. Koch, R.C. and H.E. Rector. Optimum Network Design and Site Exposure Criteria for Particulate Matter. GEOMET Technologies, Inc., Rockville, MD. Prepared for U.S. Environmental Protection Agency, Research Triangle Park, NC. EPA Contract No. 68-02-3584. March 1983.

17. Frank, N. and T. Pace. Procedures for Estimating Probability of Nonattainment of a PM_{10} NAAQS Using Total Suspended Particulate or Inhalable Particulate Data. OAQPS, U.S. Environmental Protection Agency, Research Triangle Park, NC. February 1984.

Appendix E—[Amended]

12. Appendix E is amended as follows:

a. The Table of Contents is amended by adding a new section 8 and renumbering the original sections 8 through 11 as sections 9 through 12 as follows:

* * * * *

8. Particulate Matter (PM_{10})
8.1 Vertical Placement
8.2 Spacing from Obstructions
8.3 Spacing from Roadways
8.4 Other considerations
9. Probe Material and Pollutant Sample Residence Time
10. Waiver Provisions
11. Discussion and Summary
12. References

b. In section 1, the last sentence of the second paragraph is amended by changing the term "section 9" to "section 10."

c. In section 2.1, the first sentence is removed.

d. In section 2.3, the fourth and fifth sentences are removed. In the first sentence of the second paragraph, the last word "diminished" is replaced by the word "enhanced" and the remainder of section 2.3 is revised to read: "To determine the impact of TSP from motor vehicles it is desirable for NAMS and SLAMS category 'a' monitors to be located in the enhanced portion of the plume. For neighborhood or larger scale sites, they should be located beyond the concentrated particulate plume generated by traffic and not so close that the roadway totally dominates the measured ambient concentration. Figure 1 shows the location requirements for TSP monitors with respect to roadways of 3000 vehicles per day or greater. The microscale site must be between 5 and 15 meters from the nearest traffic lane and between 2 and 7 meters in elevation. Setback distances and vertical placement of the sampler inlet for middle scale and neighborhood scale sites are also shown in Figure 1."

e. The text of section 2.4 is revised to read: "In order to minimize the impact of wind blown dusts, stations should not be located on bare ground. Additional information on TSP probe siting may be found in reference 10."

f. Figure 1 in section 2 is revised by a new Figure 1 as shown.

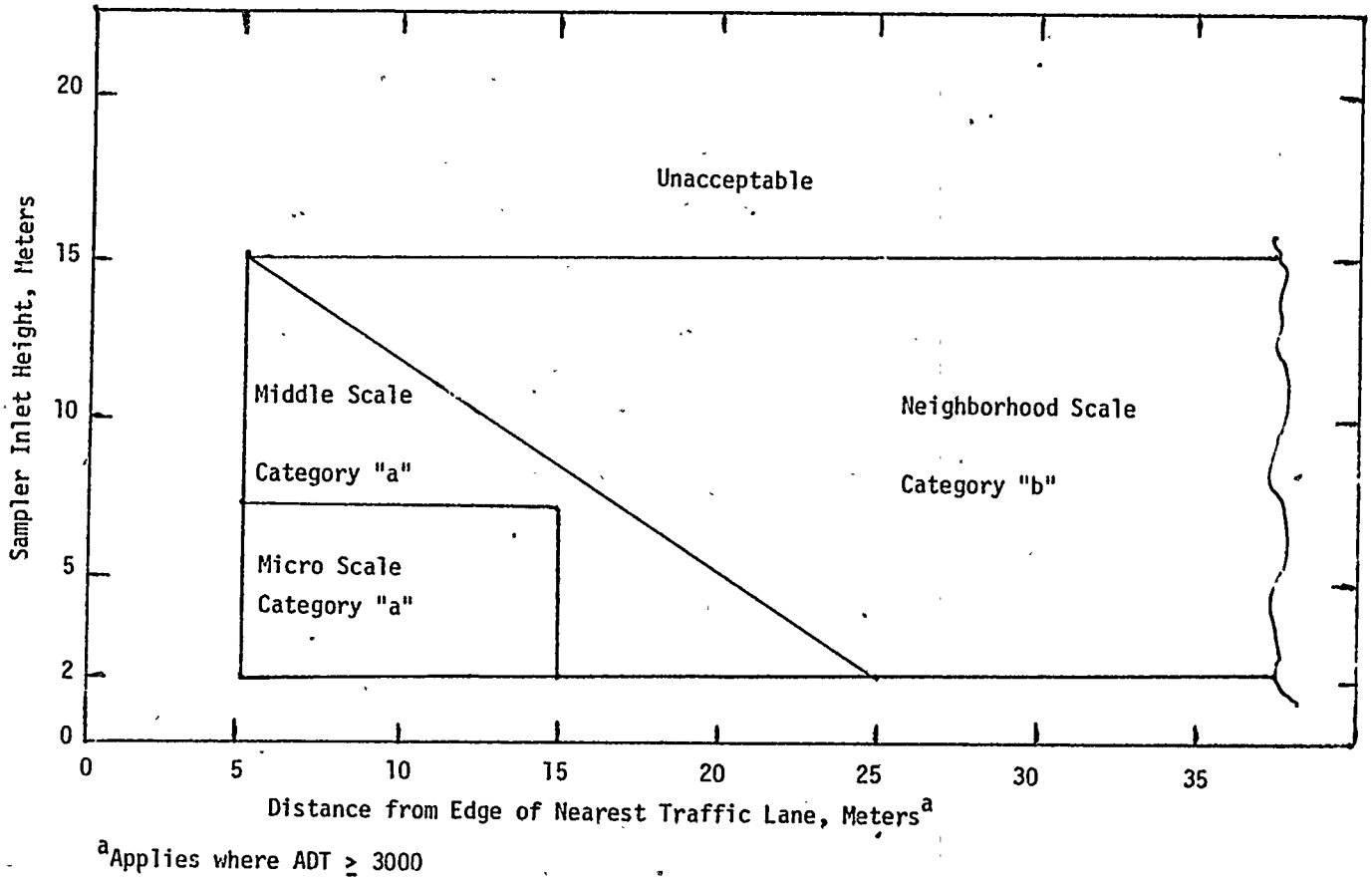


Figure 1. Acceptable Areas for TSP Micro, Middle and Neighborhood Scale Monitors

g. Section 8 is revised to read as follows:

8. Particulate Matter (PM_{10}).

8.1 Vertical Placement—Although there are limited studies on the PM_{10} concentration gradients around roadways or other ground level sources, References 1, 2, 4, 18 and 19 of this Appendix show a distinct variation in the distribution of TSP and Pb levels near roadways. TSP, which is greatly affected by gravity, has large concentration gradients, both horizontal and vertical, immediately adjacent to roads. Lead, being predominately sub-micron in size, behaves more like a gas and exhibits smaller vertical and horizontal gradients than TSP. PM_{10}, being intermediate in size between these two extremes exhibits dispersion properties of both gas and settleable particulates and does show vertical and horizontal gradients.[30] Similar to monitoring for other pollutants, optimal placement of the sampler inlet for PM_{10} monitoring should be at breathing height level. However, practical factors such as prevention of vandalism, security, and safety precautions must also be considered when siting a PM_{10} monitor. Given these considerations, the sampler inlet for microscale PM_{10} monitors must be 2–7 meters above ground level. The lower limit was based on a compromise between ease of servicing the sampler and the desire to avoid re-entrainment from dusty surfaces. The upper limit represents a compromise between the desire to have measurements which are most representative of population exposures and a consideration of the practical factors noted above.

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

8.2 *Spacing from Obstructions*—If the sampler is located on a roof or other structure, then there must be a minimum of 2 meters separation from walls, parapets, penthouses, etc. No furnace or incineration flues should be nearby. This separation distance from flues is dependent on the height of the flues, type of waste or fuel burned, and quality of the fuel (ash content). In the case of emissions from a chimney resulting from natural gas combustion, as a precautionary measure, the sampler should be placed at least 5 meters from the chimney.

On the other hand, if fuel oil, coal, or solid waste is burned and the stack is sufficiently short so that the plume could reasonably be expected to impact on the sampler intake a significant part of the time, other buildings/locations in the area that are free from these types of sources should be considered for sampling. Trees provide surfaces for particulate deposition and also restrict airflow. Therefore, the sampler should be place at least 20 meters from trees.

The sampler must also be located away from obstacles such as buildings, so that the distance between obstacles and the sampler is at least twice the height that the obstacle protrudes above the samples. Sampling stations that are located closer to obstacles than this criterion allows should not be classified as neighborhood, urban, or regional scale, since the measurements from such a station would closely represent middle scale

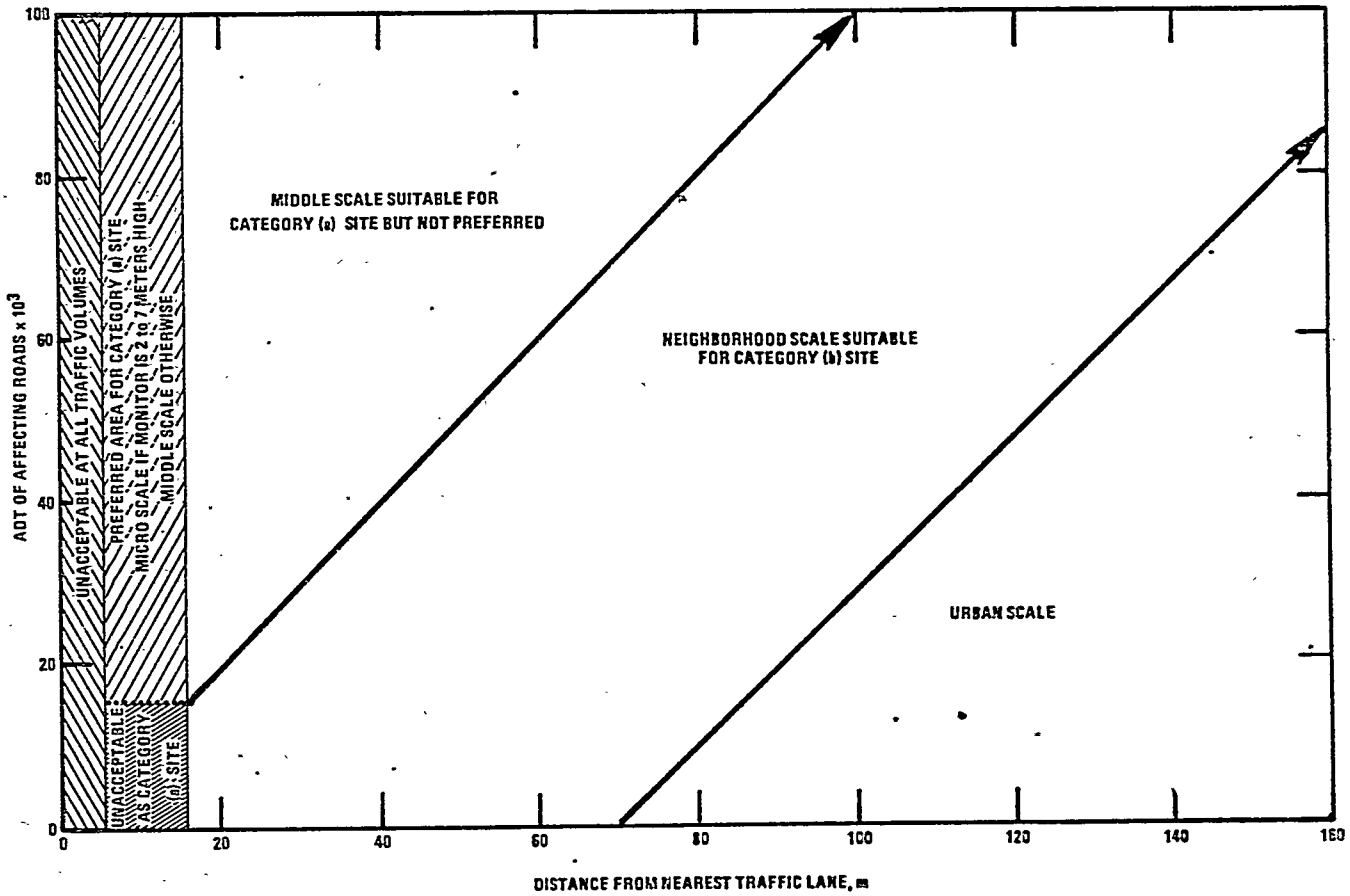
stations. Therefore, stations not meeting the criterion should be classified as middle scale.

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

8.3 *Spacing from Roads.* Since emissions associated with the operation of motor vehicles contribute to urban area particulate matter ambient levels, spacing from roadway criteria are necessary for ensuring national consistency in PM_{10} sampler siting.

The intent is to locate category (a) NAMS sites in areas of highest concentration whether it be from mobile or multiple stationary sources. If the areas is primarily affected by mobile sources, then the monitors should be located near roadways with the highest traffic volume and at separation distances most likely to produce the highest concentrations. For the microscale station, the location must be between 5 and 15 meters from the major roadway. For the middle scale station, a range of acceptable distances from the roadway is shown in Figure 2. This figure also includes separation distances between a roadway and neighborhood or larger scale stations by default. Any station, 2 to 5 meters high, and further back than the middle scale requirements will generally be neighborhood, urban or regional scale. For example, according to Figure 2, if a PM_{10} sampler is primarily influenced by roadway emissions and that sampler is setback 10 meters from a 30,000 ADT road, the station should be classified as a micro scale, if the sampler height is between 2 and 7 meters. If the sampler height is between 7 and 15 meters, the station should be classified as middle scale. If the sampler is 20 meters from the same road, it will be classified as middle scale; if 40 meters, neighborhood scale; and if 110 meters an urban scale.

Figure 2. Acceptable Areas for PM_{10} Micro, Middle, Neighborhood, and Urban Samplers



It is important to note that the separation distances shown in Figure 2 are measured from the edge of the nearest traffic lane of the roadway presumed to have the most influence on the site. In general, this presumption is an oversimplification of the usual urban settings which normally have several streets that impact a given site. The effects of surrounding streets, wind speed, wind direction and topography should be considered along with Figure 2 before a final decision is made on the most appropriate spatial scale assigned to the sampling station.

8.4 *Other Considerations.* For these areas that are primarily influenced by stationary source emissions as opposed to roadway emissions, guidance in locating these areas may be found in the guideline document Optimum Network Design and Site Exposure Criteria for Particulate Matter.[29]

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

h. The original section 8 "Probe Material and Pollutant Sample Residence Time" is redesignated as section 9.

i. The orignial section 9 "Waiver Provisions" is redesignated as section 10.

j. The original section 10 "Discussion and Summary" is redesignated as section 11; the Table 5 therein is revised to read as follows:

11. Discussion and Summary

* * * * *

TABLE 5.—SUMMARY OF PROBE SITING CRITERIA

Pollutant	Scale	Height above ground, meters	Distance from supporting structure, meters		Other spacing criteria
			Vertical	Horizontal[a]	
TSP	Microscale	2 to 7		>2	1. Should be >20 meters from trees. 2. Distance from sampler to obstacle, such as buildings, must be at least twice the height the obstacle protrudes above the sampler.[b] 3. Must have unrestricted airflow 270° around the sampler. 4. No furnace or incineration flues should be nearby.[c] 5. Must have minumum spacing from roads.
	Middle, neighborhood, urban and regional scale.	2 to 15		>2	1. Should be >20 meters from trees. 2. Distance from sampler to obstacle, such as buildings, must be at least twice the height the obstacle protrudes above the sampler.[b] 3. Must have unrestricted airflow 270° around the sampler. 4. No furnace or o incineration flues should be nearby.[c] 5. Must have minimum spacing from roads. This varies with spatial scale (see Figure 1).
SO_2	All	3 to 15	>1	>1	1. Should be >20 meters from trees. 2. Distance from inlet probe to obstacle, such as buildings, must be at least twice the height the obstacle protrudes above the inlet probe.[b] 3. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 4. No furnance or incineration flues should be nearby.[c]

TABLE 5.—SUMMARY OF PROBE SITING CRITERIA—Continued

Pollutant	Scale	Height above ground, meters	Distance from supporting structure, meters		Other spacing criteria
			Vertical	Horizontal[a]	
CO	Micro	3±½	>1	>1	1. Must be >10 meters from street intersection and should be at a midblock location. 2. Must be 2-20 meters from edge of nearest traffic lane. 3. Must have unrestricted airflow 180° around the inlet probe.
	Middle neighborhood	3 to 15	>1	>1	1. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 2. Spacing from roads varies with traffic (see Table 1).
O_3	All	3 to 15	>1	>1	1. Should be >20 meters from trees. 2. Distance from inlet probe to obstacle, such as buildings, must be at least twice the height the obstacle protrudes above the inlet probe. 3. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 4. Spacing from roads varies with traffic (see Table 2).
NO_2	All	3 to 15	>1	>1	1. Should be >20 meters from trees. 2. Distance from inlet probe to obstacle, such as buildings, must be at least twice the height the obstacle protrudes above the inlet probe.[b] 3. Must have unrestricted airflow 270° around the inlet probe, or 180° if probe is on the side of a building. 4. Spacing from roads varies with traffic (see Table 3).
Pb	Micro	2 to 7		>2	1. Should be >20 meters from trees. 2. Distance from sampler to obstacle, such as buildings must be at least twice the height the obstacle protrudes above the sampler. 3. Must have unrestricted airflow 270° around the sampler except for street canyon sites. 4. No furnace or incineration flues should be nearby.[c]

TABLE 5.—SUMMARY OF PROBE SITING CRITERIA—Continued

Pollutant	Scale	Height above ground, meters	Distance from supporting structure, meters		Other spacing criteria
			Vertical	Horizontal[a]	
					5. Must be 5 to 15 meters from major roadway.
	Middle, neighborhood, urban and regional.	2 to 15		>2	1. Should be >20 meters from trees. 2. Distance from sampler to obstacle, such as buildings must be at least twice the height the obstacle protrudes above the sampler. 3. Must have unrestricted airflow 270° around the sampler. 4. No furnace or incineration flues should be nearby.[c] 5. Spacing from roads varies with traffic (see Table 4).
PM_{10}	Micro	2 to 7		>2	1. Should be >20 meters from trees. 2. Distance from sampler to obstacle, such as buildings, must be twice the height the obstacle protrudes above the sampler. 3. Must have unrestricted airflow 270° around the sampler except for street canyon sites. 4. No furnace or incineration flues should be nearby. 5. Spacing from roads varies with traffic (see Figure 2).
	Middle, neighborhood, urban and regional scale.	2 to 15		>2	1. Should be >20 meters from trees. 2. Distance from sampler to obstacle, such as buildings, must be at least twice the height the obstacle protrudes above the sampler. 3. Must have unrestricted airflow 270° around the sampler. 4. No furnace or incineration flues should be nearby. 5. Spacing from roads varies with traffic (see Figure 2).

[a] When probe is located on rooftop, this separation distance is in reference to walls, parapets, or penthouses located on the roof.
[b] Sites not meeting this criterion would be classified as middle scale (see text).
[c] Distance is dependent on height of furnace or incineration flues, type of fuel or waste burned, and quality of fuel (sulfur, ash or lead content). This is to avoid undue influences from minor pollutant sources.

k. The original section 11 [References] is redesignated as section 12; and the list of references is amended by adding references 29 and 30 as follows:

12. References.

* * * * *

29. Koch, R. C. and H. E. Rector. Optimum Network Design and Site Exposure Criteria for Particulate Matter. GEOMET Technologies, Inc., Rockville, MD. Prepared for U.S. Environmental Protection Agency, Research Triangle Park, N.C. EPA Contract No. 68-02-3584. (March 1983.)

30. Burton, R. M. and J. C. Suggs. Distribution of Particulate Matter From the Roadway of a Philadelphia Site. Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, N.C. (September 1983 Draft).

Appendix F—[Amended]

13. Appendix F is amended as follows:

a. The following is added to the end of the table of contents:

2.7 Particulater Matter (PM_{10})
2.7.1 Site and Monitoring Information
2.7.2 Annual Summary Statistics

b. In section 2.2, the title is revised, subparagraph 2.2.2 is revised, and subparagraph 2.2.3 is added to read as follows:

2.2 *Total Suspended Particulates (TSP)*

* * * * *

2.2.2 *Annual Summary Statistics.* Annual arithmetic mean ($\mu g/m^{10}$) as specified in Appendix K of Part 50. Daily TSP values exceeding the level of the 24-hour PM^{10} NAAQS and dates of occurrence. If more than 10 occurrences, list only the 10 highest daily values. Sampling schedule used such as one every six days, one every three days, etc. Number of additional sampling days beyond sampling schedule used. Number of 24-hour average concentrations in ranges:

Range	Number of values
0 to 60 ($\mu g/m^3$)	
61 to 120	
121 to 180	
181 to 240	
241 to 300	
301 to 360	
361 to 420	
Greater than 420	

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

c. Section 2.7 is added to read as follows:

2.7 *Particulate Matter (PM_{10})*

2.7.1 *Site and Monitoring Information.* City name (when applicable), county name, and street address of site location. SAROAD site code. Number of daily observations.

2.7.2 *Annual Summary Statistics.* Annual arithmetic mean ($\mu g/m^3$) as specified in Appendix K of Part 50. All daily PM_{10} values above the level of the 24-hour PM_{10} NAAQS and dates of occurrence. Sampling schedule used such as once every six days, once every three days, etc. Number of additional sampling days beyond sampling schedule used. Number of 24-hour average concentrations in ranges:

Range	Number of values
0 to 30 (μg/m³)	
31 to 60	
61 to 90	
91 to 120	
121 to 150	
151 to 180	
181 to 210	
Greater than 210	

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

Appendix G—[Amended]

14. Appendix G is amended as follows:

a. Paragraph 2.f. is revised to read as follows:

2. Definitions.

* * * * *

f. "Critical pollutant" means the pollutant with the highest subindex during the reporting period.

b. In the first paragraph of section 3, the term "TSP" is removed in the third sentence and replaced by the words "PM_{10}", the word "particulate" is removed and replaced with "PM_{10}" in the fourth sentence, and the term "hi-volume" is removed twice in the fourth sentence and replaced by the words "reference or equivalent method."

c. In section 7, the words "total suspended particulates (TSP)" are deleted in the second sentence of the first paragraph and replaced by the words "particulate matter (PM_{10})," the first sentence of the second paragraph is removed and the word "six" in the second sentence of the second paragraph is replaced by the word "five".

d. Section 7.2 is revised to read as follows:

7.2 *Example Computation.*

Suppose a PM_{10} 24-hour concentration of 283 μg/m³ is observed. The PM_{10} subindex is calculatd using equation 1 as follows: In Table 1, the observed concentration of X_1=283 μg/m³ lies between 180* and 350* μg/m³, therefore this computation is carried out for the second segment (j=2). For this segment, $X_{1,2}$=180 and $X_{1,3}$=350, with corresponding subindex values for $I_{1,2}$=100 and $I_{1,3}$=200. The computation is as follows:

$$I_1=\frac{I_{1,3}-I_{1,2}}{X_{1,3}-X_{1,2}}(283-X_{1,2})+I_1=\frac{200-100}{350-180}(283-180)+100=\frac{100}{170}\times 103+100=161$$

Therefore, the PM_{10} subindex is I=161. If four other pollutant subindices calculated in a similar manner from observations on the same data were: I_2=0, I_3=0, I_4=0, and I_5=0, then the overall index is reported as the maximum of these values:

PSI=max(161,0,0,20,30)=161

A typical report might contain the following statement: "Today's air quality index is 161 which is regarded as unhealthful. The responsible pollutant is particulate matter. This report represents conditions prevailing over most of the downtown urban area for the previous 24-hour period ending at noon today." If the index were forecast for the next day, the following additional languate might also be used: "The current forecast is for improved air quality tomorrow with the index not expected to exceed 80."

e. In Table 1, in the sixth column entitled 1-hr. O_3, the number 118 is removed and replaced with 120, the term "μmg/m³" is removed from the heading of the fifth column and replaced with "mg/m³," the fourth column entitled TSP×SO_x (μg/m³)² is removed, and the second column is revised to read as follows:

Table 1.—Breakpoints for PSI in Metric Units [1]

• • •	24-hr PM	• • •
μg/m³		
*55		
*160		
*350		
*420		
*500		
*600		

• • • •

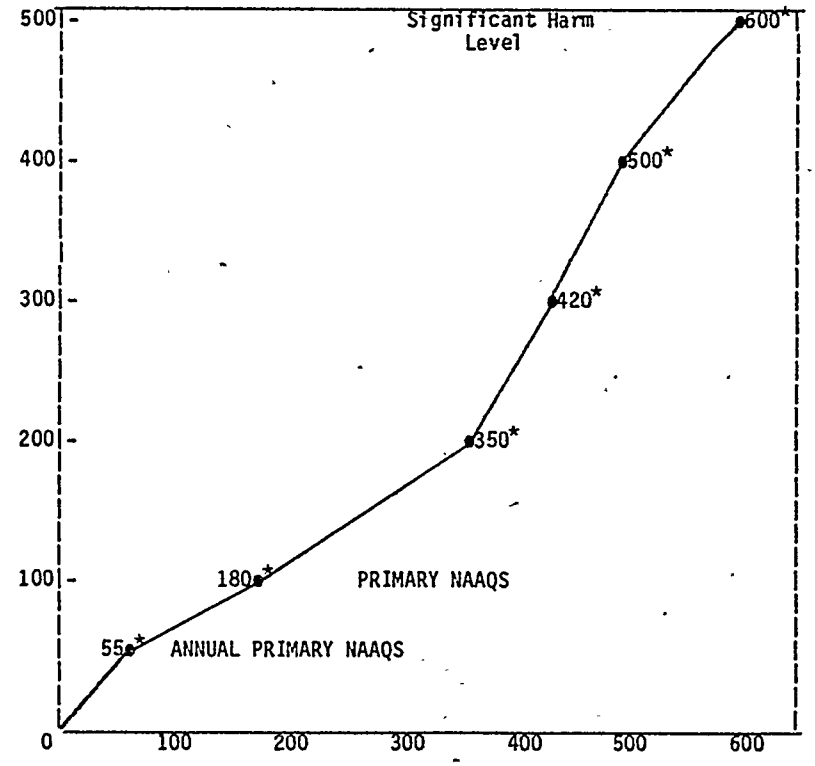
*All the concentration levels are used for illustrative purposes only. The actual levels will be determined at the time of promulgation of the standard.

f. In Table 2, the third column entitled TSP × SO_2(μg/m³×ppm) is removed.

*The levels are used for illustrative purposes only. The actual level will be determined at the time of promulgation of the standard.

g. Figure 2 is revised to read as follows:

Figure 2. PSI function for suspended particulate matter, PM_{10}



*All of the values used are for illustrative purposes only and will be replaced with the appropriate air quality standards, federal episode levels, and significant harm level at the time of promulgation.

h. Figure 6 is removed.

[FR Doc. 84-6362 Filed 3-19-84; 8:45 am]
BILLING CODE 6560-20-M

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40 CFR Part 53

[AD-FRL 2491-7]

Ambient Air Monitoring Reference and Equivalent Methods

AGENCY: Environmental Protection Agency (EPA).

ACTION: Proposed rule.

SUMMARY: Elsewhere in this issue of the Federal Register the U.S. Environmental Protection Agency (EPA) is proposing revisions to the national ambient air quality standards for particulate matter and is also proposing a new reference method for the determination of atmospheric concentrations of PM_{10}, a proposed new indicator for particulate matter. Since the proposed reference method includes a sampler that would be specified primarily by performance, EPA, in conjunction with that action, is herein proposing performance specifications, explicit test procedures, and other requirements applicable to reference and equivalent methods for PM_{10}. These PM_{10} specifications and test procedures are analogous to existing specifications and test procedures for reference and equivalent methods for other criteria pollutants contained in 40 CFR Part 53. Therefore, EPA is proposing appropriate revisions to add the new PM_{10} requirements to Part 53. EPA is also proposing some minor clarifications to existing provisions of Part 53, pertaining to the other pollutants for which ambient air quality standards exist.

DATE: Comments must be received on or before May 21, 1984.

ADDRESS: Comments, preferably in duplicate, should be sent to Public Docket No. A-82-43, U.S. Environmental Protection Agency, Central Docket Section (A-130), West Tower Lobby, Gallery I, 401 M Street, S.W., Washington, DC 20460. The docket may be inspected at this address between the hours of 8:00 a.m. and 4:00 p.m., Monday through Friday. A reasonable fee may be charged for copying services.

FOR FURTHER INFORMATION CONTACT: Larry J. Purdue, Chief, Methods Standardization Branch (MD-77), Quality Assurance Division, Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711 (919-541-2665).

SUPPLEMENTARY INFORMATION:

Background

Elsewhere in this issue of the Federal Register, EPA is proposing to revise the national ambient air quality standards (NAAQS) for particulate matter (40 CFR Part 50) and is proposing a new reference method (Appendix J) for the determination of ambient concentrations of particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}).

Similar to the current manual reference methods for Total Suspended Particulate Matter (TSP) and lead, the proposed PM_{10} reference method would require a sampler for collecting particulate samples for subsequent analysis. However, while the sampler required in the TSP and lead methods is explicitly specified by design and dimensions and must be reproduced precisely, EPA is proposing to specify the sampler in the new PM_{10} reference method primarily by performance, together with explicit test procedures to be used to determine acceptability. This approach allows for the use of currently available and tested sampler designs while providing greater flexibility to encourage improvements and innovations in future sampler designs. It is also consistent with the approach used for specifying reference methods for several other criteria pollutants (CO,