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Environmental Protection Agency

40 CFR Part 50

National Ambient Air Quality Standards for Particulate Matter; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 50

[AD–FRL–5961–6]

National Ambient Air Quality Standards for Particulate Matter

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final rule.

SUMMARY: On July 18, 1997, EPA announced a supplemental comment period for the limited purpose of taking comments on certain field and laboratory test results associated with the development of the reference method (Appendix L of 40 CFR Part 50) for measuring particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers ($PM_{2.5}$) in the ambient air. In the announcement, EPA indicated that upon the close of the comment period it would decide whether any further action would be appropriate. Having carefully assessed the comments received, EPA has determined that no further action is necessary.

ADDRESSES: The comments received during the supplemental comment period and EPA's responses to those comments have been entered into Docket No. A–95–54. The docket is available for public inspection in the Central Docket Section of the U.S. Environmental Protection Agency, South Conference Center, Rm. 4, 401 M St., SW., Washington, DC 20460. The docket may be inspected between 8 a.m. and 3 p.m., Monday through Friday, except legal holidays, and a reasonable fee may be charged for copying.

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SUPPLEMENTARY INFORMATION: On July 18, 1997, EPA published (62 FR 38652) a final rule revising the national ambient air quality standards for particulate matter. In Unit VI.B. (Appendix L—New Reference Method for $PM_{2.5}$) of the preamble to the final rule, EPA concluded that the proposed design and performance specifications for the reference sampler, with modifications described in the final rule, would achieve the design objectives set forth in the proposal. Accordingly, EPA adopted the sampler and other method requirements specified in the revised Appendix L as the reference method for measuring $PM_{2.5}$ in the ambient air. As discussed in the preamble to the final rule, a series of field tests were performed using prototype samplers manufactured in accordance with the proposed design and performance specifications. The results of these field tests confirmed that the prototype samplers performed in accordance with design expectations. Operational experience gained through these field tests did, however, identify the need for minor modifications as discussed in the preamble to the final rule. As explained in that preamble, EPA made other modifications to the proposed design and performance specifications in response to public comment. As part of this process, EPA performed laboratory tests to ensure that the modifications achieved their intended objectives. While the results of the field and laboratory tests were largely confirmatory in nature and did not indicate a need to alter the basic design and performance specifications, they did identify areas that needed further refinement. Given that these tests were performed, by necessity, during and after the close of the public comment period and because the results were not available for placement in the docket until late in the rulemaking process, the preamble to the final rule announced that a supplemental comment period would be afforded for the limited purpose of taking comments on these field and laboratory test results. The following documents present the results of the field and laboratory tests and associated analyses that EPA considered, as discussed in Unit VI.B. of the preamble to the final rule, in making minor modifications or other refinements to the proposed reference method for measuring $PM_{2.5}$ in the ambient air. The documents are:

1. Adaptation of the Low-Flowrate, PM_{10}, Dichotomous Sampler Inlet to Fine Particle Collection.
2. Filter Temperature Specification Report.
3. Flow Rate Specification Report.
4. Laboratory and Field Evaluation of FRM Sampler Report.
5. Prototype $PM_{2.5}$ Federal Reference Method Field Studies Report.

In a separate document published on July 18, 1997 (62 FR 38762), EPA announced a supplemental comment period for the limited purpose of taking public comment on the five documents specified above. The document emphasized that comments received on the reference method for $PM_{2.5}$ that went beyond the scope of the five documents would not be considered. The EPA also indicated in the document that upon the close of the supplemental comment period, it would consider the comments received and then decide whether any further action was appropriate. In response to the July 18, 1997 document, EPA received comments from three organizations. The EPA has conducted a careful assessment of the comments and has concluded that they raise no issues not considered prior to promulgation of Appendix L or addressed in the quality assurance guidelines to be presented in Section 2.12 of the Quality Assurance Manual for Air Pollution Measurement Systems. Accordingly, EPA has concluded that no additional rulemaking action is necessary as a result of the comments received during the supplemental comment period. A summary of the significant issues raised by the commenters and EPA's responses has been entered in Docket No. A–95–54 and is reproduced as Appendix A to this document.

Appendix A—Responses to Significant Comments on Field and Laboratory Test Results Regarding Federal Reference Method for Measuring $PM_{2.5}$ in the Ambient Air, Docket No. A–95–54, October 1997

Summary

On July 18, 1997 (62 FR 38762), EPA announced a supplemental comment period for the limited purpose of taking public comment on the results of various laboratory and field tests and associated analyses involving the new Federal Reference Method for measuring $PM_{2.5}$ in the ambient air (Appendix L of 40 CFR part 50). The new Federal Reference Method (FRM) was adopted on July 18, 1997 (62 FR 38652) in conjunction with new national ambient air quality standards for $PM_{2.5}$ (40 CFR 50.7). During the supplemental comment period announced on July 18, three organizations submitted comments.

The EPA has reviewed the comments received and has concluded that none of them presents issues that were not previously considered in the development of the FRM for $PM_{2.5}$, or that have not been addressed in the specific quality assurance guidelines to be presented in Section 2.12 of the Quality Assurance Manual for Air Pollution Measurement Systems. Accordingly, it is unnecessary to take further rulemaking action or to postpone

implementation of the Federal Reference Method for $PM_{2.5}$ as a result of any of the comments.

Significant comments raised in each commenter's letter are summarized below, together with EPA's responses.

Item VI–D–04 Author: EPRI.

Comment: FRM sampler provides biased results due to known losses of volatile and semi-volatile aerosol components.

Response: The FRM sampler was never intended to collect and measure all semi-volatile aerosol components. The sampler was designed to closely approximate the measurements obtained by the type of samplers used in the health studies that served as the basis for the $PM_{2.5}$ standards. Moreover, the new monitoring regulations require supplemental monitoring at a 50-site national speciation network in which volatile and semi-volatile aerosol components will be measured, thus providing a more complete characterization of the ambient aerosol.

Item VI–D–05 Author: American Petroleum Institute.

Comment: Efficacy of the rain shroud has not been demonstrated regarding minimizing rain or snow intrusion.

Response: The EPA has been evaluating three identical prototype inlets which meet the dimensional specifications of the new $PM_{2.5}$ FRM inlet. In these field tests conducted at Research Triangle Park, NC, three prototype FRM samplers containing the prototype inlets were collocated with six prototype FRM samplers containing the older style PM_{10} inlet (as proposed for the $PM_{2.5}$ reference method sampler on December 13, 1996). Although relatively few significant rain events occurred in the area during this time period, inspection of the samplers appeared to indicate that the new inlet design was more effective at minimizing rain intrusion than the older design.

The performance of the prototype inlets was also evaluated under artificial conditions designed to simulate periods of heavy rainfall. For these tests, two identical prototype reference method samplers were collocated outdoors such that their inlets were at the same elevation but positioned approximately 0.7 m apart horizontally. One of the two samplers used the prototype new $PM_{2.5}$ inlet design while the other sampler used the older PM_{10} inlet design. An oscillating type sprinkler was then used to expose the two samplers to conditions of accelerated rainfall. The sprinkler nozzle was oriented to provide equal coverage to the two inlets and adjusted so the angle of incidence continuously varied between 0° and 90° relative to the inlet. A rain gauge was positioned between the two samplers and used to measure the quantity of simulated rainfall to which the samplers were exposed. Over a 2-day time period, eight discrete tests were conducted, each having a duration of 3 hours. At the completion of each test, the sprinkler was turned off, the rain gauge measurement was noted, and the water volume was measured in each of the sampler's collection jars. Prior to the next test, the rain gauge and collection jars were emptied, and the inlet locations were alternated between samplers in order to minimize any positional effects or flow system effects on the test results.

Results of these simulated rainfall tests are summarized in Table 1. The simulated rainfall during each 3-hour time period ranged between 3.5 inches and 7 inches with a mean value of 4.75 inches. Inspection of Table 1 reveals that the older style PM_{10} inlet collected a range of 80 ml to 450 ml of water during each rain event. As expected, observations during the simulated tests indicated that rain intrusion into the inlet was maximum when rain impinged at an angle normal to the face of the sampler's insect screen. This phenomenon is typically observed in the field during periods of rain accompanied by elevated horizontal wind speeds. In contrast to the older PM_{10} inlet, no water droplets were observed to collect inside the prototype $PM_{2.5}$ inlet during any of the eight replicate tests. During the entire testing totaling 38 inches of simulated rainfall, the new $PM_{2.5}$ inlet collected no water while the older PM_{10} inlet collected over 1600 ml of water. Although these simulated rainfall tests cannot exactly simulate all the conditions that the samplers might encounter in the field, these results indicate that the new $PM_{2.5}$ inlet design was much more effective at minimizing rain intrusion than the older, original PM_{10} design.

TABLE 1.—RESULTS OF SIMULATED RAINFALL TESTS FOR $PM_{2.5}$ Inlet Evaluation

Test No.	Simulated rainfall (inches)	Volume of water in collection jar (ml)	
		PM_{10} inlet	$PM_{2.5}$ inlet
1	4.5	100	0
2	4.5	220	0
3	4.0	80	0
4	4.5	200	0
5	5.0	450	0
6	5.0	80	0
7	3.5	80	0
8	7.0	420	0

TABLE 1.—RESULTS OF SIMULATED RAINFALL TESTS FOR $PM_{2.5}$ Inlet Evaluation—Continued

Test No.	Simulated rainfall (inches)	Volume of water in collection jar (ml)	
		PM_{10} inlet	$PM_{2.5}$ inlet
	Mean = 4.75 in	Mean = 204 ml	Mean = 0 ml

Comment: Filter temperature overheats measured in February do not adequately represent those which might be measured in summer.

Response: Evaluation of prototype FRM at RTP, NC after February indicated that overheats of 3° C were occasionally observed but 5° C overheats were not observed even on days when radiant fluxes at the sampling site exceeded 1200 W/m^2.

Comment: The 6/30/97 McElroy/Frank memorandum provides a tabular summary of FRM $PM_{2.5}$ precision measurements used to revise upward the method detection limit (MDL) specification from 1 μg/m^3 to 2 μg/m^3. Detailed analysis is difficult since individual data are not provided or cited. However, inserting the reported mean daily precisions into the definition of MDL (and assuming that blank means=0) yields minimum MDLs of 2.3 μg/m^3 for Denver and RTP locations and 3.7 μg/m^3 for Azusa, values that differ from those reported in the table where Denver = 2 μg/m^3, RTP = 3 μg/m^3, Azusa = 2 μg/m^3.

Response: The change in estimated method detection limit from 1 μg/m^3 to 2 μg/m^3 was due to information gained through field use of prototype samplers since the regulation was initially proposed. As specified originally in the December 13, 1996 proposal, the detection limit of the $PM_{2.5}$ mass concentration measurement "* * * is determined primarily by the repeatability (precision) of filter blanks * * *." At the time the regulation was proposed, field data had not yet been collected to determine the variability of field blanks. For this reason, laboratory blanks were used to provide a preliminary estimate of the method's precision. Once prototype samplers became available, specialized field studies conducted in Denver, Azusa, and RTP provided a data base upon which to provide actual estimates of the method's detection limit. The final regulation as promulgated on July 18, 1997 updated the preliminary estimate and modified the text to indicate that field blanks were used for estimating the method detection limit. In particular, Section 3.1 was modified to read, "The

lower detection limit of the mass concentration measurement range is estimated to be approximately 2 μg/m³, based on noted mass changes in field blanks * * *.'' Thus, the use of actual field data in conjunction with a minor modification in the MDL's definition accounted for the revision in the method detection limit.

The commenter apparently misinterpreted the precision table included in the docket (reproduced in Table 2 below). The values reported in the last column of the table refer to the precision of measured $PM_{2.5}$ concentrations and have no relationship with measured precision of field blanks. This apparent misinterpretation led to the commenter's conclusion that the original method detection limit calculations were in error. The enclosed Table 3 below presents actual data from the three field sites relating to the observed mass changes in the field blanks. As indicated in the final column of Table 3, the method detection limits determined at Denver, Azusa, and RTP were 2 μg/m³, 2 μg/m³, and 3 μg/m³, respectively. This actual field information was the basis for the July 18, 1997 text which stated that the method detection limit ''* * * is estimated to be approximately 2 μg/m³.''

TABLE 2.—SUMMARY OF PRECISION TESTS AT 3 SEPARATE SITES

[Method Detection Limit (Field Blanks) = |Mean| + 10 * (Std. Dev.)]

Site	Dates	No. days	Prototype samplers evaluated	$PM_{2.5}$ range (μg/m³)	Mean $PM_{2.5}$ conc. (μg/m³)	Method detection limit (μg/m³)	Mean daily precision (std. dev.) (μg/m³)
DENVER, CO	Dec. 10–22	10	6 Graseby-Andersen	1.4 to 20.6	10.9	2	0.23
AZUSA, CA	March 25–April 10, 1997.	9	6 Graseby-Andersen	6.0 to 32.1	18.6	2	0.37
RTP, NC	April 4–30, 1997	13	3 R&P	7.2 to 18.5	11.7	3	0.23

TABLE 3.—CALCULATED METHOD DETECTION LIMIT AT 3 SEPARATE SITES

[Method Detection Limit (Field Blanks) = Mean + 10 * (Std. Dev.)]

Site	Dates	Number of sampling days	Total number of field blanks	Mean of daily field blanks (μg/m³)	Standard deviation of daily field blanks (μg/m³)	Method detection limit (μg/m³)
Denver, Co	Dec. 10–22, 1996	10	30	−.010	0.19	2
Azusa, CA	March 25—April 10, 1997	8	24	0.18	0.22	2
RTP, NC	April 4–30, 1997	8	24	0.52	0.27	3

Comment: The 25 C limit should be termed ''post-acquisition'' rather than ''post-sampling.''

Response: This is a good suggestion, and this terminology will be employed in Section 2.12 of the Quality Assurance Handbook for Air Pollution Measurement Systems.

Comment: The 9/96 G. H. Achtelik report offers at best a lower bound estimate of filter volatiles loss.

Response: Studies are currently being performed in Riverside, CA to further characterize the effects of volatile losses. In addition, EPA requires a 50-site chemical speciation network in which volatile and semi-volatile aerosol components will be measured.

Comment: Midnight to midnight sampling may provide different measured concentrations than noon to noon sampling due to water of crystallization effects.

Response: It was necessary to maintain the midnight to midnight sampling for $PM_{2.5}$ to be consistent with the sampling schedules for other particulate measurements and to not unduly constrain the work schedules of site operators. However, if such effects are suspected, operators are encouraged to re-weigh filters after additional conditioning (beyond the minimum 24 hours).

Comment: A number of lingering problems were identified in the field tests.

Response: One of the purposes of these field tests was to develop preventative maintenance guidelines for routine operation of these samplers. None of these problems was unexpected, and each will be addressed in Section 2.12 of the Quality Assurance Handbook for Air Pollution Measurement Systems. Note also that these tests were performed using prototype and not production model $PM_{2.5}$ samplers.

Comment: A field calibration protocol should be developed to test the performance of the inlets.

Response: While the intent of the comment is understood, the recommended calibration protocol would be cumbersome, time consuming, and not precise enough to measure any realistic changes in fractionator performance.

Comment: Poor correlation achieved by the Tucson site technician might indicate the samplers are not user-friendly and/or require special field personnel.

Response: It should be noted that all of these studies were performed using prototype samplers that were operated using procedures that were at that time still under development. Taking this under consideration, the intramethod and intermethod results from all the other studies could have been interpreted as being closer than expected. The lower intramethod precision observed at the Tucson site can no doubt be attributed to a combination of contributing factors. As noted in the EPA staff report, ''* * * the Tucson study was operated by a site technician as additional and unassisted duties to his normal work load * * *.'' Of equal importance is the fact that the mean concentration at the Tucson site was appreciably lower than at any of the other five sampling sites. At low ambient concentrations, the effect of

sample handling, conditioning, and weighing uncertainties becomes much more important than at higher concentrations. It is reasonable to expect, therefore, that higher intrasampler variability would be observed at the Tucson site than at the other sampling sites. An assertive quality assurance program will be included within the implementation of the national monitoring network.

Specialized tests were conducted in Azusa, CA to determine if local site personnel would experience significantly more variability with the prototype FRM samplers than would be experienced by specially trained researchers. First, aerosol researchers conducted 6 days of 22-hour sampling using six identical $PM_{2.5}$ samplers. Mean precision in $PM_{2.5}$ concentrations was measured to be 0.4 μg/m^3. Using the same procedures, site operators from the South Coast Air Quality Management District then conducted their own precision tests with the same samplers. Mean precision in $PM_{2.5}$ concentrations was also measured to be 0.4 μg/m^3. Incidentally, this measured intrasampler variability was appreciably less than the 2 μg/m^3 maximum value allowed by the regulations.

Item VI–D–06 Author: National Cotton Council of America.

Comment: Based on impactor theory developed by Ranz and Wong, Parnell et al contend that the impactor cutpoint is actually 2.74 μm rather than the 2.5 μm design value.

Response: There are basically two problems associated with the Parnell et al approach. First, although the 1952 Ranz and Wong research led to important insights regarding impactor theory, it was an early work which could not properly account for the effects of complex impactor design parameters such as jet-to-plate distance, throat length, and fluid Reynolds number. Only the development of sophisticated numerical analysis techniques in conjunction with the advent of high speed computers allowed detailed analysis of fluid flow fields and of particle trajectories within the flow fields. In particular, important advances in our understanding of inertial impactors were made by Marple (1970) and Marple and Liu (1975). It was upon these improved design guidelines that the EPA prototype WINS was developed. Based on this well-accepted inertial impactor theory, one would predict a cutpoint of 2.44 μm aerodynamic diameter for the WINS impactor rather than the 2.74 μm value predicted by the simplistic approach of Ranz and Wong.

The second problem associated with the Parnell et al. approach is that impactor theory can never be used to reliably predict an actual impactor's performance. Despite advances since the Ranz and Wong work, conventional impactor theory only provides starting guidelines upon which to base impactor design. In reality, a number of factors can affect a given impactor's performance including actual component dimensions, flow rate, particle bounce, particle re-entrainment, wall losses, and electrostatic effects. If one is interested in determining an impactor's actual performance, therefore, the impactor must be calibrated in the laboratory under carefully controlled conditions using primary calibration aerosols. The novel geometry of the WINS impactor reinforced the need for laboratory calibration to determine its actual performance. As described in ''Modification and Evaluations of the WINS Impactor,'' the experimentally determined cutpoint of the WINS impactor was measured to be approximately 2.48 μm aerodynamic diameter at standard temperature and pressure conditions.

References: Marple V.A. and Willeke K. (1976) Impactor design. Atmos. Envir. 10:891–896.

Marple V. A. and Liu B.Y.H. (1975) On fluid flow and aerosol impaction in inertial impactors. J. Coll. & Interface Sci. 53:31–34.

Comment: PM from agricultural operations has different characteristics than that used in the laboratory calibration. Actual performance of the WINS may be different in the field.

Response: Laboratory tests showed that there was no difference in collection between liquid and solid aerosols. Fractionation of the aerosol using its aerodynamic properties automatically accounts for the particle's physical size, shape, and density.

Comment: The data presented in ''Flow Rate Specification Report'' seems to indicate that flow rate errors in FRM prototype samplers are not random but systematically understate the actual flow rates. As a consequence, the sampled particles actually have a higher momentum than the FRM measurements imply, adversely affecting the interpretation of the penetration curves.

Response: It is important to understand that no flow control system is inherently accurate and that all systems require periodic calibration. There are several factors which affect the flow rate accuracy of any individual FRM sampler. Because automatic volumetric flow control involves separate measurements of several key parameters (*e.g.*, ambient temperature, ambient pressure, etc.), any inaccuracies in their actual measurements will naturally result in inaccuracies in flow control. Although these parameters are typically calibrated at the same time as the initial flow calibration, any drift in their response since the time of calibration will naturally result in variations in flow control. For example, if pressure transducer circuitry is not properly compensated for temperature, significant reductions in ambient temperature can result in directional biases in ambient pressure measurements. These pressure measurement biases can, in turn, naturally result in directional biases in flow control.

Because collocated, identical instruments are typically calibrated in the field using the same flow transfer standard, it is reasonable to expect that any directional bias in the transfer standard's calibration will also result in biases among the group of collocated samplers in the same direction as that of the transfer standard. Thus, if the flow transfer standard and NIST traceable audit device do not agree exactly, we tend to observe directional differences in flow response among a set of samplers. In the case of the sample flow data provided in the docket, the actual flow rates measured by the NIST traceable flow standard were always higher (mean value = 0.9 percent higher) than the flow value indicated by the instruments. Actual flow rates are positively biased, therefore, which accounts for the percent error direction used in reporting the flow audit results.

Regardless of one's individual choice of bias direction, the effect of the flow bias can be predicted with respect to magnitude and direction. These effects can be conveniently grouped into aspiration and particle transport effects, effects of flow bias on fractionator performance, and effects of flow bias on calculated $PM_{2.5}$ concentrations. These factors are considered separately below.

Aspiration and Particle Transport Effects: Although major biases in sampler flow rate can adversely effect the sampler's inlet aspiration, minor flow rate biases should have negligible effects on the inlet's ability to withdraw representative aerosol samples from the ambient air and transport the aspirated aerosol efficiently throughout the sampling system. The FRM specifications for flow rate control were designed to ensure that large errors in flow control would be identified during sampling and that appropriate action (*i.e.*, sampler shutdown and/or warning flags) would be automatically taken.

Effects on Fractionator Performance: Similar to the effect of flow rate bias on the sampler's aspiration performance, minor flow rate biases should have negligible effects on the sampler's ability to accurately fractionate an aspirated aerosol. For small variations in flow rate (such that the jet Reynolds number is not significantly altered), the fractionator's cutpoint is inversely proportional to the square root of the volumetric flow rate. For the EPA WINS impactor which possesses a cutpoint of 2.48 µm at 16.67 L/min., for example, a 2 percent increase in flow rate would result in only a 1 percent decrease in cutpoint to 2.46 µm. Similarly, a 2 percent decrease in flow rate would result in only a 1 percent increase in cutpoint to 2.50 µm. Moreover, these 1 percent predicted changes in fractionator cutpoint would result in an even smaller bias in collected $PM_{2.5}$ mass concentration. Since the expected mass collected is a function of both the fractionation curve and the mass size distribution of the aerosol to which it is exposed, numerical sensitivity analysis has been performed on three idealized ambient distributions. Assumed parameters for the distribution are identical to those used in 40 CFR part 53 Table F–3 for coarse, ''typical,'' and fine ambient aerosol distributions. Since only the cutpoint of the fractionator curve can be expected to change at low flow rate biases, the predicted fractionation curve can numerically integrate with each of the ambient distributions to calculate the expected measured mass concentration as a function of flow rate bias.

Results presented in the table below indicate that a maximum bias in expected mass concentration of approximately 0.6 percent would be associated with flow biases of 2 percent. Note that higher flow rates result in lower fractionator cutpoints, which results in lower mass gains than would normally occur.

Distribution	Expected bias in measured mass concentration solely as a function of flow-induced cutpoint changes		
	−2% flow bias (Dp50=2.46 µm) (percent)	0% flow bias (Dp50=2.48 µm) (percent)	+2% flow bias (Dp50=2.50 µm) (percent)
Coarse	+0.5	0	−0.6
"Typical"	+0.2	0	−0.2
Fine	+0.2	0	−0.2

Effects on Calculated $PM_{2.5}$ Mass Concentration: As discussed above, the effects of flow biases on inlet aspiration performance and fractionator cutpoint are essentially negligible. The primary effect of flow rate biases on $PM_{2.5}$ measurements concerns the calculation of $PM_{2.5}$ concentration from the measured mass gain of the filter divided by the volume of air sampled as reported by the sampler. Because the FRM samplers are designed to continuously adjust volumetric flow rate to the design setpoint flow rate of 16.67 actual L/min., the sampled air volume reported by the instrument is typically very close to the design flow rate times the sampling duration. If, for example, the flow rate reported by the sampler was in fact low by 2 percent, the sampler would have sampled, fractionated, and collected a fine particulate mass which was approximately 2 percent higher than it should have been. Since the calculated $PM_{2.5}$ concentration is simply the measured mass divided by the indicated sampled air volume, the calculated $PM_{2.5}$ concentration would be positively biased by approximately 2 percent. Note that the effects of flow biases on fractionator performance and collected aerosol mass are in opposite directions, thus partially offsetting each other.

Comment: The fractionator used in the FRM should be evaluated in the laboratory after collecting appreciable quantities of polydisperse particles on the impaction plate.

Response: These sensitivity tests were in fact conducted in the laboratory and described in ''Modification and Evaluation of the WINS Impactor.'' The WINS impactor was exposed to laboratory generated polydisperse Arizona test dust for three 24-hour periods where the mean dust concentration was measured to be 330 $\mu g/m^3$. After each 24-hour collection period, the performance of the loaded substrate was evaluated in the laboratory using primary calibration aerosols. Results showed that the fractionator could be exposed to ambient aerosol concentrations averaging 330 $\mu g/m^3$ for 6 consecutive days before a 5 percent bias in measured $PM_{2.5}$ concentration would be expected.

Comment: Favorable results of collocated field tests should not imply that the samplers are accurately measuring $PM_{2.5}$ values, only that similar samplers produce similar results. To verify accuracy, the six samplers should be simultaneously tested in the laboratory using a known and typical aerosol as described in the previous comment.

Response: Because the size and volatility of particles comprising fine ambient particulates vary over a wide range of environmental and sampling conditions, the accuracy of $PM_{2.5}$ measurements cannot be defined in an absolute sense. Instead, EPA defines $PM_{2.5}$ sampler accuracy based on how well the sampler meets all design, construction, and operational specifications set forth for samplers approved for determining compliance with the $PM_{2.5}$ regulations. In particular, field accuracy can be defined by the level of agreement between a given $PM_{2.5}$ sampler and a collocated $PM_{2.5}$ reference audit sampler operating simultaneously. In the case of collocated prototype FRM samplers, favorable agreement among the samplers implies that adequate control is being exercised over uncertainties associated with the sampler's construction, calibration, setup, and operation.

Laboratory calibration of size selective components requires accurate generation and measurement of primary aerosol standards under very carefully controlled conditions. Simultaneous calibration of six identical samplers under these conditions would be impractical. To ensure that production samplers accurately meet the required specifications, the samplers must be manufactured in an ISO–9001 registered facility, and the facility must be maintained in compliance with all applicable ISO 9001 requirements. The manufacturer must also conduct specific tests and submit supporting evidence to EPA demonstrating conformance to critical component specifications such as materials, dimensions, tolerances,

and surface finishes. In conjunction with final assembly and inspection requirements, field tests are used to demonstrate that the samplers meet required performance specifications.

List of Subjects in 40 CFR Part 50

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

Authority: Secs. 109 and 301(a), Clean Air Act, as amended (42 U.S.C. 7409, 7601(a)).

Dated: January 29, 1998.

Carol M. Browner,

Administrator.

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