

STATE OF CALIFORNIA
AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES MANUAL

APPENDIX AA

SYSTEM AUDIT PROCEDURES
FOR PM_{2.5} MASS ANALYSIS

MONITORING & LABORATORY DIVISION
JANUARY 1999

SYSTEM AUDIT PROCEDURES FOR PM2.5
MASS ANALYSIS

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AIR MONITORING QUALITY ASSURANCE

VOLUME V

AUDIT PROCEDURES MANUAL

APPENDIX AA.1.0

SYSTEM AUDIT PROCEDURES
FOR PM_{2.5} MASS ANALYSIS

MONITORING & LABORATORY DIVISION

JANUARY 1999

AA.1.0 SYSTEM AUDIT PROCEDURES FOR PM2.5 MASS ANALYSIS

AA.1.0.1 Introduction - Fine particulate matter (PM2.5) mass analysis system audits are conducted by the California Air Resources Board's (ARB) Quality Assurance Section (QAS). A PM2.5 mass analysis system audit entails the completion of a PM2.5 laboratory operations system audit questionnaire and an on-site inspection and assessment of the total measurement system (sample collection, sample analysis, data processing, etc.). The audit assesses an agency's ability to comply with established rules and regulations governing the preparation, transport, analysis, and storage of PM2.5 filters as well as the reporting of PM2.5 data. A system audit includes an assessment of the following program areas: staff, facilities, data and document control, and quality control. The on-site inspection includes a review of the data trail from the point of generation, to entry into the data acquisition system, through the review process, and submittal to the United States Environmental Protection Agency's (U.S. EPA) Aerometric Information Retrieval System (AIRS).

The system audit includes a performance audit consisting of an on-site review to check the accuracy of the PM2.5 filter weighing microbalance and the relative humidity and temperature sensors, and a check of the laboratory operations to verify their ability to generate data of acceptable quality. Performance audits will be conducted annually following the initial system audit.

This procedure addresses the laboratory evaluations of a system and performance audit, including an evaluation of the laboratory standard operating procedures and mass balance analysis.

AA.1.0.2 Preliminary Assessment and System Audit Planning - In performing a system audit of a given agency, the auditor is seeking a complete and accurate picture of that agency's current PM2.5 sampling operations. The auditor should perform the on-site inspections and interviews with key personnel, evaluate the laboratory operated by the agency, and examine the data processing procedures.

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APPENDIX AA.1.1

CRITERIA FOR EVALUATION

MONITORING & LABORATORY DIVISION
JANUARY 1999

AA.1.1 CRITERIA FOR EVALUATION

AA.1.1.1 Introduction - A system audit is typically conducted in three steps. First, a questionnaire is sent to the organization prior to the audit visit. The organization should then fill out the questionnaire as completely as possible and return it with sufficient documentation. Second, the questionnaire is reviewed by the auditor to become familiar with the system operations and to determine any deficiencies and potential problem areas. Third, after the questionnaire has been reviewed, the on-site inspection and assessment are scheduled which includes a performance audit of the laboratory operations and equipment. The preliminary review of the questionnaire serves the purpose of allowing a greater amount of time to be spent on-site examining potential problem areas.

The auditor should interview the laboratory manager; any person who has direct responsibility for PM_{2.5} mass analysis; personnel associated with data validation, analysis and reporting; and the person identified by the laboratory manager who has responsibility for quality assurance. The information gathered from these interviews should be complete and up-to-date, and should present an accurate picture of the current and proposed levels of implementation of all quality assurance activities, including internal quality control.

At the conclusion of the audit, an exit interview informs the organization of the audit results and discusses any potential data impacting problems revealed. During this activity, the auditor also explains the reporting procedures schedule. The questionnaire described below is specific to the PM_{2.5} mass analysis system audit.

The system and performance audits are conducted in accordance with U.S. EPA Title 40 Code of Federal Regulations (CFR) Part 50, Appendix L, the U.S. EPA's "Quality Assurance Systems", Volume 11, Section 2.12, and U.S. EPA's Model Quality Assurance Project Plan for the PM_{2.5} Ambient Air Monitoring Program at State and Local Air Monitoring Stations (SLAMS).

AA.1.1.2 PM_{2.5} Laboratory Operations System Audit Questionnaire - The PM_{2.5} Laboratory Operations System Audit Questionnaire is presented in Figure AA.1.1.1. The questionnaire includes information on staff, procedures, laboratory equipment and environment, presampling filter inspection and weighing, postsampling filter inspection and weighing, data handling, and data reporting. The questionnaire should be completed by the person responsible for the overall program and should be returned to the auditor.

PM2.5 LABORATORY OPERATIONS SYSTEM AUDIT QUESTIONNAIRE

Agency _____

Address _____

Phone Number (____) _____

Organization Director _____

PM2.5 Program Supervisor _____

Data Management Supervisor _____

Quality Assurance Officer _____

Questionnaire Completed _____

(By)

(Date)

On-Site Visit

Date _____ Audit Team Members _____

Affiliation of Audit Team _____

Figure AA. 1.1.1 PM2.5 Laboratory Operations System Audit Questionnaire (cont.)

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A. STAFFING

- a. Please provide a current organization chart indicating each responsible person's role in the program.
- b. Please include a list of educational background, experience, and training for each responsible person identified in the program organizational chart.
- c. Are staff members adequately conversant with appropriate standard operating procedures to fulfill job duties? Yes[] No[]

Comments: _____

Figure AA. 1.1.1 PM2.5 Laboratory Operations System Audit Questionnaire (cont.)

B. QUALITY ASSURANCE PLAN/STANDARD OPERATING PROCEDURES

- a. Has your organization developed a quality assurance project plan? Yes[] No[]
- b. Does your organization have standard operating procedures (SOP) that include filter processing and weighing? Yes[] No[]
- c. Does the SOP include procedures to ensure complete chain of custody? Yes[] No[]

Comments: _____

C. EQUIPMENT AND ENVIRONMENT

Calibration Weights

- a. Are American National Standards Institute (ANSI)/American Society for Testing and Materials (ASTM) class 1, 1.1, 2, or better mass reference standards (weights) used? Yes[] No[]
- b. If so, are they weighed to the nearest 0.001 mg? Yes[] No[]
- c. Are weights in the range of 100 to 200 mg? Yes[] No[]
- d. Do the weights have an individual tolerance of no more than 0.025 mg? Yes[] No[]
- e. Are the weights calibrated annually? Yes[] No[]
- f. Are the weights calibrated by a National Institute of Standards and Technology (NIST) certified laboratory? Yes[] No[]
- g. Does the laboratory have two separate sets of mass reference standards (working calibration standards and laboratory primary standards)? Yes[] No[]
- h. Are the working calibration standards verified against the laboratory primary standards every three to six months and the results recorded? Yes[] No[]

C. EQUIPMENT AND ENVIRONMENT (cont.)

- i. Are smooth, nonmetallic forceps used exclusively for handling the mass reference standards? Yes[] No[]
- j. Are the forceps cleaned each weighing day with alcohol and lint-free wipes and allowed to air dry before handling standards? Yes[] No[]
- k. Record the actual readings obtained using your working calibration standards and laboratory primary standards:
- Working Calibration Standards 1) _____ 2) _____ 3) _____
- Laboratory Primary Standards 1) _____ 2) _____ 3) _____

2. Microbalance

- a. What is the make and model of the laboratory's microbalance(s)? _____
- b. Is a serial number assigned? Yes[] No[]
If so, what is the serial number? _____
- c. Do the microbalance specifications have:
1) Readability to 0.00 1 mg? Yes[] No[]
2) Repeatability to 0.00 1 mg? Yes[] No[]
- d. Is the microbalance calibrated annually? Yes[] No[]
- e. Is the microbalance located on a sturdy base to prevent vibrations and away from sources of vibration that could interfere with weighing? Yes[] No[]
- f. If not, is the microbalance located on top of a stabilizing slab and/or are composite vibration dampening pads placed at three points under the microbalance's legs or stabilizing slab? Yes[] No[]
- g. Is the microbalance's base sufficiently level to permit leveling of the microbalance according to manufacturer's instructions? Yes[] No[]
- h. Is the microbalance located out of direct sunlight and away from local heating and cooling sources such as open flames, hot plates, water baths, ventilation ducts, windows, and heat producing lamps? Yes[] No[]

C. EQUIPMENT AND ENVIRONMENT (cont.)

- i. Is the weighing chamber covered to prevent interference for air drafts such as doors, aisles with frequent traffic, ventilation ducts, and equipment with fans or moving parts? Yes[] No[]
- j. Is the microbalance located in the same controlled environment in which the filters are conditioned? Yes[] No[]
- k. Is a slightly positive pressure maintained in the environment where the microbalance is kept? Yes[] No[]
- l. Is ingress to and egress from the microbalance environment kept to a minimum? Yes[] No[]
- m. Is dust contamination minimized in the weighing room by:
 - 1) Cleaning the weighing room daily? Yes[] No[]
 - 2) Installing a sticky floor covering on the entrance(s) to the weighing area? Yes[] No[]
 - 3) Wearing clean lab clothing over anything exposed to uncontrolled environments? Yes[] No[]

3. Filter Equilibration

- a. Are filters equilibrated for a minimum of 24 hours in a controlled environment before weighing? Yes[] No[]
- b. Is the weighing room heating and air conditioning maintained 24 hours a day, including weekends? Yes[] No[]
- c. Temperature
 - 1) Is the mean temperature held constant (± 2 °C standard deviation) between 20 °C and 23 °C? Yes[] No[]
 - 2) Is the equilibration room temperature sensor accurate to ± 1 °C? Yes[] No[]
 - 3) Is the temperature checked and temperature continually recorded during filter equilibration (either by a recording hygrothermograph or by electronic instrument)? Yes[] No[]
 - 4) Is the temperature sensor calibrated monthly against a reference thermometer and the results recorded? Yes[] No[]
- d. Relative Humidity (RH)
 - 1) Is the mean %RH held constant (± 5 % standard deviation) between 30% and 40% RH? Yes[] No[]
 - 2) Is the equilibration room %RH sensor accurate to ± 2 % RH? Yes[] No[]

C. EQUIPMENT AND ENVIRONMENT (cont.)

- 3) Is the %RH sensor checked and %RH continually recorded during filter equilibration (either by recording hygrothermograph or by electronic instruments)? Yes[] No[]
- 4) Is the %RH sensor calibrated monthly against a sling psychrometer or other reference %RH meter and the results recorded? Yes[] No[]
- e. Are the filters equilibrated at the same conditions (mean %RH within $\pm 5\%$ and mean temperature within $\pm 2^\circ\text{C}$) before pre- and postsampling weighings? Yes[] No[]
- f. During filter equilibration, are filters placed on a covered rack or open-sided cabinet within the conditioning chamber? Yes[] No[]
- g. Are filters equilibrated in their filter handling containers with the lid off? Yes[] No[]
- h. For the filters that are returned to the laboratory at 4°C or less, i.e., how soon after the filters are removed from the 4°C or less environment are they actually weighed? (Give range of days.)

- i. What action is taken if the correct equilibration period for each new lot of filters is not determined?

- j. What action is taken if the mean temperature is not maintained between 20°C and 23°C and/or the variability is more than $\pm 2^\circ\text{C}$ standard deviation over 24 hours?

C. EQUIPMENT AND ENVIRONMENT (cont.)

- k. What action is taken if the mean %RH is not maintained between 30% and 40% and/or the variability is more than $\pm 5\%$ standard deviation over 24 hours?

4. Filter Handling

- a. Are antistatic and powder-free gloves worn to handle filters? Yes[] No[]
- b. Are filters handled by the support ring with smooth non-serrated forceps used only for that purpose? Yes[] No[]
- c. Are filter-handling forceps cleaned each weighing day with alcohol and lint-free wipes and allowed to air dry before handling the filter? Yes[] No[]
- d. Is each filter kept in a clean filter-handling container, except during weighing, until it is loaded into the filter cassette prior to sampling? Yes[] No[]

Comments: _____

D. PRESAMPLING FILTER INSPECTION AND WEIGHING

1. Filters

- a. What type and size of filters are used? _____
-
- b. From where are the filters obtained? (U.S. EPA, ARB. etc.) _____
-

- c. Do the filters meet the specifications set forth in 40 CFR 50 Appendix L? Yes[] No[]
- d. Visual Inspection. Are the filters checked for:
- 1) Pinholes Yes[] No[]
 - 2) Loose Material Yes[] No[]
 - 3) Poor Workmanship Yes[] No[]
 - 4) Separation of Ring Yes[] No[]
 - 5) Discoloration Yes[] No[]
 - 6) Irregularities Yes[] No[]
 - 7) Chaff or Flashing Yes[] No[]
 - 8) Filter Nonuniformity Yes[] No[]
- e. What action is taken if any defective filters are found? _____

- f. Are lot blank filters used to determine filter weight stability and are the results of the stability recorded? Yes[] No[]
- g. Are weight changes for equilibrated lot blank filters verified to be less than 15 ug prior to equilibrating the entire lot for routine sampling? Yes[] No[]
- h. Is the correct equilibration period (at least 24 hours) determined for each new lot of filters based on the lot blank filter stability study for that lot of filters? Yes[] No[]
- i. Are equilibrating filters placed in a cabinet with doors partially closed to aid in prevention of contamination from particles in room air? Yes[] No[]
- j. Does each filter have a unique identification number? Yes[] No[]
- k. Are filter numbers legibly written on filter handling containers and on laboratory data forms in permanent ink? Yes[] No[]
- l. Are filters exposed to a static eliminating device for a minimum of thirty seconds immediately prior to weighing? Yes[] No[]
- m. Are the static eliminating devices replaced every six months? Yes[] No[]

D. PRESAMPLING FILTER INSPECTION AND WEIGHING (cont.)

- n. Is presample filter weighing conducted within 30 days of the sampling period? Yes[] No[]
- o. Are filters weighed without intermediate or transient exposure to other conditions or environments? Yes[] No[]
- p. Are enough laboratory blanks weighed during a presampling weighing session to provide at least 10% or one single-use lab blank during each subsequent postsampling weighing session? Yes[] No[]
- q. Are enough field blanks weighed during a presampling weighing session to provide at least 10% or one single-use field blank during each subsequent weighing session? Yes[] No[]
- r. Are field blanks implemented at 10-15% of a monitor's frequency? Yes[] No[]
- s. Are filters found to be outside the normal weight range of 110 to 160mg investigated or rejected? Yes[] No[]
- t. What action is taken if laboratory blank filters consistently show a negative replication (>15 ug)?

- u. Are at least 10% of the routine filters preweighed (duplicate weighing) per each weighing session and the results recorded? Yes[] No[]
- v. What action is taken if the duplicate measurement disagrees from the original measurement by more than 15 ug?

- w. After weighing, is each filter returned to its filter-handling container, the lid replaced, and returned to the conditioning chamber to protect against contamination prior to sampling? Yes[] No[]
- x. Are filter cassettes checked for cracks, evidence of wear, of contamination, and cleaned or replaced as necessary? Yes[] No[]

D. PRESAMPLING FILTER INSPECTION AND WEIGHING (cont.)

- y. Are extra filters prepared for sampling in case a filter is invalidated? Yes[] No[]
- z. If filters are mailed, are they sufficiently protected in the container, and are field operators supplied with proper shipping materials (in addition to protective containers) to protect exposed filters during shipment back to the analytical laboratory? Yes[] No[]

2. Log Books/QC Check Sheets

- a. Are log books/log sheets maintained? Yes[] No[]
- b. Is a maintenance log maintained for all laboratory equipment? Yes[] No[]
- c. Do log books/log sheets show calibrations? Yes[] No[]
- d. Are they initialed by the operator? Yes[] No[]
- e. Are they dated? Yes[] No[]
- f. Do they show filter weights? Yes[] No[]
- g. Do they show filter times for each filter preweighing and sampling? Yes[] No[]
- h. Do they show what filter temperatures were during transport following sampling? Yes[] No[]
- i. Do they show filter times for each filter between sampling and postweighing? Yes[] No[]
- j. Is the data archived? Yes[] No[]

If so, for how long and where are they stored? _____

3. Microbalance

- a. Is the microbalance calibrated by weighing a set of standard weights? Yes[] No[]

D. PRESAMPLING FILTER INSPECTION AND WEIGHING (cont.)

- b. Is the microbalance zero value rechecked and recorded after every 10th filter? Yes[] No[]
- c. Is at least one working standard reweighed after every 10th filter and the result recorded? Yes[] No[]
- d. Describe what action is taken if the working standard measurement does not agree within 3 ug of the verified values. Yes[] No[]
- e. Are tare weights checked by weighing at least 10% or one lab blank per weighing session and the results recorded? Yes[] No[]
- f. What action is taken if the lab blank weights are not within ± 15 ug of their original weights. Yes[] No[]
- g. Are tare weights checked by reweighing at least 10% or one routine (duplicate) filter at the end of the weighing session? Yes[] No[]
- h. What action is taken if the reweighed routine filters are not within ± 15 ug of their original weights. Yes[] No[]

Comments: _____

E. POSTSAMPLING FILTER INSPECTION AND WEIGHING

Filters

- a. Are exposed filters logged in for processing? Yes[] No[]
- b. Are antistatic and powder-free gloves worn to handle filters? Yes[] No[]
- c. Are the filter-handling forceps cleaned each weighing day with alcohol and lint-free wipes and allowed to air dry before handling the filters? Yes[] No[]
- d. Are exposed filters inspected prior to postsampling equilibration? Yes[] No[]

Figure AA. 1.1.1 PM2.5 Laboratory Operations System Audit Questionnaire (cont.)

E. POSTSAMPLING FILTER INSPECTION AND WEIGHING (cont.)

- e. Are filters invalidated for:
- | | |
|--|------------|
| 1) Flow outside a nominal 16.67 lpm ($\pm 4\%$)? | Yes[] No[] |
| 2) Contamination or damage? | Yes[] No[] |
| 3) Non-midnight start/stop time (± 30 minutes)? | Yes[] No[] |
| 4) Changes in flow rate calibration ($> \pm 4\%$) as determined by field \pm QC checks? | Yes[] No[] |
| 5) Changes in flow rates more than $\pm 5\%$ from design operating flow rate? | Yes[] No[] |
| 6) Missing/Unobtainable information from the filter and field data worksheets? | Yes[] No[] |
| 7) Not being weighed within 10 days following the end of sampling if kept at 25°C or less once removed from the sampler, including during transport? | Yes[] No[] |
| 8) Not being weighed within 30 days following the end of sampling if kept at 4°C or less once removed from the sampler, including during transport? | Yes[] No[] |

f. Briefly describe what action is taken if any of the above filter criteria are not met.

g. Are exposed filters removed from their cassettes and transferred to their filter-handling containers and equilibrated for a minimum of 24 hours following postsampling? Yes[] No[]

h. Is the mean %RH held between 30% and 40%, with a variability of not more than $\pm 5\%$ standard deviation over 24 hours? Yes[] No[]

i. Is the mean temperature held between 20°C and 23°C , with a variability of not more than $\pm 2^{\circ}\text{C}$ standard deviation over 24 hours? Yes[] No[]

j. Are filters equilibrated at the same conditions (mean %RH within $\pm 5\%$ and mean temperature within $\pm 2^{\circ}\text{C}$) before pre- and postsampling weighing? Yes[] No[]

k. What action is taken if postsampled filters are not equilibrated for a minimum of 24 hours?

Figure AA.1 .1.1 PM_{2.5} Laboratory Operations System Audit Questionnaire (cont.)

E. POSTSAMPLING FILTER INSPECTION AND WEIGHING (cont.)

- l. What action is taken if postsampling RH and temperature equilibration requirements are not satisfied?

- m. Are pre- and postsampling filter weighings conducted on the same analytical balance? Yes[] No[]

- n. Are static charges neutralized on filters prior to weighing? Yes[] No[]

- o. Is postsampling equilibration and weighing completed within 240 hours (10 days) after the end of the sampling period, or within 30 days if the filter is maintained at 4°C or less during the entire time between retrieval from the sampler and start of equilibration? Yes[] No[]

- p. Are at least one laboratory blank and one field blank (or 10% of weighed filters, if larger) weighed during the postsampling filter weighing session? Yes[] No[]

- q. What action is taken if the pre- and postsampling weights for the laboratory blanks disagree by more than ± 15 ug?

- r. What action is taken if the pre- and postsampling weights for the field blanks disagree by more than ± 30 ug?

- s. Are at least 10% of the routine filters reweighed (duplicate weighing) at the end of the weighing session and the results recorded? Yes[] No[]

- t. What action is taken if the duplicate measurement disagrees from the original measurement by more than ± 15 ug?

Figure AA.1.1.1 PM2.5 Laboratory Operations System Audit Questionnaire (cont.)

E. POSTSAMPLING FILTER INSPECTION AND WEIGHING (cont.)

- u. What action is taken if filters will receive supplemental analysis?

- v. Are exposed filters stored for analysis? Yes[] No[]

If yes, where are they stored, under what conditions are they stored, and for how long will they be stored? _____

2. Log Books/Sheets

- a. Do logs contain postsampling filter weights? Yes[] No[]

- b. Do logs indicate the maximum temperature filters were exposed to during transport following sampling? Yes[] No[]

- c. Do logs report how long filters remained in the sampler following postsampling? Yes[] No[]

- d. Do logs report how long each filter sat between sampling and postweighing? Yes[] No[]

3. Microbalance

- a. Is the microbalance calibrated every weighing day by weighing a set of standards? Yes[] No[]

- b. Is the microbalance zero value rechecked and recorded after every tenth filter? Yes[] No[]

- c. Is at least one working standard reweighed after every tenth filter? Yes[] No[]

- d. Are gross weights checked by reweighing at least 10% or one field blank per weighing session and the results recorded? Yes[] No[]

Figure AA. 1.1.1 PM2.5 Laboratory Operations System Audit Questionnaire (cont.)

E. POSTSAMPLING FILTER INSPECTION AND WEIGHING (cont.)

- e. What action is taken if the field blank weights are not within "30 ug of their original weights?

- f. Are gross weights checked by reweighing at least 10% or one (routine (duplicate) filter at the end of the weighing session? Yes[] No[]

- g. What action is taken if the reweighed routine filters are not within ± 15 ug of their original weights? _____

4. Calculations

- a. Give a brief description of the procedure and/or formula used to convert field data to final concentrations. _____

5. Quality Control (QC)

- a. As part of your QC program, what percent of routine filters are reweighed duplicates? _____ %

- b. As part of your QC program, what percent of data are verified by recalculation? _____ %

- c. Is sample batching a part of your QC program? Yes[] No[]

- d. Are QC control charts maintained for each microbalance, RH and temperature sensors, working standard accuracy, duplicate accuracy, etc.? Yes[] No[]

- e. Are QC control charts reviewed at least quarterly by the laboratory supervisor? Yes[] No[]

E. POSTSAMPLING FILTER INSPECTION AND WEIGHING (cont.)

- f. Are quarterly QC control reports submitted to the ARB's QAS for review? Yes[] No[]
- g. Does the laboratory supervisor certify on the laboratory data forms the acceptability of filter weighing and QC checks and the completeness of the data? Yes[] No[]
- h. Is sample handling verified by participation in system audits? Yes[] No[]
- i. Is sample handling validated by reviewing data from collocated sampling, field blanks, and FRM performance evaluations? Yes[] No[]

Note: Please submit a copy of your quarterly QC report to the ARB's QAS when you return the questionnaire.

Comments: _____

F. DATA HANDLING

- a. Please describe your field data reduction process. (Attach additional sheets if necessary.) _____

- b. Please describe your laboratory data reduction process and how it is merged with (a) above. (Attach additional sheets if necessary.) _____

c. Please describe your data validation (flagging) process. (Attach additional sheets if necessary.)

d. Does your laboratory have procedures to determine whether PM2.5 monitors and laboratory analyses are producing data that comply with the data quality objectives (DQO)? Yes[] No[]

e. Are the data archived? Yes[] No[]

If so, for how long, in what format (e.g., hard copy, electronic), and where are the data stored? _____

Comments: _____

G. DATA REPORTING

1. Reporting

a. To whom are the results of the filter weighings reported? (e.g. U.S. EPA, ARB, etc.)

b. What type of data handling software (laboratory information management system) is used to input and report data? _____

G. DATA REPORTING (cont.)

c. How often are the results forwarded to the reporting organization? (e.g. monthly, quarterly, etc.) _____

d. In what form are the results reported? (e.g., hard copy, diskette, electronic)

Comments: _____

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PM2.5 MASS ANALYSIS
SYSTEM AUDITS

MONITORING & LABORATORY DIVISION
JANUARY 1999

AA.2.0 PM2.5 MASS ANALYSIS SYSTEM AUDITS

AA.2.0.1 Components of a PM2.5 Mass Analysis System Audit - The components of a PM2.5 mass analysis system audit are listed below:

1. Assessment of Staff:
 - A. Background and education,
 - B. Chain of command regarding description of assignments and specific duties.
 - C. Training, and
 - D. Level of staffing.
2. Assessment of Facilities:
 - A. Laboratory and support facilities,
 - B. Calibration frequency, and
 - C. Documentation.
3. Assessment of Data and Document Control:
 - A. Chain of custody,
 - B. Validation and processing procedures.
 - C. Reporting formats,
 - D. Storage of filters and data, and
 - E. Documentation.
4. Assessment of the Quality control Programs:
 - A. Adequacy of procedures, and
 - B. Adherence to procedures.

AA.2.0.2 Pre-Audit Activities - Each agency is contacted to establish a time-frame for conducting the system audit. The auditor should inform the agency of the system audit details and that it will include completion of a questionnaire and an on-site inspection. The agency should be given thirty (30) calendar days to complete the questionnaire. Once the completed questionnaire is returned, it will be reviewed and the auditor will prepare a checklist detailing specific points for discussion with agency personnel.

AA.2.0.3 On-Site Audit Activities - The auditor should meet initially with the agency's director or his designee to discuss the scope, duration and activities involved with the audit. This should be followed by a meeting with key personnel identified from the completed questionnaire.

Once the audit is completed, the auditor should meet again with key personnel and with the agency's director or designee to present the findings. This is also an opportunity for the agency to present any responses to the findings. The auditor should simply state the audit results including an indication of the potential data quality impact.

AA.2.0.4 Post-Audit Activities - A detailed system audit report is prepared by the auditor following the on-site visit. Preparation of the report requires that the auditor compare the agency's documented logs and procedures to the required regulations and guidelines.

A preliminary draft system audit report is submitted to the audited agency for review and comment together with a letter thanking agency personnel for their assistance, time, and cooperation. Comments on the report should be received from the audited agency within thirty (30) calendar days from the report date.

The agency's comments on the preliminary draft audit report should be reviewed through incorporation into the final draft report within thirty (30) days of receipt of the written comments. Their comments should include, where possible, the time-frame for implementing the recommendations. Many of the recommendations will require follow-up after completion of the final system audit report. A final draft report is then submitted to the agency for review and comment. Comments on the final draft report should be received from the audited agency within thirty (30) calendar days from the report date. A final report is submitted shortly thereafter to the agency, U.S. EPA, and ARB's Technical Support Division.

The system audit report includes an executive summary, conclusion, recommendations, system audit objectives, organization, laboratory facility and operations, data management, quality assurance and quality control, performance audit, data quality, follow-up, and a copy of the completed questionnaire. Details of a PM2.5 Mass Analysis System Audit Report are listed below:

1. Executive Summary

The executive summary is a summarization of the system audit report. This section states when the laboratory initiated PM2.5 mass analyses, why the audit was conducted (requirements), data quality, the outstanding areas of the program, and areas needing improvement.

2. Conclusion

The conclusion section discusses data quality and ARB's audit findings.

3. Recommendations

The recommendations section lists the areas of the program which may be improved to ensure the data are of acceptable quality, and can be considered data-for-record. The section also includes recommendations which should be implemented to improve the overall quality of the program.

4. System Audit Objectives

This section discusses why the system audit was conducted.

5. Organization

This section lists the staff responsible for overseeing the PM_{2.5} mass analysis program, from the staff conducting the weighings, to the air pollution control officer.

6. Laboratory Facility and Operations

The laboratory facility and operations section discusses laboratory set-up, PM_{2.5} filter preparations, mass determination, and filter processing.

7. Data Management

This section examines the data trail from the point of generation, to entry into the data acquisition system, through the review process, and submittal to the U.S. EPA and ARB.

8. Quality Assurance and Quality Control

The quality assurance and quality control section discusses the quality control procedures conducted by, and those which should have been conducted by, the laboratory. These are quality control guidelines outlined in the U.S. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Section 2.12 (U.S. EPA, 1998).

9. Performance Audit

The performance audit section discusses the results of the standard weight checks and the review of the weighing techniques.

10. Data Quality

This section discusses the quality of the data generated and submitted by the laboratory to the U.S. EPA and ARB.

11. Follow-up

The follow-up section discusses the recommendations that will require follow-up and review at a future date. The audits are conducted in accordance with U.S. EPA 40 CFR Part 50, Appendix L. The audit results should include information on the network size, staff data management system, equipment, and quality assurance and quality control functions.

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APPENDIX AA.3.0

PM2.5 MASS ANALYSIS LABORATORY PERFORMANCE AUDIT

MONITORING & LABORATORY DIVISION
JANUARY 1999

AA.3.0 PM2.5 MASS ANALYSIS LABORATORY PERFORMANCE AUDIT

A performance audit of each PM2.5 mass analysis laboratory is conducted with the system audit and then annually following the initial system audit.

AA.3.0.1 Components of a PM2.5 Mass Analysis Performance Audit - The components of a PM2.5 mass analysis performance audit are listed below:

1. Assessment of Balance:
 - A. Weighing a set of Class 1 standard weights, and
 - B. Reviewing the operator's weighing technique.
2. Assessment of Relative Humidity and Temperature Sensors:
 - A. Check of relative humidity and temperature sensors against certified relative humidity and temperature sensors.
3. Assessment of Documentation:
 - A. Review of maintenance log books,
 - B. Review of calibration log books, and
 - C. Review of quality control records.

AA.3.0.2 Performance Audit - The performance audit entails the following:

- 1) conducting standard weight checks using a set of Class 1 standard weights;
 - 2) conducting relative humidity and temperature sensor checks; and 3) a review of the weighing technique, calibration and maintenance logs, and quality control (QC) records.
1. The standard weights used for the checks of the balance range from 50 milligrams to 200 milligrams. The U.S. EPA requires the balance response to be within ± 3 micrograms of the actual weight. If the criteria is not satisfied, an investigation and any appropriate corrective action should be taken by the laboratory.
 2. A Rotronics Hygroskop GT-L or Fisher Scientific relative humidity (RH) and temperature sensor is used to check the laboratory's RH and temperature sensors. The U.S. EPA requires the RH response to be within $\pm 6\%$ of the actual RH and the temperature response to be within $\pm 2^{\circ}\text{C}$ of the actual temperature. If the criteria is not satisfied, the laboratory should have the sensor calibrated or replaced.

3. During the weighing of filters, laboratory staff should be observed performing sanitary practices to prevent contamination of the filters; checking and recording the weighing room RH and temperature; conducting and recording the daily standard weight check; rechecking the balance zero after each weighing; and crosschecking the filter's identification numbers with the chain of custody document (e.g., a 24-Hour Sample Report/Field Data sheet). See Figure AA.3.0.1.

The laboratory's quality control reports and calibrations and maintenance logs should be reviewed for accuracy, completeness, and adherence to specified requirements. The reports and logs should be easily accessible.

A letter should be sent to the laboratory within 30 days following the performance audit. The letter should include the results of the audit and any findings, if appropriate. If there are any findings, the letter should specify a time-frame for corrective action to be taken by the laboratory.

The audits are conducted in accordance with U.S. EPA 40 CFR Part 50, Appendix L. The balance, RH, and temperature sensors are checked against National Institute of Standards and Technology traceable weights and sensors.

CARB 24 Hour - FIELD SAMPLE REPORT
 Federal Reference Method PM 2.5 Filter Samplers

Bar Code:
LIMS Sample ID:

Site Name: _____
 AIRS Site Number: _____
 Field Technician: _____
 Agency: _____

Cassette I. D. Number: _____
 Sampling Date / Port Number: _____ / _____
 Sampler Make, Model & ID#: _____

SAMPLE SUMMARY

Check if data electronically submitted to Laboratory

Elapsed Time: _____ Hr:min
 Volume: _____ M³
 Flow CV: _____ %
 Start Date / Time: _____ / _____

Average:	Ambient Temp: (°C)	Ambient Pressure: (mm Hg)
Minimum:		
Maximum:		

Local Condition Codes: _____

Sampler Flag Codes: _____

H. High Winds	E. Forest Fire	F. Flowrate 5-min average, out of spec
K. Farming Nearby	J. Construction Nearby	T. Filter Temp differential, 30 minutes interval out of spec
N. Sanding/Salting Streets	L. Highway Construction	E. Elapsed sample time, out of spec
P. Roofing Operations	Q. Prescribe Burn	

Operator Comments: _____

Chain of Custody

ACTION	DATE	TIME	FILTER TEMP °C	NAME
Sample Load				
Sample Removal				
Sample placed in cooler				
Sample shipped to Lab				
Sample received at Lab				
Start post-conditioning				

FOR LABORATORY USE ONLY

Postweigh by: _____

	Mass:	Dup Mass:	Date:	Analyst:
Preweight				
Postweight				

Lab Comments: _____

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REFERENCES

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AA.4.0 REFERENCES

1. Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II, Ambient Air Specific Methods, Section 2.0.11, Systems Audit Criteria and Procedures for Ambient Air Monitoring Programs, U.S. EPA, April 1985.
2. Code of Federal Regulations: 40 CFR 50 Appendix L, Reference Method for the Determination of Fine Particulate Matter as PM_{2.5} in the Atmosphere, U.S. EPA, July 1997.
3. Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II, Ambient Air Specific Methods, Section 2.12, Monitoring PM_{2.5} in Ambient Air Using Designated Reference or Class I Equivalent Methods, U.S. EPA, April 1998.
4. Quality Assurance Guidance Document: Quality Assurance Project Plan for the PM_{2.5} Ambient Air Monitoring Program at State and Local Air Monitoring Stations (SLAMS), U.S. EPA, April 1998.