CALIFORNIA
AIR RESOURCES BOARD

Standard Operating Procedure for PM10 Mass Analysis (High Volume) Laboratory Performance Audit

Volume V
Audit Procedures Manual for Air Quality Monitoring

QMB SOP Appendix AP
Version 1.0

Quality Assurance Section
Quality Management Branch
Monitoring and Laboratory Division

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AP.1.0 INTRODUCTION

A performance audit of each PM10 mass analysis laboratory is conducted annually. The purpose of this Standard Operating Procedure (SOP) is to ensure that Quality Assurance Section (QAS) auditors conduct audits in a complete and consistent manner.

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

In addition to the performance audit, the Quality Management Branch (QMB) conducts more detailed Technical System Audits (TSA's) every six years to address District's management systems, including for laboratory operations. The TSA covers the data review process, entry into the data acquisition system, and submittal to the United States Environmental Protection Agency's (U.S. EPA) Air Quality System (AQS). The TSA also reviews storage and archiving of data, chain of custody documents, log books, and check sheets.

AP.1.0.1 BACKGROUND

Regulations governing PM10 became effective on July 1, 1987.

The performance audit is referenced from 40 CFR Part 50, Appendix J, U.S. EPA's Quality Assurance Handbook for Air Pollution Measurement Systems Volume II (January 2017), and Quality Assurance Guidance Document 2.11 (January 1990).

AP.1.0.2 PERSONNEL QUALIFICATIONS

The QAS auditor should be familiar with the regulations and guidance cited in the "Background" (AP.1.0.1) prior to conducting any laboratory audits. The auditor is expected to have a minimum level of on the job training and familiarity with audit equipment prior to conducting an audit.

AP.1.0.3 APPLICABILITY

This SOP covers the performance audit of the PM10 mass analysis laboratory audit for high volume [8" X 10"] filters only. The current regulatory agencies operating PM10 mass analysis laboratories within California are the California Air Resources Board (CARB) and the following districts: Bay Area Air Quality Management District, Great Basin Unified Air Pollution Control District, Lake County Air Quality Management District, South Coast Air Quality Management District, San Diego County Air Pollution Control District, and Sacramento Metropolitan Air Quality Management District.

AP.1.0.4 ACRONYMS AND DEFINITIONS

Table 1. Acronyms and Definitions

Acronym	Definition
AQDA	Air Quality Data Action
AQS	Air Quality System
CAN	Corrective Action Notification
CARB	California Air Resources Board
U.S. EPA QA	United States Environmental Agency Quality Assurance
NIST	National Institute of Standards and Technology
PM10	Particulate Matter 10 Microns in Aerodynamic Size or Less
QAS	Quality Assurance Section
QC	Quality Control
QC/QA	Quality Control/Quality Assurance
QMB	Quality Management Branch
RH	Relative Humidity
SOP	Standard Operating Procedure
TSA	Technical System Audit
U.S. EPA	United States Environmental Agency

AP.1.0.5 HEALTH AND SAFETY

All personnel must follow general health and safety guidelines as described by the facility where the audit is conducted.

AP.1.1 IMPLEMENTATION

AP.1.1.1 COMPONENTS OF A PM10 MASS ANALYSIS AUDIT

The components of PM10 mass analysis performance audit are:

1. Assessment of the Balance:
    a. Weighing a set of Class 1 standard weights.
    b. Reviewing the operator's weighing technique as written in the district's SOP.
    c. Verify that the balance is at least sensitive to minimum of four decimal places (grams).

2. Assessment of the Relative Humidity (RH) and Temperature Sensors:
    a. Check the relative humidity and temperature sensors of the laboratory against certified relative humidity and temperature sensors.

3. Assessment of Documentation:
    a. Review of maintenance log books
    b. Review of calibration log books
    c. Review of quality control checks/records

4. Follow up and Corrective Action
    a. Letter to District or Memorandum to CARB
    b. Air Quality Data Action (AQDA) Request
    c. Corrective Action Notification (CAN)

AP.1.2 PERFORMANCE AUDIT

The performance audit can be conducted in any order and is described in sections AP.1.2.1 through AP.1.2.5. Plan for a minimum of one hour to review records, interview the operator, and observe operator practices.

AP.1.2.1 BALANCE AND WEIGHTS

Conduct standard weight checks using a set of CARB Audit Class 1 National Institute of Standards and Technology (NIST) standard weights. CARB has the standard weights certified annually.

The standard weights used for the checks of the balance range from one gram to five grams. CARB audits at five points, one, two, three, four, and five grams. Normally, the auditor will request the District/CARB operator to perform the weighing, as they are more familiar with the District balance. Ensure that the balance remains at zero for 30 seconds between weighings for an accurate reading.

Verify the calibration date for the laboratories' balance and weights are current and conducted by an approved vendor. Record the results of the weighing along with the calibration date of the balance on worksheet. (See QA audit Worksheet AP.1.4 and Audit Reminders/References AP.1.5).

Documentation for the calibration of the balance should be reviewed as well as the maintenance log for the balance.

In the U.S. EPA QA Handbook Volume II (Method) 2.11, Section 4.5.1- 4.5.2, the U.S. EPA requires the balance response to be within $\pm$ 0.0005 grams of the certified audit weight. If this criterion is not satisfied, an investigation and any appropriate corrective action should be taken by the laboratory. If the balance is found to be outside $\pm$ 0.0005 grams, the auditor will issue an AQDA.

AP.1.2.2 LABORATORY PRACTICES AND PROCEDURES

The laboratory staff should be able to explain the filter handling process from the shipment of the filters from the supplier to the post weighing process. 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 a chain of custody document (e.g., a 24-Hour Sample Report/Field Data sheet).

AP.1.2.3 FILTER CONDITIONING ENVIRONMENT

Conduct relative humidity and temperature sensor checks.

Use certified relative humidity (RH) and temperature sensors to verify laboratory's RH and temperature sensors. The U.S. EPA requires the RH response to be within $\pm$5% of the actual RH and the temperature response to be within $\pm$2°C of the actual temperature.

If one or both of these criteria are not satisfied, the laboratory should have the sensor calibrated or replaced.

Auditors should place the certified CARB audit relative humidity (RH) and temperature sensors as close to the District/CARB sensors as possible to obtain an accurate comparison. Record the results of the RH and temperature measurements on QAS worksheet. (See QA audit Worksheet AP.1.4 and Audit Reminders/References AP.1.5).

Review calibration documents for the filter conditioning/balance room temperature and relative humidity sensor. Record the date of the last calibration/certification. A logbook should accompany the instrument.

CARB's Standards Laboratory certifies the RH and temperature standards annually using NIST criteria.

AP.1.2.4 ASSESSMENT AND DOCUMENTATION

Review the operator's weighing technique, calibration and maintenance logs, and quality control (QC) records. An SOP describing the entire PM10 mass analysis process should be on hand and maintained.

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.

Documentation should include annotation of quality control checks which includes field blanks, lab blanks, holding times (filter conditioning) balance checks, and duplicate filter weighing.

AP.1.2.5 FOLLOW UP AND CORRECTIVE ACTION

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. An AQDA or CAN could result if data quality is determined to be impacted. In response to the AQDA or CAN, the laboratory must provide a time frame for a corrective action to be implemented.

AP.1.3 REFERENCES

EPA Quality Assurance Handbook for Air Pollution Measurement Systems: "Volume II: Ambient Air Quality Monitoring Program" EPA-454/B-17-001, (January 2017): https://www3.epa.gov/ttn/amtic/files/ambient/pm25/qa/Final%20Handbook%20Document%201_17.pdf

Section 2.11 of EPA Quality Assurance Handbook Reference Method for the Determination of PM10 (High Volume PM Sampler) at Standard Temperature and Pressure (January 1990). https://www3.epa.gov/ttn/amtic/files/ambient/qaqc/m211_OCR.pdf

40 CFR Appendix J to Part 50 – Reference Method for the Determination of Particulate Matter as PM10 in the Atmosphere: https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=0f3bfa16342b3e5b858743bbbbdcfa4f&r=PART&n=40y2.0.1.1.1#ap40.2.50_119.j

AP.1.4 QA AUDIT WORKSHEET

QA AUDIT WORKSHEET
PM10 MASS ANALYSIS

Audit Weights

Site Name: _____ Date: _____ SN/ID: _____

Operator: _____ Auditors: _____ Cert. date: _____

Equilibration Room/Chamber

Last Lab Audit performed on: _____

Temperature (Specs. = ±2°C)	Audit	District
Model:		
SN/ID:		
Last Cal. Date:		
Temp:	°C	°C

Relative Humidity (Specs. = ±2%RH)	Audit	District
Model:		
SN/ID:		
Last Cal. Date:		
RH:	%	%

Balance Check with Audit Weights
(Specs. = ±0.0005g)

	Audit Weights	District Balance
1 g:		
2 g:		
3 g:		
4 g:		
5 g:		

PM 10 Balance

Model: _____

SN/ID: _____

Calibrated by: _____

Last Cal. Date: _____

Weights

Primary
- Certified by: _____
- Cert. date: _____
- SN/ID: _____
- Class/Type: _____

Working
- Certified by: _____
- Cert. date: _____
- SN/ID: _____
- Class/Type: _____

Comparison check date(s) (primary to working): _____
*since last audit (suggested quarterly)

Records

	YES	NO
Are Logs complete, accurate, and up-to-date?	☐	☐
Are results within required specifications?		
Daily calibrations within ±0.0005 grams?	☐	☐
Temperature = 15°C to 30°C, ±3°C?	☐	☐
RH = 20% to 45%, ±5% ?	☐	☐

	YES	NO
Is there a current SOP on hand?	☐	☐
Chain-of-custody forms reviewed?	☐	☐
Are results within required specifications?		
Unexposed duplicate weighings within ±0.0028 grams?	☐	☐
Exposed duplicate weighings within ±0.005 grams? (10% of weighings, 5-7 per session)	☐	☐

Data Recorded and verified by: _____ _____

California Air Resources Board

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AP.1.5 AUDIT REMINDERS/REFERENCES

PM10 Mass Analysis
Audit Reminders/References

Filter Conditioning Environment (Equilibration Room/Chamber)

- Take the temperature and relative humidity readings in the Lab.
- Record related sensor information.

  Lab temperature: recommendation once each 6 months, acceptable range ±2°C
  EPA QA Handbook Volume II, Appendix D, rev. 1 (12/08), pg 24 of 30
  Lab humidity: recommendation once each 6 months, acceptable range ±2%
  EPA QA Handbook Volume II, Appendix D, rev. 1 (12/08), pg 24 of 30

- Weigh the Audit weights on the District's balance. Document the known values of the audit weights and the results.
- Record information about the lab's Primary weights, Working weights, PM10 Balance, and the Audit weights (ASTM Class 1, 1.1, or 2 mass reference standards).
- Note when the Primary weights were last compared to the Working Weights.

  Working weights/balance check: weights must agree within ±0.5mg (0.0005g)
  EPA QA Handbook Volume II (Method) 2.11, sec 4.5, 7.5.2
  Primary to Working weight comparison: recommended check every 3 or 6 months
  EPA QA Handbook Volume II (Method) 2.11, sec 1.2.4

Lab Records/Internal QC

- The calibration of the balance must be checked at least daily and weights must agree within 0.5mg (0.0005g).

  Daily calibrations (weights): EPA QA Handbook Volume II (Method) 2.11, sec 4.5.1 – 4.5.2

- Temperature should be held constant with a mean value between 15 and 30 °C, with a variability of not more than ±3 °C.

  Temperature range/control: CFR Part 50, App. J, sec. 7.4.1 – 7.4.2
  also EPA QA Handbook Volume II (Method) 2.11, sec 4.3

- Relative humidity (RH) should be held constant at a mean value between 20 and 45 percent, with a variability of not more than ±5 percent.

  Humidity range/control: CFR Part 50, App. J, sec. 7.4.3 – 7.4.4
  also EPA QA Handbook Volume II (Method) 2.11, sec 4.3

- Tare and Gross Weight checks: On each day of operation, the operator should reweigh five to seven exposed and unexposed filters. Weights of clean filters should be within ±2.8mg (0.0028g) of original values. No definitive limits are set for exposed filters, however if the difference exceeds ±5.0mg (0.005g), the discrepancy should be investigated.

  Duplicate weighings: EPA QA Handbook Volume II (Method) 2.11, sec 4.5.3