CALIFORNIA
AIR RESOURCES BOARD

Standard Operating Procedure for PM2.5 Mass Analysis Laboratory Performance Audit

Volume V
Audit Procedures Manual for Air Quality Monitoring

QMB SOP Appendix AQ
Version 1.0

Quality Assurance Section
Quality Management Branch
Monitoring and Laboratory Division

Approval Signatures	Approval Date
Ranjit Bhullar, Manager Quality Assurance Section	12.27.18
Michael Miguel, Assistant Division Chief Monitoring and Laboratory Division	12/27/18

Disclaimer: Mention of any trade name or commercial product in this standard operating procedure does not constitute endorsement or recommendation of this product by the California Air Resources Board. Specific brand names and instrument descriptions listed in the standard operating procedure are for equipment used by the California Air Resources Board's laboratory. Any functionally equivalent instrumentation is acceptable.

TABLE OF CONTENTS
APPENDIX AQ
PM2.5 MASS ANALYSIS
LABORATORY PERFORMANCE AUDIT

AQ.1.0 INTRODUCTION

A performance audit of each PM2.5 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.

The Quality Management Branch (QMB), or U.S. EPA conducts more detailed Technical System Audits (TSA's) every six years to address District's management systems. 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 QC/QA sheets.

AQ.1.0.1 BACKGROUND

Regulations governing PM2.5 became effective on September 16, 1997.

The performance audit is referenced from 40 CFR Part 50, Appendix L, U.S. EPA's Quality Assurance Handbook for Air Pollution Measurement Systems Volume II (January 2017), and Quality Assurance Guidance Document 2.12 (January 2016).

AQ.1.0.2 PERSONNEL QUALIFICATIONS

The QAS auditor should be familiar with the regulations and guidance cited in the "Background" (AQ.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.

AQ.1.0.3 APPLICABILITY

This SOP covers the performance audit of the PM2.5 mass analysis laboratory audit. The current regulatory agencies operating PM2.5 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, and San Diego County Air Pollution Control District.

AQ.1.0.4 ACRONYMS AND DEFINITIONS

Table 1. Acronyms and Definitions

Acronym	Definition
AQDA	Air Quality Data Action
AQS	Air Quality System
°C	Degree Centigrade
CAN	Corrective Action Notification
CARB	California Air Resources Board
CFR	Code of Federal Regulations
NIST	National Institute of Standards and Technology
PM2.5	Particulate Matter 2.5 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
U.S. EPA QA	United States Environmental Agency Quality Assurance

AQ.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.

AQ.1.1 IMPLEMENTATION

AQ.1.1.1 COMPONENTS OF A PM2.5 MASS ANALYSIS AUDIT

The components of PM2.5 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 three decimal places (milligrams).

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).

AQ.1.2 PERFORMANCE AUDIT

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

AQ.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 annually certified.

The standard weights used for the checks of the balance range from 50 milligrams to 400 milligrams. CARB audits at five points: 50, 100, 150, 200, and 400 milligrams. 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 AQ.1.4 and Audit Reminders/References AQ.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) 2.12, section 7.9, the U.S. EPA requires the balance response to be within ± 0.003 milligrams 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 ± 0.003 milligrams, the auditor will issue an AQDA.

AQ.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).

AQ.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 ±2% of the actual RH and the temperature response to be within ±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 AQ.1.4 and Audit Reminders/References AQ.1.5).

Review calibration documents for the filter conditioning/balance room temperature and relative humidity sensor. Verify the pre and post weighing temperature and RH records are within ±2°C and ±5% respectively. Record the date of the last calibration/certification. A logbook should accompany the instrument.

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

AQ.1.2.4 ASSESSMENT AND DOCUMENTATION

Review the operators weighing technique, calibration and maintenance logs, and quality control (QC) records. An SOP describing the entire PM2.5 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 QC checks which include field blanks, lab blanks, and trip blanks, holding times (filter conditioning), balance checks, and duplicate filter weighing.

AQ.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.

AQ.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 2.12 of Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods, EPA-454/B-16-001 (January 2016). https://www3.epa.gov/ttnamti1/files/ambient/pm25/qa/m212.pdf

40 CFR Appendix L to Part 50 – Reference Method for the Determination of Fine Particulate Matter as PM2.5 in the Atmosphere: https://www.gpo.gov/fdsys/granule/CFR-2011-title40-vol2/CFR-2011-title40-vol2-part50-appL

AQ.1.4 QA AUDIT WORKSHEET

QA AUDIT WORKSHEET
PM2.5 MASS ANALYSIS

Site Name: _____ Date: _____ Van: _____

Operator: _____ Auditors: _____

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. = ±0.025mg)

	Audit Weights	District Balance
50 mg:		
100 mg:		
150 mg:		
200 mg:		
400mg:		

PM2.5 Balance

Model: _____

SN/ID: _____

Calibrated by: _____

Last Cal. Date: _____

Weights

Primary
Certified by: _____
Cert. date: _____
SN/ID: _____

Working
Certified by: _____
Cert. date: _____
SN/ID: _____

Comparison check date (primary to working): _____

Audit
Certified by: _____
Cert. date: _____
SN/ID: _____

Records	YES	NO
Are Logs complete, accurate, and up-to-date?	☐	☐
Is there a current SOP on hand?	☐	☐
Pre/Post sampling filter conditioning (mean difference)		
Temp control: 20°C to 23°C and ≤ ±2°C over 24 hours?	☐	☐
RH control: 30% to 40% and ≤ ±5% over 24 hours ?	☐	☐

Are results within required specifications?	YES	NO
Chain-of-custody forms reviewed?	☐	☐
Duplicate weighings within ±15µg?	☐	☐
Trip, Lot, and Lab blanks within ±15µg?	☐	☐
Field blanks within ±30µg?	☐	☐
Daily calibrations within ±3.0 µg?	☐	☐

Data Recorded and verified by: _____ _____

California Air Resources Board QAS-030 (rev. 12/11/2018)

AQ.1.5 AUDIT REMINDERS/REFERENCES

PM2.5 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: recommend verification once each 3 months, calibration once each 6 months; acceptable range < ±2.1°C
  EPA QA Handbook Volume II, rev. 0 (01/17), Table 10-2
  Lab humidity: recommend verification once each 3 months, calibration once each 6 months; acceptable range < ±2.1%
  EPA QA Handbook Volume II, rev. 0 (01/17), Table 10-2

- 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, PM2.5 Balance, and the Audit weights (ASTM Class 1 or 1.1 mass reference standards).
- Note when the Primary weights were last compared to the Working Weights.

  Working weights/balance check: weights must agree within ±0.025mg
  EPA QA Handbook Volume II, rev. 0 (01/17), Table 10-2
  Primary to Working weight comparison: recommended check every 3 or 6 months
  EPA QA Handbook Volume II, rev. 0 (01/17), Table 10-2

Lab Records/Internal QC

- The calibration of the balance must be checked at least daily and weights must agree within 3µg (0.003mg).

  Daily calibrations (weights): EPA QA Handbook Volume II, rev. 0 (01/17), Table 10-2

- Pre and post-sampling filter equilibration temperature should be held constant with a mean value between 20 and 23 °C, with a variability of not more than ±2 °C over 24 hours.

  Temperature range/control: 40 CFR Part 50, App. L, sec. 8.2.1 – 8.2.2
  also EPA QA Method 2.12 for PM2.5 (Jan 2016) Table 9-1

- Pre and post-sampling filter equilibration relative humidity (RH) should be held constant at a mean value between 30 and 40 percent, with a variability of not more than ±5 percent over 24 hours.

  Humidity range/control: 40 CFR Part 50, App. L, sec. 8.2.3 – 8.2.4
  also EPA QA Method 2.12 for PM2.5 (Jan 2016) Table 9-1

- Duplicate weighings and Blank checks:

  Duplicate weighings: EPA QA Handbook Volume II, rev. 0 (01/17), Table 10-2
  Blanks: EPA QA Method 2.12 for PM2.5 (Jan 2016) Section 10.5