GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

AIR MONITORING QUALITY ASSURANCE

FINAL DRAFT

QUALITY ASSURANCE PROJECT PLAN FOR
THE PM2.5 AMBIENT AIR MONITORING PROGRAM
AT STATE AND LOCAL AIR MONITORING STATIONS (SLAMS)

MARCH 2001

Acronyms and Abbreviations

AIRS	Aerometric Information Retrieval System
AMTAC	Air Monitoring Technical Advisory Committee
ANSI	American National Standards Institute
APS	Air Pollution Specialist
APTI	Air Pollution Training Institute
AQDAS	Air Quality Data Acquisition System
AQDB	Air Quality Data Branch
AQDRS	Air Quality Data Review Section
AQM-C	Air Quality Monitoring - Central
AQM-N&OS	Air Quality Monitoring - North and Operations Support
AQM-S	Air Quality Monitoring - South
AQSB	Air Quality Surveillance Branch
ARB	Air Resources Board
ASTM	American Society for Testing and Materials
AWMA	Air and Waste Management Association
CAA	Clean Air Act
CFR	Code of Federal Regulations
DAS	data acquisition system
DQA	data quality assessment
DQOs	data quality objectives
ELB	Engineering and Laboratory Branch
EMAD	Emissions, Monitorning, and Analysis Division
FEM	Federal equivalent method
FIPS	Federal Information Processing Standards
FRM	Federal reference method
GBUAPCD	Great Basin Unified Air Pollution Control District
GIS	geographical information systems
GLP	good laboratory practice
GPS	global positioning system
HVAC	heating ventilation and air conditioning
ILS	Inorganic Laboratory Section
LIMS	laboratory information management system
LPM	liters per minute
MLD	Monitoring and Laboratory Division
MOU	Memorandum of Understanding
MQAG	Monitoring and Quality Assurance Group
MQOs	measurement quality objectives
NAAQS	National Ambient Air Quality Standards
NAMS	national air monitoring station
NIST	National Institute of Standards and Technology
NPAP	National Performance Audit Program
OAQPS	Office of Air Quality Planning and Standards
OARM	Office of Administration and Resources Management

ORD	Office of Research and Development
PAMS	Photochemical Assessment Monitoring Stations
PE&S	Program Evaluation and Standards
PM2.5	particulate matter $\leq$ 2.5 microns
POC	pollutant occurrence code
PTFE	polytetrafluoroethylene
Q_a	sampler flow rate at ambient (actual) conditions of temperature and pressure.
QA	quality assurance
QA/QC	quality assurance/quality control
QAAR	quality assurance annual report
QAPP	quality assurance project plan
QAS	Quality Assurance Section
QMOSB	Quality Management and Operations Support Branch
QMP	quality management plan
R&P	Rupprecht & Patashnick
SA	System audit
SIPS	State Implementation Plans
SLAMS	state and local monitoring stations
SOP	standard operating procedure
SPM&DS	Special Purpose Monitoring and Data Support
SPMS	special purpose monitoring stations
T_a	temperature, ambient or actual
TSD	Technical Support Division
TSP	total suspended particulate
U.S. EPA	United States Environmental Protection Agency
V_a	air volume, at ambient, actual, or volumetric conditions
VOC	volatile organic compound
WAM	Work Assignment Manager

1.0 Quality Assurance Project Plan Identification and Approval

Title: Great Basin Unified Air Pollution Control District (GBUAPCD) Quality Assurance Project Plan (QAPP) for the PM2.5 Ambient Air Monitoring Program at State and Local Air Monitoring Stations (SLAMS)

The attached QAPP for the PM2.5 Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the District to follow the elements described within.

Great Basin Unified Air Pollution Control District

1) Signature: _____ Date:_____
Bill Cox - Director of Technical Services

California Air Resources Board

1) Signature: _____ Date:_____
Mike Miguel - Manager, Quality Assurance Section

U.S. EPA Region IX

1) Signature: _____ Date:_____
John Kennedy - Chief, Air Division - Technical Support Office

2) Signature: _____ Date:_____
Vance S. Fong, P.E., - Manager, Policy and Management Division,
Quality Assurance Office

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3.0 Distribution List

A copy of this QAPP has been distributed to the individuals in Table 3-1.

Table 3-1 Distribution List

GREAT BASIN STAFF

Dr. Ellen Hardebeck Air Pollution Control Officer	Mr. Duane Ono Deputy APCO	Mr. Bill Cox Director of Technical
Mr. Christopher Lanane Air Monitoring Specialist	Mr. Mike Horn Instrument Tech. II	Mr. R. Guy Davis Instrument Tech. II
Mr. Paul Doubt Laboratory Technician I	Mr. Dan Johnson Instrument Tech. II	Mr. H. Gabriel Ibarra Instrument Tech. II

CALIFORNIA AIR RESOURCES BOARD STAFF

MLD Division Chief Mr. William V. Loscutoff	PTSD Division Chief Mr. Bob Fletcher	MLD ELB Mr. Russell Grace
PTSD AQDB Mr. Bob Effa	MLD QMOSB Mr. Jeff Cook	MLD AQSB Mr. Peter Ouchida
MLD QAS Mr. Mike Miguel	MLD AQSB Mr. Curt Schreiber	MLD AQSB Mr. Ken Stroud

OTHER GOVERNMENT AND INDUSTRY

U.S. EPA Region IX
Mr. John Kennedy, Chief

U.S. EPA Region IX
Mr. Bob Pallarino

U.S. EPA Region IX
Mr. Matthew Plate

U.S. EPA Region IX
Ms. Catherine Brown

U.S. EPA Region IX
Mr. Manny Aquitania

U.S. EPA Region IX
Mr. Vance Fong

4.0 Project/Task Organization

4.1 Roles and Responsibilities

Federal, State, and local agencies all have important roles in developing and implementing satisfactory air monitoring programs. As part of the planning effort, U.S. EPA is responsible for developing National Ambient Air Quality Standards (NAAQS), defining the quality of the data necessary to make comparisons to the NAAQS, and identifying a minimum set of QC samples from which to judge data quality. The State and local organizations are responsible for taking this information and developing and implementing a system that will meet the data quality requirements. Then, it is the responsibility of both U.S. EPA and the State and local organizations to assess the quality of the data and take corrective action when appropriate. The responsibilities of each organization follow.

4.1.1 Office of Air Quality Planning and Standards (OAQPS)

OAQPS is the organization charged under the authority of the Clean Air Act (CAA) to protect and enhance the quality of the nation's air resources. OAQPS sets standards for pollutants considered harmful to public health or welfare and, in cooperation with U.S. EPA's Regional Offices and the states, enforces compliance with the standards through state implementation plans (SIPs) and regulations controlling emissions from stationary sources. The OAQPS evaluates the need to regulate potential air pollutants and develops national standards; works with State and local agencies to develop plans for meeting these standards; monitors national air quality trends and maintains a database of information on air pollution and controls; provides technical guidance and training on air pollution control strategies; and monitors compliance with air pollution standards.

Within the OAQPS Emissions Monitoring and Analysis Division, the Monitoring and Quality Assurance Group (MQAG) is responsible for the oversight of the Ambient Air Quality Monitoring Network. MQAG has the following responsibilities:

- ensures that the methods and procedures used in making air pollution measurements are adequate to meet the programs objectives and that the resulting data are of satisfactory quality
- operates the National Performance Audit Program (NPAP) and the FRM Performance Evaluation
- evaluates the performance, through technical systems audits and management systems reviews, of organizations making air pollution measurements of importance to the regulatory process
- implements satisfactory quality assurance programs over U.S. EPA's Ambient Air Quality Monitoring Network
- ensures that national regional laboratories are available to support chemical speciation and QA programs

- ensures that guidance pertaining to the quality assurance aspects of the Ambient Air Program are written and revised as necessary
- renders technical assistance to the U.S. EPA Regional Offices and air pollution monitoring community

4.1.2 U.S. EPA Region IX Office

U.S. EPA Regional Offices have been developed to address environmental issues related to the states within their jurisdiction and to administer and oversee regulatory and congressionally mandated programs. The major quality assurance responsibilities of U.S. EPA's Region IX Office, in regards to the Ambient Air Quality Program, are the coordination of quality assurance matters at the Regional levels with the State and local agencies. This is accomplished by the designation of U.S. EPA Regional Project Officers who are responsible for the technical aspects of the program including:

- review QAPPs by Regional QA Officers who are delegated the authority by the Regional Administrator to review and approve QAPPs for the Agency
- support the FRM Performance Evaluation Program
- evaluate quality system performance, through technical systems audits and network reviews whose frequency is addressed in the Code of Federal Regulations and Section 20
- act as liaisons by making available the technical and quality assurance information developed by U.S. EPA Headquarters and the Region to the State and local agencies, and make U.S. EPA Headquarters aware of the unmet quality assurance needs of the State and local agencies

California ARB will direct technical and QA questions to Region IX.

4.1.3 California ARB

The ARB's mission is to promote and protect public health, welfare, and ecological resources through the effective and efficient reduction of air pollutants while recognizing and considering the effects on the economy of the State. By legislative mandate, the ARB has oversight of California's air pollution control program with the responsibility for improving and maintaining the air quality in the State.

40 CFR Part 58 defines a State Agency as "the air pollution control agency primarily responsible for the development and implementation of a plan (SIP) under the Act (CAA)". Section 302 of the CAA provides a more detailed description of the air pollution control agency.

40 CFR Part 58 defines the Local Agency as "any local government agency, other than the state agency, which is charged with the responsibility for carrying out a portion of the plan (SIP)".

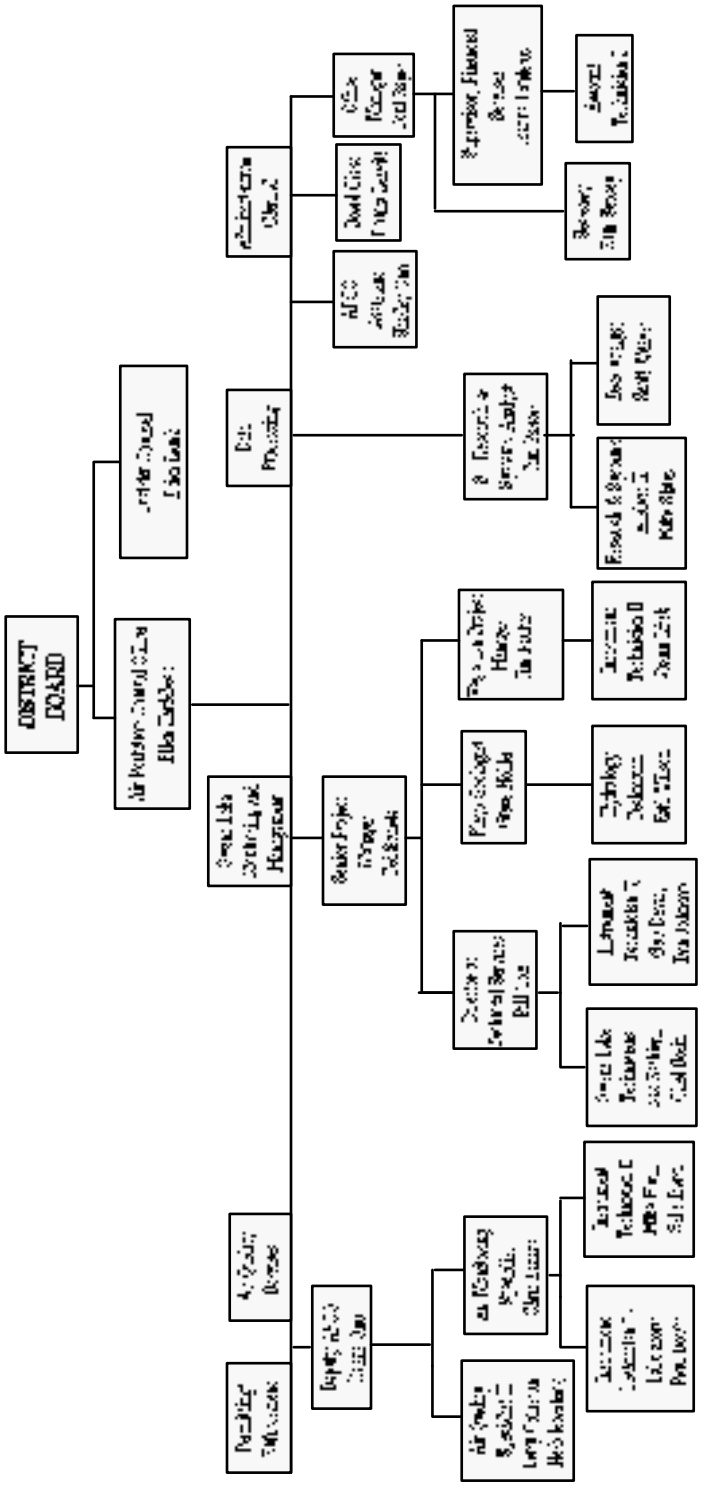
The major responsibility of State and local agencies is the implementation of a satisfactory monitoring program, which would naturally include the implementation of an appropriate quality assurance program. The Great Basin Unified Air Pollution Control District is the responsible local agency for Inyo, Mono, and Alpine Counties including four (4) nonattainment areas for PM-10: the Owens Valley, the Town of Mammoth Lakes, the Mono Basin, and the Inyo County portion of the Searles Valley.

4.1.4 Great Basin Unified APCD

The Great Basin Unified Air Pollution Control District (GBUAPCD) is charged with the protection of the public health and welfare from the adverse affects of air pollution. To this end, it is the GBUAPCD's responsibility to develop long-range comprehensive programs to achieve and maintain federal and state air quality standards. The GBUAPCD is responsible for the implementation of the air quality monitoring program and the enforcement of federal, state, and local rules and regulations governing air quality at the local level.

The GBUAPCD is required to implement a comprehensive quality assurance program covering all aspects of the air monitoring program. The GBUAPCD's air quality monitoring responsibilities include: operation, maintenance, and calibration of field monitors; operation, maintenance, and calibration of laboratory equipment used for filter processing; internal quality assurance audits of monitoring equipment; reporting of the collected data.

The GBUAPCD is loosely divided into six groups: permitting and enforcement, contract management, technical services, vegetation sciences, data processing, and administration. The organizational structure of the GBUAPCD is shown in Figure 4.1.



The Technical Services Group consists of two sections: the air quality monitoring section and the soils and hydrological sciences section. The air quality monitoring section (AQMS) handles all of the air quality and meteorological monitoring throughout the GBUAPCD that includes: particulate matter (PM) monitoring, both filter-based and continuous, pollutant gas continuous monitoring and meteorological monitoring. The AQMS also operates and maintains the GBUAPCD's ARB-certified PM-2.5 laboratory, in which all of the PM filters collected throughout the GBUAPCD are processed.

The AQMS conducts internal quality assurance (QA) audits of the monitors throughout the network. The AQMS has one dedicated staff person who is responsible for auditing the GBUAPCD's PM monitors quarterly and the meteorological sensors semiannually. The auditor produces reports after each audit that are submitted to the air monitoring specialist and the instrument technician responsible for site operations at the station audited. The AQMS also participates in the EPA National Performance Audit Program (NPAP) for PM-10 monitors. The ARB conducts annual audits of the monitors throughout the network and of the GBUAPCD's laboratory.

The Data Processing Group is also involved in the processing and validation of all of the air quality data collected throughout the GBUAPCD, including PM data, continuous monitor data, and meteorological data. They are responsible for uploading validated data to the EPA's Aerometric Information and Retrieval System (AIRS), and for archiving the data at the GBUAPCD offices.

4.1.4.1 Personnel

The people involved in the GBUAPCD's PM-2.5 monitoring program and their responsibilities relating to that program are described in detail below.

Air Pollution Control Officer - Dr. Ellen Hardebeck

Dr. Hardebeck serves the Great Basin Unified Air Pollution Control District Board of Directors as the chief administrator of the GBUAPCD, overseeing all GBUAPCD activities.

Deputy Air Pollution Control Officer - Duane Ono

The Deputy Air Pollution Control Officer oversees the QA and Lab personnel responsible for air quality monitoring, quality control, and quality assurance for the GBUAPCD, including: installation, operation, maintenance, calibration, internal quality assurance auditing of all GBUAPCD monitoring and laboratory equipment. The Deputy APCO is also involved in monitoring experiment design at Owens Lake and Mono Lake.

Air Monitoring Specialist - Christopher Lanane

The Air Monitoring Specialist supervises the day-to-day operation of the monitoring network. The Air Monitoring Specialist's responsibilities include overseeing all activities relating to:

- supervision of instrument technicians
- monitoring station siting, permitting, and installation
- monitoring station design and construction
- field sampler installation, operation, maintenance, and calibration
- state-of-the-art laboratory design and construction
- laboratory sample handling and analysis
- field data collection and validation
- internal quality assurance activities
- acting as liaison between GBUAPCD and other regulatory agencies on air quality monitoring issues

Instrument Technician II - Field Operations - Dan Johnson, Gabe Ibarra, Guy Davis

Each Instrument Technician II/Field Operations is involved in the ongoing monitoring activities conducted by the GBUAPCD and is responsible for carrying out the following activities:

- operates, calibrates, installs, maintains and repairs air monitoring, meteorological, data acquisition, and particulate sampling, instrumentation
- transports PM filters from laboratory to monitoring stations and back again
- retrieves, and edits (Level I Data Validation) air quality data collected from the operation of the air monitoring equipment
- troubleshoots, repairs, retrofits, modifies and acceptance tests ambient air monitoring, meteorological, data acquisition, particulate sampling, automatic calibration and test instrumentation
- responsible for adhering to the guidelines specified in the Manufacturer's Operation Manual and the Standard Operating Procedure(s) (SOP) for the monitoring equipment

Instrument Technician II - Quality Assurance - Mike Horn

The Instrument Technician II/Quality Assurance is responsible for conducting system and performance audits for the air quality monitoring program by adhering to U.S. EPA regulations and guidelines and SOPs. Responsibilities include:

- conducting quality assurance performance and system audits for the criteria pollutant program and preparing and issuing appropriate reports and findings
- developing quality assurance SOPs and methodologies
- verifying that all required QA activities were performed as required in the QAPP
- analyzing and evaluating ambient air quality data and making recommendations regarding its quality, accuracy, and validity (Level II Data Validation).

Instrument Technician I - Laboratory - Paul Doubt

The Instrument Technician I/Laboratory is responsible for carrying out required tasks and ensuring the data quality result of the tasks by adhering to guidance and protocol specified by the appropriate guidelines, e.g. PM2.5 QAPP and SOPs, for the lab activities. Those responsibilities include:

- weighing PM filters before and after sampling
- processing filter mass data
- maintaining the laboratory atmospheric conditioning system
- receiving PM filters in the laboratory from the field
- participating in the development and implementation of the QAPP
- participating in the development of data quality requirements (overall and laboratory) with the appropriate QA staff
- writing and modifying SOPs
- verifying that all required QA activities are performed and that measurement quality standards are met as required in the QAPP
- following all manufacturer's specifications
- performing and documenting preventative maintenance of all laboratory equipment
- documenting deviations from established procedures and methods
- report all problems and corrective actions to management
- assessing and reporting data quality
- preparing and delivering reports to management
- flagging suspect data

Data Processing - Senior Research & Systems Analyst - Jim Parker
Research & Systems Analyst II - Mike Slates
Contract Data Analyst - Scott Weaver

The Senior Research & Systems Analyst oversees all of the data processing activities of the GBUAPCD. The data processing personnel are responsible for coordinating the information management activities of the GBUAPCD's air quality monitoring program, which includes the PM2.5 Ambient Air Monitoring Program. Specific responsibilities include:

- ensuring that data and information collected for the monitoring program are properly captured, stored, and transmitted for use by program participants
- developing local data management standard operating procedures
- ensuring that information management activities are developed within reasonable time frames for review and approval
- following good automated data processes
- coordinating the development of the information management system with data users
- ensuring the development of data standards for data structure, entry , transfer, and archive
- ensuring adherence to the QAPP where applicable

- ensuring access to data for timely reporting and interpretation processes
- ensuring timely delivery of all required data to the U.S. EPA's AIRS system

5.0 Problem Definition/Background

5.1 Problem Statement and Background

Between the years 1900 and 1970, the emission of six principal ambient air pollutants increased significantly. The principal pollutants, also called criteria pollutants, are: particulate matter (PM10, PM2.5), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. In 1969, the first State Ambient Air Quality Standards are promulgated by California for total suspended particulates, photochemical oxidents, sulfur dioxide, nitrogen dioxide, and carbon monoxide. In 1970, the Federal Clean Air Act (CAA) was signed into law. The CAA and its amendments provides the framework for all pertinent organizations to protect air quality. This framework provides for the monitoring of these criteria pollutants by State and local organizations through the Air Quality Monitoring Program.

The criteria pollutant defined as particulate matter is a general term used to describe a broad class of substances that exist as liquid or solid particles over a wide range of sizes. As part of the Ambient Air Quality Monitoring Program, U.S. EPA measures two particle size fractions; those less than or equal to 10 micrometers (PM10), and those less than or equal to 2.5 micrometers (PM2.5). This QAPP focuses on the QA activities associated with PM2.5.

The background and rationale for the implementation of the PM2.5 ambient air monitoring network can be found in the Federal Register. In general, some of the findings are listed below.

The characteristics, sources, and potential health effects of larger or "coarse" particles (from 2.5 to 10 micrometers (mm) in diameter) and smaller or “fine" particles (smaller than 2.5 mm in diameter) are very different.

- Coarse particles come from sources such as windblown dust from the desert or agricultural fields and dust kicked up on unpaved roads from vehicle traffic.

- Fine particles are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds that are emitted from combustion activities and then become particles as a result of chemical transformations in the air.

- Coarse particles can deposit in the respiratory system and contribute to health effects such as aggravation of asthma. U.S. EPA's "staff paper" concludes that fine particles, which also deposit deeply in the lungs, are more likely than coarse particles to contribute to the health effects (e.g., premature mortality and hospital admissions) found in a number of recently published community epidemiological studies. Although some studies find that adverse health effects are more strongly associated with high PM10 levels and the coarse fraction.

- These recent community studies find that adverse public health effects are associated with exposure to particles at levels well below the current PM standards for both short-term (e.g., less than 1 day to up to 5 days) and long-term (generally a year to several years) periods.

- These health effects include premature death and increased hospital admissions and emergency room visits (primarily among the elderly and individuals with cardiopulmonary disease); increased respiratory symptoms and disease (among children and individuals with cardiopulmonary disease such as asthma); decreased lung function (particularly in children and individuals with asthma); and alterations in lung tissue and structure and in respiratory tract defense mechanisms.

Air quality samples are generally collected for one or more of the following purposes:

To judge compliance with and/or progress made towards meeting the National Ambient Air Quality Standards and the California Ambient Air Quality Standards,
To develop, modify or activate control strategies that prevent or alleviate air pollution episodes,
To observe pollution trends throughout the region, including non-urban areas,
To provide a data base for research and evaluation of effects.
5. To call health advisories and to initiate supplemental control requirements such as “no-burn days.”

With the end use of the air quality samples as a prime consideration, various networks can be designed to meet one of six basic monitoring objectives listed below:

- Determine the highest concentrations to occur in the area covered by the network
- Determine representative concentrations in areas of high population density
- Determine the impact on ambient pollution levels of significant source or source categories
- Determine general background concentration levels
- Determine the extent of Regional pollutant transport among populated areas, and in support of secondary standards
- Determine the welfare-related impacts

The monitoring network consists of four major categories of monitoring stations that measure the criteria pollutants, including PM2.5. These stations are described below.

The **SLAMS** consist of a network of ~ 3,500 monitoring stations whose size and distribution is largely determined by the needs of State and local air pollution control agencies to meet their respective SIP requirements. There will be 89 SLAMS PM2.5 sites in California.

The National Air Monitoring Stations (**NAMS)** (~1,080 stations) are a subset of the SLAMS network with emphasis being given to urban and multi-source areas. In effect, they are key sites under SLAMS, with emphasis on areas of maximum concentrations and high population density.

The Photochemical Assessment Monitoring Stations (**PAMS**) network is required to measure ozone precursors in each ozone non-attainment area that is designated serious, severe, or extreme. The required networks will have from two to five sites, depending on the population of the area. There is a phase-in period of one site per year starting in 1994. The ultimate PAMS network could exceed 90 sites at the end of the five-year phase-in period. It is anticipated that there will be PM2.5 monitors located at seven PAMS sites in California.

Special Purpose Monitoring Stations (SPMS) provide for special studies needed by the State and local agencies to support their SIPs and other air program activities. The SPMS are not permanently established and, thus, can be adjusted easily to accommodate changing needs and priorities. The SPMS are used to supplement the fixed monitoring network as circumstances require and resources permit. If the data from SPMS are used for SIP purposes, they must meet all QA and methodology requirements for SLAMS monitoring. SPMS have not yet been identified in California, though it is anticipated that there will be 37 speciation samplers operating in the statewide network.

This QAPP focuses only on the QA activities of the SLAMS and NAMS network and the objectives of this network which include any sampler used for comparison to the National Ambient Air Quality Standards (NAAQS).

Throughout this document, the term *decision maker* will be used. This term represents individuals that are the ultimate users of ambient air data and therefore may be responsible for activities such as setting and making comparisons to the NAAQS, and evaluating trends. Since there is more than one objective for this data, and more than one decision maker, the quality of the data (see Element 7) will be based on the highest priority objective, which was identified as the determination of violations of the NAAQS. This QAPP will describe how the GBUAPCD PM2.5 Ambient Air Quality Monitoring Program intends to control and evaluate data quality to meet the NAAQS data quality objective.

6.0 Project/Task Description

6.1 Description of Work to be Performed

In general, the measurement goal of the PM2.5 Ambient Air Quality Monitoring Program is to estimate the concentration, in units of micrograms per cubic meter ($\mu g/m^3$), of particulates less than or equal to 2.5 micrometers (μm) that have been collected on a 46.2mm polytetrafluoroethylene (PTFE) filter. For the SLAMS/NAMS network, which is what this QAPP describes, the primary goal is to compare the PM2.5 concentrations to the annual and 24-hour National Ambient Air Quality Standard (NAAQS). The national primary and secondary ambient air quality standards for PM2.5 are 15.0 micrograms per cubic meter ($\mu g/m^3$) annual arithmetic mean concentration and 65 $\mu g/m^3$ 24-hour average concentration measured in ambient air. A description of the NAAQS and its calculation can be found in the 1997 Federal Register[1] Notice. In addition, Appendix L of part 50 also provides the following summary of the measurement principle:

> " An electrically powered air sampler draws ambient air at a constant volumetric flow rate into a specially shaped inlet and through an inertial particle size separator (impactor) where the suspended particulate matter in the PM2.5 size range is separated for collection on a polytetrafluoroethylene (PTFE) filter over the specified sampling period. The air sampler and other aspects of this reference method are specified either explicitly in this appendix or generally with reference to other applicable regulations or quality assurance guidance.
>
> Each filter is weighed (after moisture and temperature equilibration) before and after sample collection to determine the net weight (mass) gain due to collected PM2.5. The total volume of air sampled is determined by the sampler from the measured flow rate at actual ambient temperature and pressure and the sampling time. The mass concentration of PM2.5 in the ambient air is computed as the total mass of collected particles in the PM2.5 size range divided by the actual volume of air sampled, and is expressed in micrograms per actual cubic meter of air ($\mu g/m^3$)."

The following sections will describe the measurements required for the routine field and laboratory activities for the network. In addition to these measurements, an initial set of measurements will be required to fulfill the requirements of the AIRS data base.

6.2 Field Activities

The performance requirements of the air sampler has been specified in Part 50, Appendix L of the 7/18/97 Federal Register Notice[1] . Table 6.0.1 summarizes some of the more critical performance requirements.

Table 6.0.1 Design/Performance Specifications

Equipment	Acceptance Criteria	Reference

Filter Design Specs.	see reference	40 CFR Pt. 50, App.L Sec 6.0
Size	46.2 mm dia ± 0.25mm	" Sec 6.1
Medium	Polytetrafluoroethylene	" Sec 6.2
Support ring	Polymethylpentene	" Sec 6.3
	0.38mm thick	"
	46.2 mm ± 0.25mm outer dia.	"
	3.68 (±0.00, -0.51mm) width	"
Pore size	2 µm	"Sec 6.4
Filter thickness	30-50 µm	"Sec 6.5
Max. pressure drop	30 cm H_2O @ 16.67L/min	"Sec 6.6
Max. Moisture pickup	10 µg increase in 24 hr.	"Sec 6.7
Collection efficiency	99.7%	"Sec 6.8
Filter weight stability	<20 µg	"Sec 6.9.1 and 6.9.2
Alkalinity	< 25.0 microequivalents/gram	"Sec 6.10
Sampler Performance Specs.		
Sample Flow Rate	1.000 m^3/hr.	40 CFR Pt. 50, App.L Sec7.4
Flow Regulation	1.000 ± 5% m^3/hr.	"
Flow Rate Precision	2% CV	
Flow Rate Accuracy	±2%	"
External Leakage	<80mL/min	"
Internal Leakage	<80mL/min	"
Ambient Temp Sensor	-30^o -+ 45^o C	Vol-II -MS. 2.12
	0.1^o C res. ±2.0^oC accuracy	40 CFR Pt. 50, App.L Sec7.4
Filter Temp Sensor	-30^o - +45^o C	"
	0.1^o C res. ±1.0^oC accuracy	"
Barometric Pressure	600-800 mm Hg	
	5 mm res. ±10mm accuracy	"
Clock/Timer	Date/time.	
	1 sec. res. ± 1 min/month accuracy	

The air samplers will be purchased, distributed, and certified by the U.S. EPA as meeting the requirements specified in the Federal Register. Therefore, the ARB assumes the sampling instruments to be adequate for the sampling for PM2.5. Other than the required federal reference or equivalent air sampler, there are no special personnel or equipment requirements. Element 15 of the QAPP lists all the equipment requirements for the GBUAPCD PM2.5 data collection operations.

6.2.1 Field Measurements

Table 6.0.2 represents the field measurements that must be collected. This table is presented in the Federal Register[1] as Table L-1 of Appendix L. These measurements are made by the air sampler and are stored in the instrument for downloading by the field operator during routine visits.

Table 6.0.2 Field Measurement Requirements

Information to be provided	Appendix L section reference	Availability				Format	
		Anytime [a]	End of period[b]	Visual display [c]	Data output[d]	Digital reading[e]	Units
Flow rate, 30-second maximum interval	7.4.5.1	_	—	_	*	XX.X	L/min
Flow rate, average for the sample period	7.4.5.2	*	_	*	_	XX.X	L/min
Flow rate, CV, for the sample period	7.4.5.2	*	_	*	_ •	XX.X	%
Flow rate, 5-min average out of spec. (FLAG)[f]	7.4.5.2	_	_	_	_ •	On/Off	
Sample volume, total	7.4.5.2	*	_	_	_ •	XX.X	m^3
Temperature, ambient, 30-second interval	7.4.8	_	—	_	—	XX.X	°C
Temperature, ambient, min., max., average for the sample period	7.4.8	*	_	_	_ •	XX.X	°C
Barometric pressure, ambient, 30-second interval	7.4.9	_	—	_	—	XXX	mm Hg
Barometric pressure, ambient, min., max., average for the sample period	7.4.9	*	_	_	_ •	XXX	mm Hg
Filter temperature, 30-second interval	7.4.11	_	—	_	—	XX.X	°C
Filter temperature, differential, 30-minute interval, out of spec. (FLAG)[f]	7.4.11	*	_	_	_ •	On/Off	
Filter temperature, maximum differential from ambient, date, time of occurrence	7.4.11	*	*	*	*	X.X, YY/MM/DD HH:mm	°C, Yr/Mo/ Day Hr min
Date and time	7.4.12	_	—	_	—	YY/MM/DD HH:mm	Yr/Mo/ Day Hr min
Sample start and stop time settings	7.4.12	_	_	_	_	YY/MM/DD HH:mm	Yr/Mo/ Day Hr min
Sample period start time	7.4.12	—	_	_	_ •	YYYY/MM/DD HH:mm	Yr/Mo/ Day Hr min
Elapsed sample time	7.4.13	*	_	_	_ •	HH:mm	Hr min
Elapsed sample time out of spec. (FLAG)[f]	7.4.13	—	_	_	_ •	On/Off	
Power interruptions >1 min, start time of first 10	7.4.15.5	*	_	*	_	1HH:mm, 2HH:mm, etc.	Hr min
User-entered information, such as sampler and site identification	7.4.16	_	_	_	_ •	As entered	

- Provision of this information is required.

* Provision of this information is optional. If information related to the entire sample period is optionally provided prior to the end of the sample period, the value provided should be the value calculated for the portion of the sampler period completed up to the time the information is provided.

• Indicates that this information is also required to be provided to the AIRS data bank.

a Information is required to be available to the operator at any time the sampler is operating, whether sampling or not.

b Information relates to the entire sampler period and must be provided following the end of the sample period until reset manually by the operator or automatically by the sampler upon the start of a new sample period.

c Information shall be available to the operator visually.

d Information is to be available as digital data at the sampler's data output port following the end of the sample period until reset manually by the operator or automatically by the sampler upon the start of a new sample period.

e Digital readings, both visual and data output, shall have no less than the number of significant digits and resolution specified.

f Flag warnings may be displayed to the operator by a single-flag indicator or each flag may be displayed individually. Only a set (on) flag warning must be indicated; an off (unset) flag may be indicated by the absence of a flag warning. Sampler users should refer to Section 10.12 of Appendix L regarding the validity of samples for which the sampler provided an associated flag warning.

In addition to the measurements collected in Table 6.0.2, the following information identified in Table 6.0.3 will be recorded. These parameters are explained in *Guidance Document 2.12*[2]

Table 6.0.3 Additional Field Measurements

Parameter	Parameter Code	Frequency	Units	Comment
Monitor ID	MONID	Every sample event	see AIRS	Unique AIRS Monitor ID that include the combination of STATE, COUNTY, SITE, PARAMETER, and POC fields
Site Name	SITENAM	Every sample event	AAA...	Unique site name associated with the site
Sampler ID	SAMPID	Every sample event	AAXXX	Sampler model number or unique bar code number associated with the model number
QC Thermometer ID Initial	QCTIDI	Every sample event	AAAXXX	Unique ID number of QC thermometer used for ambient air temp check at the beginning of sampling
QC Temperature Measurement Initial	QCTEMPI	Every sample event	XX^{o}C	QC temp reading at the beginning of sampling
QC Baromter ID Initial	QCBIDI	Every sample event	AAAXXX	Unique alpha-numeric ID of QC barometric pressure device used for barometric pressure reading check

QC Bar. Pressure Reading Initial	QCBI	Every sample event	XXX mm Hg	QC temp reading at the beginning of sampling
QC Thermometer ID Final	QCTIDF	Every sample event	AAAXXX	Unique ID number of QC thermometer used for ambient air temp check at the beginning of sampling
QC Temperature Measurement Final	QCTEMPF	Every sample event	XX^{o}C	QC temp reading at the end of sampling
QC Baromter ID Final	QCBIDF	Every sample event	AAAXXX	Unique alpha-numeric ID of QC barometric pressure device used for barometric pressure reading check
QC Bar. Pressure Reading Final	QCBF	Every sample event	XXX mm Hg	QC temp reading at the end of sampling
Filter ID	FID	Every sample event	AAYYXXXX	Unique filter ID of filter given by the weighing laboratory.
Filter Integrity flag	FFIF	Every sample event		VFI- Void Filter Integrity GFI-Good Filter Integrity
Site Operator Initial	SOI	Every sample event	AAA	Initials of the site operator setting up the sampling run
Site Operator Final	SOF	Every sample event	AAA	Initials of the site operator completing the sampling run
Free Form Notes	FFM	As needed	AAA....	Free form notes about the sampling run

Note: "AAA" denotes an alphabetic character and "XXX" denotes a numeric character.

6.3 Laboratory Activities

Laboratory activities for the PM2.5 program include preparing the filters for the routine field operator, which includes three general phases:

Pre-Sampling weighing

- Receiving filters from the U.S. EPA
- Checking filter integrity
- Conditioning filters
- Weighing filters
- Storing prior to field use
- Packaging filters for field use
- Associated QA/QC activities
- Maintaining microbalance at specified environmental conditions
- Equipment maintenance and calibrations

Shipping/Receiving

- Receiving filters from the field and logging these in
- Storing filters
- Associated QA/QC activities (see Element 12)

Post-Sampling Weighing

- Checking filter integrity
- Stabilizing/weighing filters
- Data downloads from field data loggers
- Data entry/upload to AIRS
- Storing filters/archiving

- Associated QA/QC activities

The details for these activities are included in various Elements of this document as well as *Guidance Document 2.12*[2]. Table 6.0.4 provides the performance specifications of the laboratory environment and equipment.

Table 6.0.4 Laboratory Performance Specifications

Equipment	Acceptance Criteria
Microbalance	Resolution of 1 µg, repeatability of 1 µg
Microbalance environment	Climate-controlled, draft-free room or chamber or equivalent, stable work surface. Mean relative humidity between 30 and 40 percent, with a variability of not more than ±5 percent standard deviation over 24 hours. Mean temperature should be held between 20 and 23 °C, with a variability of not more than ±2 %C standard deviation over 24 hours.
Mass reference standards	Standards up to 200 mg*, individual standard's tolerance less than 25 µg, handle with smooth, nonmetallic forceps

* For the following three reasons, the multipoint calibration for this method will be zero, 100 and 200 mg: 1) the required sample collection filters weigh between 100 and 200 mg; 2) the anticipated range of sample loadings for the 24-hour sample period is rarely going to be more than a few 100 µg; and 3) the lowest, commercially available check weights that are certified according to nationally accepted standards are in the single milligram range. Since the critical weight is not the absolute unloaded or loaded filter weight, but the difference between the two, microgram standard check weights are not necessary to ensure data quality, as long as proper weighing procedure precautions are taken for controlling contamination or other sources of mass variation in the procedure (see SOP in Appendix B).

6.3.1 Laboratory Measurements

With the exception of the shipping/receiving, which is discussed in detail in Element 12, Table 6.0.5 lists the parameters that will be required to be recorded for pre and postsampling weighing laboratory activities.

Table 6.0.5 Laboratory Measurements

Parameter	Frequency	Units	Comments
Filter Conditioning[1]			
Start Date	every filter	YY/MM/DD	Date of start of conditioning period
Start Time	every filter	XX.XX	Start hour and minute of conditioning
Filter Number	every filter	RFYYXXXX LBYYXXXX FBYYXXXX	Unique filter ID of routine filter (RF) Lab Blanks (LB) Field Blanks (FB)
Relative Humidity	continuous	XX%	% relative humidity value for conditioning session based upon readings of continuous data collected by datalogger
Temperature	continuous	XX^{o}C	temperature value for conditioning session based upon readings of continuous data collected by datalogger
End Date	every filter	YY/MM/DD	Date of end of conditioning period
End Time	every filter	XX.XX	End hour and minute of conditioning
Presampling Filter Weighing			
Date	every filter	YY/MM/DD	Date for presampling run of filters that can then be associated with each filter
Filter Lot Number	every filter	AAAXXX	Lot number associated with filter
Balance Number	every filter	AAAXXX	Unique balance ID for balance used in pre-weighing
Analyst	every filter	AAA	Initials of the technician preweighing filters
Relative Humidity	continuous	XX%	%relative humidity value for weighing session based upon readings of continuous data collected by datalogger
Temperature	continuous	XX^{o}C	temperature value for weighing session based upon readings of continuous data collected by datalogger

Filter Number	every filter	RFYYXXXX LBYYXXXX FBYYXXXX FCYYXXXX DFYYXXXX	Unique filter ID of routine filter (RF) Lab Blanks (LB) Field Blanks (FB) Flow Check Filter (FC) and Duplicate Filter (DF)
QC Sample Number	every QC check	C1XXX C2XXX C3XXX	Unique ID for calibration checks and or other types of QC samples used
Presampling Mass	every filter	XXX.XXX mg	Mass weight in mg of the filter
Monitor ID[2]	Every sample	see AIRS	Unique AIRS Monitor ID that include the combination of STATE, COUNTY, SITE, PARAMETER, and POC fields
Free Form Notes	As needed	AAA...	Preweighing Free Form notes
Postsampling Filter Weighing Date	every filter	YY/MM/DD	Date for postsampling run of filters that can then be associated with each filter
Balance Number	every filter	AAAXXX	Unique balance ID for balance used in postweighing
Analyst	every filter	AAA	Initials of the technician postweighing filters
Relative Humidity	continuous	XX%	% relative humidity value for weighing period based upon readings of continuous data collected by datalogger
Temperature	continuous	XX^{o}C	temperature value for weighing period based upon readings of continuous data collected by datalogger
Filter Number	every filter	RFYYXXXX LBYYXXXX FBYYXXXX DFYYXXXX	Unique filter ID of routine filter (RF) Lab Blanks (LB) Field Blanks (FB) and Duplicate Filter (DF)
QC Sample Number	every QC check	C1XXX C2XXX C3XXX	Unique ID for calibration checks and or other types of QC samples used
Postsampling Mass	every filter	XXX.XXX mg	Mass weight in mg of the filter
Net Mass	every filter	XXX.XXX mg	Net weight (Postsampling Mass - PreSampling Mass) - in mg of PM2.5
Free Form Notes	as needed	AAA...	Postweighing free form notes

Note: For units, "AAA", denotes an alphabetic character and "XXX" denotes a numeric character.

Environmental conditions (relative humidity and temperature) in the laboratory will be continuously recorded. Pre- and postweighing of filters will only occur after compliance with specified environmental limits during filter conditioning and weighing periods is verified.

2- The Monitor ID may be assigned at sampling rather than pre-assigned during presampling weighing.

6.4 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer

review, inspection, or surveillance. Definitions for each of these activities can be found in the glossary (Appendix A). Element 20 will discuss the details of the GBUAPCD's assessments.

Table 6.0.6 provides information on the parties implementing the assessment and their frequency.

Table 6.0.6 Assessment Schedule

Assessment Type	Assessment Agency	Frequency
System Audit	U.S. EPA Regional Office ARB's QA Section	1 every 3 years 1st year*
Network Review	U.S. EPA Regional Office, and Planning and Technical Support Division	every year 1/year
FRM Performance Evaluation	U.S. EPA Regional Office	25% of sites/year/4 times per year.
Data Quality Assessment	ARB'S QA Section, and Planning and Technical Support Division	every year

NOTE: ARB'S QUALITY ASSURANCE SECTION (QAS) WILL PRECERTIFY ALL PM2.5 LABORATORIES WHICH IS A CONDITION FOR SUBMITTAL OF PM2.5 DATA TO THE U.S. EPA'S AIRS. THE QAS WILL CONDUCT SYSTEM AUDITS OF LABORATORIES DURING THEIR FIRST YEAR OF OPERATION FOLLOWING PRECERTIFICATION. ADDITIONALLY, THEY WILL CONDUCT ANNUAL PM2.5 LABORATORY PERFORMANCE AUDITS OF THE MICROBALANCES AND RELATIVE HUMIDITY AND TEMPERATURE SENSORS AND WILL REVIEW THE LABORATORIES' QUARTERLY QC REPORTS. IF PROBLEMS ARE IDENTIFIED DURING THE LABORATORY PERFORMANCE AUDITS AND WITH THE QC REPORTS, ADDITIONAL SYSTEM AUDITS WILL BE SCHEDULED.

6.5 Schedule of Activities

Table 6.0.7 contains a list of the critical activities required to plan, implement, and assess the PM2.5 program.

Table 6.0.7 Schedule of Critical PM2.5 Activities

Activity	Due Date	Comments
Network development	January 15, 1998	Preliminary list of sites and samplers required
Sampler order	March 2, 1998	Samplers ordered from National contract
Laboratory design	February 1, 1998	Listing of laboratory requirements
Laboratory procurement	April 1, 1998	Ordering/purchase of all laboratory and miscellaneous field equipment
Personnel Requirements	April 1, 1998	Advertising for field and laboratory personnel (if required)
QAPP development	May-Sept., 1998	Development of the QAPP
Network design completion	July 1, 1998	Final network design
Samplers begin to arrive	July 1, 1998	Delivery of FRM samplers begins
Sampler siting/testing	July-December, 1998	Establishment of sites and preliminary testing of samplers
Field/Laboratory Training	August, 1998	Field and laboratory training activities and certification.
Draft QAPP Submittal	September 1, 1998	Draft QAPP submittal to U.S. EPA Region IX

QAPP Submittal	November 12, 1998	QAPP submittal to U.S. EPA
QAPP Approval	November 30, 1998	Approval by U.S. EPA
Pilot testing	August-December 1998	Pilot activities to ensure efficiency of measurement system
Installation of 1998 sites	December 31, 1998	Sites must be established and ready to collect data
Routine Sampling	January 1, 1999	Routine activities must start

6.6 Project Records

The GBUAPCD will establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records. Table 6.0.8 represents the categories and types of records and documents which are applicable to document control for PM2.5 information. Information on key documents in each category are explained in more detail in Element 9.

Table 6.0.8 Critical Documents and Records

Categories	Record/Document Types
Management and Organization	State Implementation Plan Reporting agency information Organizational structure Personnel qualifications and training Training Certification Quality management plan Document control plan U.S. EPA Directives Grant allocations Support Contract
Site Information	Network description Site characterization file Site maps Site Pictures
Environmental Data Operations	QA Project Plans Standard operating procedures (SOPs) Field and laboratory notebooks Sample handling/custody records Inspection/maintenance records
Raw Data	Any original data (routine and QC data) including data entry forms
Data Reporting	Air quality index report Annual SLAMS air quality information Data/summary reports Journal articles/papers/presentations
Data Management	Data algorithms Data management plans/flowcharts PM2.5 Data Data Management Systems
Quality Assurance	Network reviews Control charts Data quality assessments QA reports System audits Response/Corrective action reports Site Audits

References

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760, July 18, 1997.

2. U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods, March 1998.

7.0 Quality Objectives and Criteria for Measurement Data

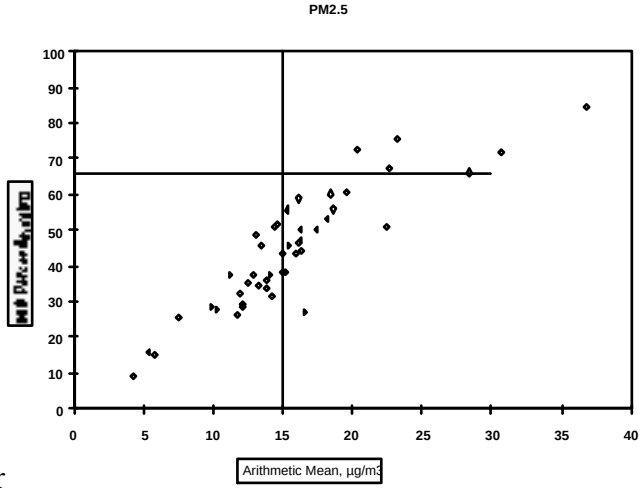
7.1 Data Quality Objectives (DQOs)

Data quality objectives (DQOs) are qualitative and quantitative statements derived from the DQO Process that clarify the monitoring objectives, define the appropriate type of data, and specify the tolerable levels of decision errors for the monitoring program[1]. By applying the DQO Process to the development of a quality system for PM2.5, the U.S. EPA guards against committing resources to data collection efforts that do not support a defensible decision. During the months from April to July of 1997, the DQO Process was implemented for the PM2.5. The DQOs were based on the data requirements of the decision maker(s). Regarding the quality of the PM2.5 measurement system, the objective is to control precision and bias in order to reduce the probability of decision errors. Assumptions necessary for the development of the DQO included:

1. *The DQO is based on the annual arithmetic mean National Ambient Air Quality Standards (NAAQS*).

The PM2.5 standards are a 15 $\mu g/m^3$ annual average and a 65 $\mu g/m^3$ 24-hour average. The annual standard is met when the 3-year average of annual arithmetic means is less than or equal to 15 $\mu g/m^3$. Due to rounding, the 3-year average does not meet the NAAQS if it equals or exceeds 15.05 prior to rounding. The 24-hour average standard is met when the 3-year average 98th percentile of daily PM2.5 concentrations is less than or equal to 65 $\mu g/m^3$.

AIRS PM2.5 data were reviewed for two purposes: (a) to determine the relative "importance" of the two standards; and (b) to suggest "reasonable" hypothetical cases for which decision makers would wish to declare attainment and nonattainment with high probability. Twenty-four locations were found to have at least one year of PM2.5 data in AIRS. Figure 7.0.1 displays the annual averages and 98th percentiles that are associated with lognormal distributions for the 47 data sets. Figure 7.0.1 does not display estimates derived according to the standard, as the data sets covered one rather than three years, but it does indicate the relative importance of the two standards. Points to the right of the vertical line may be viewed as exceeding the annual average standard. Points above the horizontal line may be viewed as exceeding the 24-hour average standard. All of those points are also to the right of the vertical line, indicating that the annual

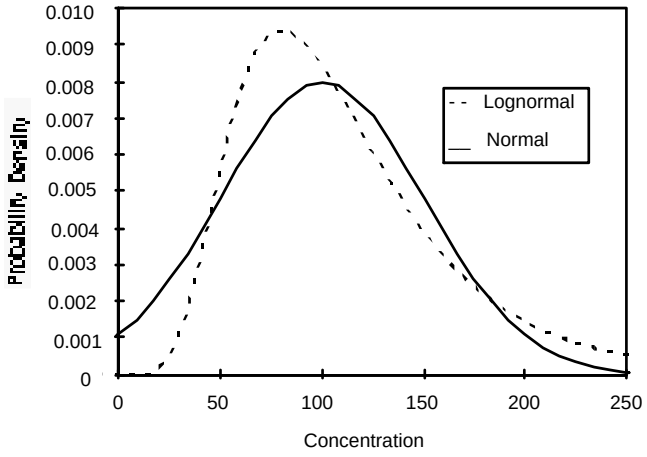


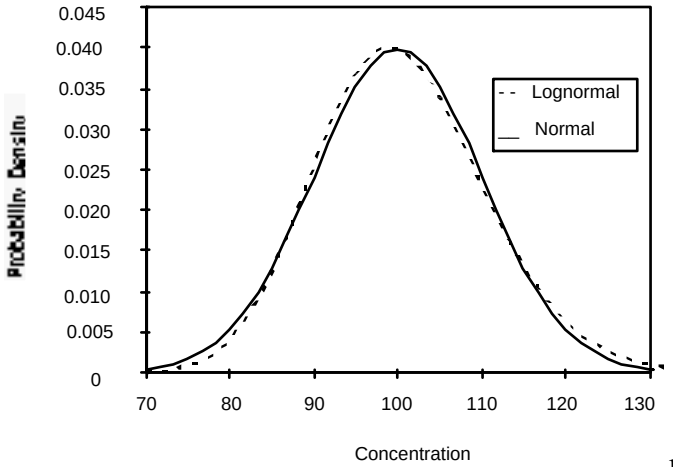
standard is the "controlling" standard for these locations. For this reason, the DQOs discussed in the remainder of this document focus on attainment with the annual average standard.

2. Normal distribution for measurement error.

Figure 7.0.2 Figure 7.0.3

Error in environmental measurements is often assumed to be normal or lognormal. Figures 7.0.2 and 7.0.3 attempt to illustrate what happens to the normal and lognormal distribution functions for the same median concentration at two values for measurement error (CV's of 10 and 50%). In the case of PM2.5, the measurement error is expected to be in the range of 5 to 10 % of the mean, as shown in Figure 7.0.2, where normal or lognormal errors produce close to identical





results. Therefore, due to these comparable results and its simplicity in modeling, the normal distribution of error was selected.

3. *Decision errors can occur when the estimated three-year average differs from the actual, or true, three-year average.*

Errors in the estimate are due to population uncertainty (sampling less frequently than every day) and measurement uncertainty (bias and imprecision). The false positive decision error occurs whenever the estimated three-year average exceeds the standard and the actual three-year average is less than the standard. The false negative decision error occurs whenever the estimated three-year average is less than the standard and the actual three-year average is greater than the standard.

4. *The limits on precision and bias are based on the smallest number of sample values in a three-year period.*

Since the requirements allow one-in-six day sampling and a 75% data completeness requirement, the minimum number of values in a three-year period is 137. It can be demonstrated that obtaining more data, either through more frequent sampling or the use of spatial averaging, will lower the risk of attainment/non-attainment decision errors at the same precision and bias acceptance levels.

5. *The decision error limits were set at 5%*.

For the two cases that follow, the decision maker will make the correct decision 95% of the time if precision and bias are maintained at the acceptable levels. For cases that are less "challenging"
(i.e., annual average values that are farther from the standard), the decision maker will make the correct decision more often. This limit was based on the minimum number of samples from assumption 4 above (137) and the present uncertainty in the measurement technology. However, if precision and bias prove to be lower than the DQO, the decision maker can expect to make the correct decision more than 95% of the time.

6. *Measurement imprecision was established at 10% coefficient of variation (CV).*

By reviewing available AIRS data and other PM2.5 comparison studies, it was determined that it was reasonable to allow measurement imprecision at 10% CV. While measurement imprecision has relatively little impact on the ability to avoid false positive and false negative decision errors, it is an important factor in estimating bias. CV's greater than 10% make it difficult to detect and correct bias problems. Two sine functions were developed (case 1 and 2) to represent distributions where decision makers began to be concerned about decision errors. Table 7.0.1 summarizes the case 1 and 2 distributions

Table 7.0.1. Summary of Case 1 and 2 parameters

	Model Equation	**Mean**	**Correct Decision**	**Incorrect Decision**	**Tolerable Error Rate**
Case 1	C_D=12.75+8.90 sin(2"D/365)+$_D$	12.75	Attainment	F(+) = nonattainment	5%
Case 2	C_D=18.4+12.85 sin(2"D/365)+$_D$	18.4	Nonattainment	F(-) = attainment	5%

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Case 1: With this model (case 1), the 3-year average is 12.75 µg/m^3. The correct decision is "attainment." A false positive error is made when the estimated average exceeds the standard. The probability of the false positive error for sampling every sixth day depends on the measurement system bias and precision, as shown in Table 7.0.2. As stated in assumption 6 above, the data in Table 7.0.2 show that precision alone has little impact on decision error, but is an important factor for bias, which is an important factor in decision error.

Since the decision error probability limits were set at 5% (assumption 5), acceptable precision (CV) and bias are combinations yielding decision errors around 5%.

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Case 2: With this model (case 2) , the 3-year average is 18.4 µg/m^3. The correct decision is "nonattainment." A false negative error is made when the estimated average is less than the standard. The probability of the false negative error for sampling every sixth day depends on the measurement system bias and precision, as shown in the Table 7.0.3. Similar to case 1, combinations of precision and bias that yield decision error probabilities around 5% were considered acceptable.

After reviewing cases 1 and 2, based upon the acceptable decision error of 5%, the DQO for acceptable precision (10% CV) and bias (± 10%) were identified. These precision and bias values will be used as a goal from which to evaluate and control measurement uncertainty.

7.2 Measurement Quality Objectives (MQOs)

Once a DQO is established, the quality of the data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. In order to meet DQOs, guidelines must be put in place to insure the accuracy and proper interpretation of the data collected. Measurement quality objectives (MQOs) are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. Information regarding these objectives and their use can be found in the U.S. EPA's Quality Assurance Handbook, Volume II[2]. MQOs can be defined in terms of the following data quality indicators:

Accuracy - Accuracy has been a term frequently used to represent closeness to "truth" and includes a combination of precision and bias error components. This term has been used throughout 40 CFR and in some of the Elements of this document. Based on ARB performance audits, PM2.5 flow data shall be within ±4% of the true value.

Precision - a measure of mutual agreement among individual measurements of the same property usually under prescribed similar conditions. This is the random component of error. Precision is estimated by various statistical techniques using some derivation of the standard deviation. For ambient particulate concentration measurements, precision shall be expressed in terms of a coefficient of variation.

Bias - the systematic or persistent distortion of a measurement process which causes error in one direction. Bias will be determined by estimating the positive and negative deviation from the true value as a percentage of the true value.

Representativeness - a measure of the degree which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Spatial and temporal data representativeness shall be achieved by assuring that criteria are met for station siting as defined in federal regulations, and that air quality measurements and statistics are compiled.

Detection Limit - a measure of the capability of an analytical method to distinguish low concentrations of a specific analyte.

Completeness - a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. Data completeness requirements are included in the reference methods (40 CFR 50). In addition, the ARB shall strive to obtain at least 85% data completeness, while maintaining the precision and accuracy objectives. Data completeness (DC) for a single pollutant at a single site (SS) is defined as:

$$\%DC = \frac{(\text{total number of}) \text{ (samples possible)} - (\text{Samples lost to}) \text{ (calibration)} - (\text{samples lost to}) \text{ (downtime)}}{} \times 100$$

total number of samples possible

Data completeness for the reporting organization (RO) for a single pollutant shall be defined as:

$$\%DC_{RO} = \frac{1}{n} \sum_{I=1}^{n} \%DC_{SS_I}$$

Where n = the number of stations reporting

Comparability - a measure of confidence with which one data set can be compared to another. Data comparability shall be achieved through the use of uniform procedures and U.S. EPA designated reference or equivalent methods statewide.

For each of these attributes, acceptance criteria can be developed. Various parts of 40 CFR have identified acceptance criteria for some of these attributes as well as *Guidance Document 2.12*[2]. In theory, if these MQOs are met, measurement uncertainty should be controlled to the levels required by the DQO. Tables 7.0.4, 7.0.5a, and 7.0.5b list the MQOs for PM2.5 program. More detailed descriptions of these MQO's and how they will be used to control and assess measurement uncertainty will be described in Elements 14 and 23, as well as SOPs (Appendix B and Appendix E) of this QAPP.

Note: Tables 7.4, 7.4a, and 7.4b are currently in works-in-progress and will be incorporated into the QAPP when they are developed and approved.

8.0 Special Training Requirements

Personnel assigned to the PM2.5 ambient air monitoring activities will meet the educational, work experience, responsibility, personal attributes, and training requirements for their positions. Records on personnel qualifications and training will be maintained in personnel files and will be accessible for review during audit activities. Adequate education and training are integral to any monitoring program that strives for reliable and comparable data. Training is aimed at increasing the effectiveness of employees and the GBUAPCD.

8.1 Ambient Air Monitoring Training

Appropriate training is available to employees supporting the Ambient Air Quality Monitoring Program, commensurate with their duties. Such training may consist of classroom lectures, workshops, forums, teleconferences, and on-the-job training.

The GBUAPCD plans to train supervisors, management, field and laboratory staff by several means. Supervisors and management at the GBUAPCD will hold and attend several U.S. EPA, ARB, and district meetings to keep informed about this new monitoring program as it develops.

ARB monitoring and laboratory staff training for the PM2.5 program will be conducted by two means. First, training was being coordinated with WESTAR, and during August 1998, training for all field and laboratory personnel was conducted. A follow-up session was conducted by WESTAR in June 1999, which District staff also attended. Second, ARB staff conducted a hands-on training session for the station operators when the PM2.5 monitors were made available for pickup. Training included sampler set-up, operation, calibration, maintenance, and repair.

GBUAPCD staff has and will participate in U.S. EPA and AWMA sponsored training courses as they are made available. GBUAPCD staff will attend PM2.5 ambient air monitoring training courses, workshops, forums, etc., on a continuous basis. In addition, GBUAPCD staff will provide additional training on laboratory and sampler operations as needed.

9.0 Documentation and Records

The following information describes the GBUAPCD's document and records procedures for the PM2.5 Program. In U.S. EPA's QAPP regulation and guidance, U.S. EPA uses the term "reporting package," which is defined as all the information required to support the concentration data reported to U.S. EPA, including all data required to be collected as well as data deemed important by the GBUAPCD under its policies and records management procedures. Table 9.0.1 identifies these documents and records.

9.1 Information Included in the Reporting Package

9.1.1 Routine Data Activities

The GBUAPCD has a records management system that allows for the efficient archive and retrieval of records. The PM2.5 information will be included in this system. Table 9.0.1 includes the documents and records that will be filed according to the statute of limitations discussed in Element 9.3.

Table 9.0.1 PM2.5 Reporting Package Information

Categories	Record/Document Types
Management and Organization	State Implementation Plan Reporting agency information Organizational structure Personnel qualifications and training Quality management plan Document control plan U.S. EPA Directives Grant allocations Support Contract
Site Information	Network description Site characterization file Site maps Site Pictures
Environmental Data Operations	QA Project Plans Standard operating procedures (SOPs) Field and laboratory notebooks Sample handling/custody records Inspection/Maintenance records Control Charts
Raw Data	All original data (routine and QC data) including data entry forms
Data Reporting	Annual SLAMS air quality information Data/summary reports Quarterly QC reports

Data Management	Data algorithms Data management plans/flowcharts PM2.5 Data Data Management Systems Quarterly QC reports
Quality Assurance	Network reviews Control charts Data quality assessments QA reports System audits Response/Corrective action reports Performance Audits

9.1.2 Annual Summary Reports Submitted to U.S. EPA

As indicated in 40 CFR Part 58, the GBUAPCD shall submit to the U.S. EPA Administrator, through the Region IX Office, an annual summary report of all the ambient air quality monitoring data from all monitoring stations designated as SLAMS. The report will be submitted by July 1 of each year for the data collected from January 1 to December 31 of the previous year. The report will contain the following information:

PM-fine (PM2.5)

Site and Monitoring Information.

- City name (when applicable)
- county name and street address of site location
- AIRS-AQS site code
- AIRS-AQS monitoring method code

Summary Data

- Annual arithmetic mean (µg/m3) as specified in 40 CFR part 50, Appendix N (Annual arithmetic mean NAAQS is 15µg/m3)
- All daily PM-fine values above the level of the 24-hour PM-fine NAAQS (35 µg/m3) and the dates of occurrence.
- Sampling schedule used as once every 6 days, every day, etc.
- Number of 24-hour average concentrations in the ranges listed in Table 9.0.2:

Table 9.0.2 PM2.5 Summary Report Ranges

Range	Number of Values
0 to 15 (µg/m3) 16 to 30 31 to 50 51 to 70 71 to 90 91 to 110	

GBUAPCD management will certify that the annual summary is accurate to the best of their knowledge. This certification will be based on the various assessments and reports performed by the organization, in particular, the Annual QA Report discussed in Element 21 that documents the quality of the PM2.5 data and the effectiveness of the quality system.

9.2 Data Reporting Package Format and Documentation Control

Table 9.0.1 represents the documents and records, at a minimum, that must be filed into the reporting package. The details of these various documents and records will be discussed in the appropriate elements of this document.

All raw data required for the calculation of a PM2.5 concentration, the submission to the AIRS database, and QA/QC data, are collected electronically or on data forms that are included in the field and analytical methods Elements. All hardcopy information will be filled out in indelible ink. Corrections will be made by inserting one line through the incorrect entry, initialing this correction, and placing the correct entry alongside the incorrect entry, if this can be accomplished legibly, or by providing the information on a new line.

9.2.1 Notebooks

The GBUAPCD will issue notebooks to each field and laboratory technician. The notebooks will be associated with the individual and the PM2.5 Program. Although data entry forms are associated with all routine environmental data operations, the notebooks can be used to record additional information about these operations.

Field notebooks - Notebooks will be issued for each sampling site. The notebooks will contain the appropriate data forms for routine operations as well as inspection and maintenance forms and SOPs.

Lab Notebooks - Notebooks will also be issued for the laboratory. These notebooks will be associated with the PM2.5 Program. One notebook will be available for general comments/notes; others will be associated with, the temperature and humidity recording instruments, the freezer, calibration equipment/standards, and the analytical balances used for this program.

Sample shipping/ receipt- The laboratory will package samples for shipping and will receive samples directly. Lab notebooks will be utilized for sample shipping and receiving information and data will be entered into the laboratory information management system.

9.2.2 Electronic data collection

It is anticipated that certain instruments will provide an automated means for collecting information that would otherwise be recorded on data entry forms. Information on these

systems are detailed in Elements 18 and 19. In order to reduce the potential for data entry errors, automated systems will be utilized where appropriate and will record the same information that is found on data entry forms.

9.3 Data Reporting Package Archiving and Retrieval

As stated in 40 CFR part 31.42, in general, all the information listed in Table 9.0.1 will be retained for three years from the date the grantee submits its final expenditure report unless otherwise noted in the funding agreement. However, if any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the three-year period, the records will be retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular three-year period, whichever is later. The GBUAPCD will extend this regulation in order to store records for three full years past the year of collection. For example, any data collected in calendar year 1999 (1/1/99 - 12/31/99) will be retained until, at a minimum, January 1, 2003; unless the information is used for litigation purposes.

10.0 Sampling Design

Complete details for this Element of the QAPP can be found in the "1998 California Particulate Matter Monitoring Network Description" which was submitted by ARB's PTSD to U.S. EPA Region IX in June 1998.

The goal of the PM2.5 monitoring program is to provide ambient data that support the nation's air quality programs. These data include aerosol mass measurements and chemically resolved, or speciated data. Mass measurements are used principally for PM2.5 national ambient air quality standards (NAAQS) comparison purposes in identifying areas that meet or do not meet the PM2.5 NAAQS and in supporting area designations as attainment or nonattainment. Chemically resolved data serve the implementation needs associated with developing emission mitigation approaches to reduce ambient aerosol levels. These needs include emissions inventory and air quality model evaluation, source attribution analysis, and tracking emission control programs.

The ARB, in partnership with the local air quality management districts within California, has developed a PM2.5 monitoring network to implement the PM2.5 NAAQS. The PM2.5 network is designed to enable the air quality management community in California to collect ambient PM2.5 data as required by Title 40 CFR Parts 50. The ambient data from this network will be used for designating areas as attainment or nonattainment for the PM2.5 air quality health standards, developing control programs, and tracking the progress of these control programs. The network design and sampling schedule were developed using criteria specified in 40 CFR Part 58. The "1998 California Particulate Matter Monitoring Network Description" describes the particulate matter monitoring strategy through July 1999. The network design was submitted to U.S. EPA Region IX, in compliance with the requirements of 40 CFR Part 58, and is included here by reference. The network design will be updated annually, as required.

Upon reviewing the ARB's PM2.5 Network Design, Region IX requested that the ARB describe how collocated sites were selected. Element 10.1, below, describes the rationale for the design of collocated samplers.

10.1 Rationale for the Design of Collocated Samplers

In order to estimate the precision and bias of the various PM2.5 samplers, the U.S. EPA requires that for each method designation at least 25% of the PM2.5 sites must be collocated. In 1998, the GBUAPCD deployed 1 monitoring site operating PM2.5 sequential samplers (Table 10.0.1). One additional PM2.5 site was scheduled for deployment, however, due to remodelling activities of the building in which the site was located, deployment was delayed until October 2000. To satisfy the minimum requirement for collocated samplers in the Great Basin, one site will operate collocated sequential samplers.

Table 10.0.1 Summary of PM2.5 Samplers to be Deployed in California in 1998

Sampling Method Designation	Number of Samplers		
	Primary	**Collocated**	**Total**
Single Channel	0	0	0
Sequential	2	1	3
Total	2	1	3

The ARB and the local air quality management districts in California selected collocated PM2.5 sites based on the following criteria listed in order of importance:

- Measured or estimated PM2.5 concentrations - monitoring sites with high measured PM2.5 concentrations or high estimated PM2.5 concentrations based on PM10 data were selected to operate collocated samplers.

- Operating agency - agencies operating more than four PM2.5 monitoring sites will have about 25% of their PM2.5 sites collocated. Agencies operating less than four monitoring sites were geographically grouped together and a high site was selected to represent a group.

- Geographical representation - the network was designed to ensure geographical representation throughout California because varying meteorological and air quality conditions may influence the precision and bias of various PM2.5 samplers.

- Practical considerations - the monitoring sites selected to operate collocated PM2.5 samplers had to have enough platform room to maintain 1-4 meter spacing between primary and collocated sampler and adequate power available.

Each collocated sampler must be operated concurrently with its associated primary sampler. The one-in-six day sampling schedule was selected for collocated samplers so that the sampling days are distributed evenly over the year and over the seven days of the week.

The adequacy of the quality assurance PM2.5 network will be reviewed during the 1999 annual network review and, if needed, additional collocated sites will be selected.

11.0 Sampling Methods Requirements

11.1 Purpose/Background

This method provides for measurement of the mass concentration of fine particulate matter having an aerodynamic diameter less than or equal to a nominal 2.5 micrometers (PM2.5) in ambient air over a 24-hour period for purposes of determining whether the primary and secondary national ambient air quality standards (NAAQS) for particulate matter specified in 40 CFR Part 50.7 are met. The measurement process is considered to be non-destructive, and the PM2.5 sample obtained can be subjected to subsequent physical or chemical analyses.

11.2 Sample Collection and Preparation

FRM samplers will be used as the monitor for collection of PM2.5 samples for comparison to the NAAQS. In the GBUAPCD network there are two models of the FRM sampler employed. The Rupprecht & Patashnick (R&P) Sampler is a sequential multiple-day sampler that meets the FRM designation. The Andersen Sampler is also a sequential multiple-day sampler that meets FRM designation. Each sampler shall be installed with adherence to procedures, guidance, and requirements detailed in 40 CFR Parts 50[1] , 53 and 58[2], U.S. EPA QA Guidance Document 2:12[3], the sampler manufacturers operation manual, GBUAPCD's Field SOPs, ARB's Field SOPs, and this QAPP.

11.2.1 Sample Set-up

Sample set-up of the FRM or speciation sampler in the GBUAPCD network takes place any day after the previous sample has been recovered. For multiple day samplers, two sample days may be set up when one-in-three-day sampling is required. It is important to recognize that the only holding time that affects sample set-up is the 30-day window (ARB has asked U.S. EPA to extend this to a 90-day window--see Table 11.0.6) from the time a filter is preweighed to the sampling period. At collocated sites, the second monitor will be set up to run at a sample frequency of one-in-six days; however, sample set-up will take place on the same day as the primary sampler. Detailed sample set-up procedures are available from the GBUAPCD PM2.5 sample methods standard operating procedure, Appendix E.

11.2.2 Sample Recovery

Sample recovery of any individual filter from the FRM or speciation sampler in the ARB network must occur within 96 hours of the end of the sample period for that filter. For one-in-three day sampling on single day samplers, this will normally be the day after a sample is taken. The next sample would also be set-up at this time. For one-in-three day sampling on multiple day samplers, this will normally be on the day after the second sample is taken. The next sample set-up for two samples would also take place on this day. At collocated sites the sample from the second monitor will be recovered on the same day as the primary sampler. Sample recovery procedures are detailed in the ARB PM2.5 sampling methods standard operating procedure, Appendix E.

Table 11.0.1 illustrates sample set-up, sample run, and sample recovery dates based upon sample frequency requirements of one-in-three day sampling.

Table 11.0.1 Sample Set-up, Run and Recovery Dates

Sample Frequency	Sampler Type	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 in 3 Week 1	Multiple Day	Sample Day 1			Sample Day 2	*Recovery & Set-up*		Sample Day 3
1 in 3 Week 2	Multiple Day			Sample Day 4	*Recovery & Set-up*		Sample Day 5	
1 in 3 Week 3	Multiple Day		Sample Day 6	*Recovery & Set-up*		Sample Day 7		
1 in 3 Week 4	Multiple Day	Sample Day 8	*Recovery & Set-up*		Sample Day 9	*Recovery & Set-up*		Sample Day 10
1 in 3 Week 5	Multiple Day			Sample Day 11	*Recovery & Set-up*		Sample Day 12	
1 in 3 Week 6	Multiple Day		Sample Day 13	*Recovery & Set-up*		Sample Day 14		
1 in 3 Week 1	Single Day	Sample Day 1	*Recovery & Set-up*		Sample Day 2	*Recovery & Set-up*		Sample Day 3
1 in 3 Week 2	Single Day		*Recovery & Set-up*	Sample Day 4	*Recovery & Set-up*		Sample Day 5	*Recovery & Set-up*
1 in 3 Week 3	Single Day		Sample Day 6	*Recovery & Set-up*		Sample Day 7	*Recovery & Set-up*	

Therefore, sites that utilize multiple day samplers with the one-in-three day sampling frequency will require one site visit a week, except for one out of every four weeks, where two sites visits will be required. For sites that utilize single day samplers with one-in-three day sampling frequency, a recovery and set-up visit will be required for every sample taken.

11.3 Support Facilities for Sampling Methods

Table 11.0.2 lists the supplies that are available to PM2.5 field operators. Support facilities for PM2.5 sampling include offices, trailers, and vehicles.

Table 11.0.2 Support Facility Supplies

Item	Minimum Quantity	Notes
Powder Free Gloves	box	*Material must be inert and static resistant*
Fuses	2	*Of the type specified in the sampler manual*
Sampler Operations Manual	1 per model	
PM2.5 Sampling SOP	1	
Flow rate verification filter	2	
Non-Permeable Membrane	2	*Contained in sampling cassette*
Filter Cassettes	2	*For use with flow rate check filter or non-permeable membrane*
Impactor Oil	1 Bottle	
Cleaning Wipes	1 Box	*Dust resistant*
Data Download Cable	1	*Downloading mechanism (to be determined)*

Since there are other items that the field operator may need during a site visit that are not expected to be at each site, the operator is expected to bring these items with him/her. Table 11.0.3 details those items each operator is expected to bring with them.

Table 11.0.3 Site Dependent Equipment and Consumables

Item	Minimum Quantity	Notes
Tools	1 box	*screw drivers, fitted wrenches, etc...*
WINS Impactor Well	1	*Without impactor oil*
FRM Filter Cassettes	1 for each sampler, plus field blanks	*Loaded with pre-weighed filter*
Transport Container	2	*1 for pre-weighed, 1 for sampled filter.*

11.4 Sampling/Measurement System Corrective Action

Corrective action measures in the PM2.5 Air Quality Monitoring Network will be taken to ensure the data quality objectives are attained. There is the potential for many types of sampling and measurement system corrective actions. Table 11.0.4 is an attempt to detail the expected problems and corrective actions needed for a well-run PM2.5 network.

Table 11.0.4 Field Corrective Action

Item	Problem	Action	Notification
Filter Inspection (Presample)	Pinhole(s) or torn	1) If additional filters have been brought, use one of them. Void filter with pinhole or tear. 2) Use new field blank filter as sample filter. 3) Obtain a new filter from lab.	1) Document on field data sheet. 2) Document on field data sheet. 3) Notify Field Manager
Filter Inspection (Postsample)	Torn or otherwise suspect particulate by-passing 46.2 mm filter.	1) Inspect area downstream of where filter rests in sampler and determine if particulate has been by-passing filter. 2) Inspect in-line filter before sample pump and determine if excessive loading has occurred. Replace as necessary.	1) Document on field data sheet. 2) Document in log book.
WINS Impactor	Heavily loaded with coarse particulate as indicated by a "cone" shape on the impactor well.	Clean downtube and WINS impactor. Load new impactor oil in WINS impactor well .	Document in log book.
Sample Flow Rate Verification	Out of Specification ($\pm$ 4% of transfer standard and $\pm$5% of design flow rate.)	1) Remove flow rate device, re-connect and repeat flow rate check. 2) Perform leak test. 3) Check flow rate at 3 points (15.0 LPM, 16.7 LPM, and 18.3 LPM) to determine if flow rate problem is with zero bias or slope. 4) Re-calibrate flow rate.	1) Document on data sheet. 2) Document on data sheet. 3) Document on data sheet. Notify Field Manager. 4) Document on data sheet, notify Field Manager, and flag data since last calibration.

Leak Test	Leak outside acceptable tolerance (<80 mL/min)	1) Remove leak check adaptor, re-connect and repeat leak test. 2) Inspect all seals and O-rings, replace as necessary and repeat leak test.	1) Document in log book. 2) Document in log book, notify Field Manager, and flag data since last successful leak test.
Sample Flow Rate	Consistently low flows documented during sample run	1) Check programming of sampler flow rate. 2) Check flow with a flow rate verification filter and determine if actual flow is low. 3) Inspect in-line filter downstream of 46.2 mm filter location, replace as necessary.	1) Document in log book. 2) Document in log book. 3) Document in log book.
Ambient Temperature Verification, and Filter Temperature Verification.	Out of Specification (± 4°C of standard)	1) Make certain thermocouples are immersed in same liquid at same point without touching sides or bottom of container. 2) Use ice bath or warm water bath to check a different temperature. If acceptable, repeat ambient temperature verification. 3) Connect new thermocouple. 4) Check ambient temperature with another NIST traceable thermometer.	1) Document on data sheet. 2) Document on data sheet. 3) Document on data sheet. Notify Field Manager. 4) Document on data sheet. Notify Field Manager.
Ambient Pressure Verification	Out of Specification (±10 mm Hg)	1) Make certain pressure sensors are each exposed to the ambient air and are not in direct sunlight. 2) Call local Airport or other source of ambient pressure data and compare that pressure to pressure data from monitors sensor. Pressure correction may be required. 3) Connect new pressure sensor.	1) Document on data sheet. 2) Document on data sheet. 3) Document on data sheet. Notify Field Manager.
Elapsed Sample Time	Out of Specification (1 min/mo)	Check Programming, Verify Power Outages	Notify Field Manager
Elapsed Sample Time	Sample did not run	1) Check Programming 2) Try programming sample run to start while operator is at site. Use a flow verification filter.	1) Document on data sheet. Notify Field Manager 2) Document in log book. Notify Field Manager.
Power	Power Interruptions	Check Line Voltage	Notify Field Manager
Power	LCD panel on, but sample not working.	Check circuit breaker, some samplers have battery back-up for data but will not work without AC power.	Document in log book

Data Downloading	Data will not transfer.	Document key information on sample data sheet. Make certain problem is resolved before data is written over in sampler microprocessor.	Notify Field Manager.

11.5 Sampling Equipment, Preservation, and Holding Time Requirements

This element details the requirements needed to prevent sample contamination, the volume of air to be sampled, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

11.5.1 Sample Contamination Prevention

The PM2.5 network has rigid requirements for preventing sample contamination. Powder-free gloves are worn or clean hands are used while handling filter cassettes. Once the filter cassette is taken outside of the gravimetric laboratory it must never be opened as damage may result to the 46.2 mm Teflon filter. Filter cassettes are to be stored in filter cassette storage containers as provided by the sampler manufacturer during transport to and from the laboratory. After exposure, filters must be transported and stored with the sample side up to prevent sample losses. They are to be transported carefully to prevent any unnecessary jarring that could cause sample loss in the storage container. Once samples have been weighed, and prior to and again after they have been to the field for sampling, they are to be stored with the particulate side up, individually, in petri slides in the laboratory.

11.5.2 Sample Volume

The volume of air to be sampled is specified in 40 CFR Part 50. Sample flow rate of air is 16.67 liters per minute (LPM). The total sample of air collected will be 24 cubic meters based upon a 24 hour sample. Samples are expected to be collected over 24 hours; however, in some cases a shorter sample period may be necessary, not to be less than 23 hours. Since capture of the fine particulate is predicated upon a design flow rate of 16.67 LPM, deviations of greater than 10% from the design flow rate will enable a shut-off mechanism for the sampler. If a sample period is less than 23 hours or greater than 25 hours, the sample will be flagged.

11.5.3 Temperature Preservation Requirements

The temperature requirements of the PM2.5 network are explicitly detailed in 40 CFR Part 50, Appendix L[1]. During transport from the gravimetric laboratory to the sample location, there are no specific requirements for temperature control; however, the filters will be located in their protective container and in the transport container. Excessive heat must be avoided (e.g., do not leave in direct sunlight or a closed-up car during summer). The filter temperature requirements are detailed in Table 11.0.5.

Table 11.0.5 Filter Temperature Requirements

Item	Temperature Requirement	Reference
Filter temperature control during sampling and until recovery.	No more than 5^{O} C above ambient temperature.	40 CFR Part 50, Appendix L, Element 7.4.10
Filter temperature control from time of recovery to start of conditioning.	Protected from exposure to temperatures over 25^{O} C.	40 CFR Part 50, Appendix L, Element 10.13
Postsample transport.	$\leq 25^{O}$ C if weighed within 10 days or $\leq 4^{O}$C if weighed within 30 days	40 CFR Part 50, Appendix L, Element 8.3.6

11.5.4 Permissible Holding Times

The permissible holding times for the PM2.5 sample are clearly detailed in both 40 CFR Part 50, Appendix L, and the U.S. EPA QA Guidance Document 2.12. These holding times are provided in Table 11.0.6.

Table 11.0.6 Holding Times

Item	Holding Time	From:	To:	Reference
Preweighed Filter	≤30 days*	Date of Pre-weigh	Date of Sample	40 CFR Part 50, Appendix L, Element 8.3.5
Recovery of Filter	≤96 hours	Completion of sample period	Time of sample recovery	40 CFR Part 50, Appendix L, Element 10.10
Transport of Filter	<24 Hours (ideally)	Time of recovery	Time placed in conditioning room	40 CFR Part 50, Appendix L, Element 10.13
Postsample Filter stored at $<4^{o}$ C.	≤30 days	Sample end date/time	Date of Post Weigh	40 CFR Part 50, Appendix L, Element 8.3.6
Postsample Filter stored at $<25^{o}$ C.	≤10 days	Sample end date/time	Date of Post Weigh	40 CFR Part 50, Appendix L, Element 8.3.6

*NOTE: The ARB has asked U.S. EPA for a waiver to the ≤30-day holding time for preweighed filters. The ARB has asked U.S. EPA to extend this time to ≤90 days.

References

The following documents were utilized in the development of this Element:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760. July 18,1997.

2. U.S. EPA (1997b) Revised Requirements for Designation of Reference and Equivalent Methods for PM2.5 and Ambient Air Quality Surveillance for Particulate Matter-Final Rule. 40 CFR Parts 53 and 58. *Federal Register*, **62**(138):38763-38854; July 18, 1997.

3. U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air
Using Designated Reference or Class I Equivalent Methods; March 1998.

12.0 Sampling Custody

Due to the potential use of the PM2.5 data for comparison to the NAAQS and the requirement for extreme care in handling the sample collection filters, sample custody procedures will be followed. Figures 12.1, 12.2, and 12.3 represent chain of custody forms that will be used to track the stages of filter handling throughout the data collection operation. Definitions of parameters on the forms are explained in Table 12-1. Although entries on this form will be made by hand, the information will be entered into the sampling tracking system, where an electronic record will be kept (see Element 19). This Element addresses sample custody procedures at the following stages:

- Pre-sampling
- Post-sampling
- Filter receipt
- Filter archive

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

PM 2.5 SAMPLER 24-HOUR SAMPLE REPORT - FIELD DATA SHEET

Site Name _____ Sample Date _____

Site ID _____ "Sample by" Date _____

Filter ID _____ Cass ID#: _____ Sampler Model/ID No. _____

SAMPLE SUMMARY

Elapsed Time _____ Hr:Min

Strt Date/Time _____ PST

Volume _____ M3

Flow CV _____ %

Avg. Flow Rate _____ LPM

	Minimum	Average	Maximum
Amb T 'C			
Press mm Hg			

Local Condition Codes _____

Sampler Status Codes _____

A. High Winds E. Forest Fire K. Farming Nearby J. Construction
L. Highway Constr. N. Sanding/Salting P. Roofing Opertn. Q. Prescribe Burn

Operator Comments _____

CHAIN OF CUSTODY

	Date	Time	Temperature	Name	Mode
Transported from Lab					
Load in Sampler					
Removed from Sampler					
Placed in Freezer					
Transported to Lab					
Received at Lab, Placed in Freezer					
Removed from Freezer for Conditioning					

FOR LABORATORY USE ONL

Postweigh by: _____

	Mass, mg.	DUP Mass, mg.	Date	Analyst
Tare Weight				
Gross Weight				

Laboratory Comments _____

Figure 12.1 Example of single filter sampler chain of custody record

Filter Archiving Tracking Form

Filter ID	Analysis Date	Archive Date	Box ID/Box #	Archived By:	Comments

Figure 12.3 Filter Archive Form

Table 12-1 Parameter List

Parameter	Frequency	Comment
Identification		
Site ID	Every sample	Site identification number of where the sample was collected.
Site Name	Every sample	Name of the site where the sample was collected.
Filter ID	Every Sample	Unique filter ID of filter given by the weighing laboratory.
Cass ID #	Every sample	The filter cassette in which the filter was installed.
Sample Date	Every sample	The date on which the atmosphere was sampled through the filter.
"Sample by" Date	Every sample	Date by which the filter must be sampled within the 30-day criterion.
Sampler Model/ID No.	Every sample	Sampler model number or District property number unique to the sampler.
Sample Summary		
Elapsed Time	Every sample	The amount of the the filter was sampling the air, in hours, minutes.
Start Date/Time	Every sample	The date and time (PST) at which sampling began for this filter.
Volume	Every sample	The sample volume in cubic meters for this particular filter
Avg. Flow Rate	Every sample	The average flow rate during this sample run, in liters per minute
Flow CV	Every sample	The coefficient of variation for the flow rate, in percent, during this run.
Local Condition Codes	Every sample	Codes that indicate activities in the vicinity of the sampler that may impact the sample.
Amb. Temp., °C	Every sample	The maximum, minimum, and average ambient temperature measured by the sampler during the run.

Amb. Pres., mm Hg	Every sample	The maximum, minimum, and average ambient pressure measured by the sampler during the run.
Sampler Status Codes	Every sample	Codes that indicate parameters measured during the sample run that are out of specification.
Operator Comments	Every sample	Notes made by the operator concerning issues that may affect the filter or sampler.
Chain of Custody		
Load in Sampler	Every sample	Date, time, and initials of the technician loading the filter in the sampler. Mode indicated on sampler.
Remove from Sampler	Every sample	Date, time, and initials of the technician removing the filter from the sampler after the run.
Placed in Freezer	Every sample	Date, time, freezer temp., initials of technician taking filter from the sampler and placed in the onsite freezer.
Sent to Lab	Every sample	Date, time, freezer temp., initials of technician taking filter from the onsite freezer and transporting it to the lab.
Received at Lab	Every sample	Date, time, cooler temp., initials of technician taking filter from the transport cooler and placing it in the laboratory freezer. If this data field is not entered, the next field ($4^{O}C$) must be.
Removed from Freezeer for Conditioning	Every sample	Date, time, laboratory temp., initials of technician taking filter from the laboratory freezer and placing it in the laboratory for equilibration prior to final weighing. If this data field is not entered, the previous field (Freezer Temp.) must be.
LABORATORY DATA		
Postweigh by	Every sample	Filter must be weighed within 30 days of sampling if maintained at <4deg. C, or within 10 days if maintained at <25 deg. C and >4deg. C.
Tare Weight	Every sample	The mass, duplicate mass if used for QC check, date, and initials of analyst performing initial weighing of filter prior to sampling.
Gross Weight	Every sample	The mass, duplicate mass if used for QC check, date, and initials of analyst performing final weighing of filter after sampling.
Laboratory Comments	As needed	Comments regarding the filter condition, anomalies, anything that occurred during the final weighing procedure that could affect sample integrity.

12.1 Sample Custody Procedure

One of the most important values in the sample custody procedure is the unique filter ID number, illustrated in Figure 12.4. The filter ID is an alpha-numeric value. The initial alpha value identifies the type of filter as being a PM fine (PF) filter. The next seven digits represent a unique number. The filter ID is preprinted on the filter outer ring by the manufacturer.

Filter ID

F or T	X	X	X	X	X	X	X
Filter Type	(---------Unique number---------)						

12.1.1 Pre-Sampling Custody

The GBUAPCD's laboratory SOPs (Appendix B) define how the filters will be enumerated, conditioned, weighed, placed into the protective shipping container, sealed with tape, and distributed to the site operators. Filters must be used within 30 days of pre-sampling weighing and must be stored onsite in their shipping containers prior to sampling to prevent contamination. In preparation for sampling:

. Select the appropriate *24-Hour Sample Report - Field Data Sheet* for the filter to be installed in the sampler.
. Remove the filter from the protective container per SOPs. Briefly examine filter to determine filter integrity has been maintained. Install the filter cassette in the sampler.
. Record "Load in Sampler" information on the *Chain of Custody* portion of the *Field Data Sheet*.

12.1.2 Post Sampling Custody

The field sampling SOPs (Appendix E) specify the techniques for properly collecting and handling the sample filters. Upon visiting the site:

- Select the appropriate *24-Hour Sample Report - Field Data Sheet*.
- Remove filter cassette from the sampler. Briefly examine it to determine appropriate filter integrity flag and place it into the protective container per SOPs.
- Record the *Sample Summary* information from the sampler onto the *Field Data Sheet.*
- Record "Remove from Sampler" information on the *Chain of Custody* portion of the *Field Data Sheet*.
- Place the protective container(s) into the station freezer in preparation for shipment.
- Record "Placed in Freezer" information on the *Chain of Custody* portion of the *Field Data Sheet*.

Shipping Information

The site operator will deliver the sample(s) to the laboratory transporting it in his/her vehicle. Shipping requirements include the following:

- Complete the "Sent to Lab" information in the *Chain of Custody* portion of the *Field Data Sheet*.
- Photocopy the *24-Hour Sample Report - Field Data Sheet* and retain the copy onsite.
- Place the original records in a plastic zip lock bag and include it in the transport containers to be taken to the laboratory.
- Seal all transport containers per SOPs.
- The site operator will transport the container to the laboratory, contacting the laboratory technician upon arrival.

12.1.3 Filter Receipt

Samples are transported to the laboratory by the site operator and delivered directly to the gravimetric laboratory with the associated field data sheet(s). The operator will notify the laboratory technician that the samples have arrived.

12.1.4 Filter Archive

Once the gravimetric laboratory receives the filters, they will use the field data sheets to log the samples back in from the field and will place them in the laboratory freezer. The laboratory technician will remove the filters from the freezer, place them in the laboratory for equilibration, and prepare them for post-sampling weighing activities. These activities are included in the analytical SOPs (Element 13). The laboratory technicians will take the filters out of the protective containers and the cassettes and examine them for integrity, which will be marked on the field data sheets. The samples will be stored within the PM2.5 weighing laboratory.

Upon completion of post-sampling weighing activities, the *Filter Archiving Form* (Figure 12.3) will be used by the laboratory technicians to archive the filter. Each filter will be packaged according to the SOPs and stored in a box uniquely identified by Site ID and box number. Samples will be archived in the laboratory freezer for five years past the date of collection. Prior to disposal, U.S. EPA Region IX will be notified of the GBUAPCD's intent to dispose of the filters.

13.0 Analytical Methods Requirements

13.1 Purpose/Background

This method provides for gravimetric analyses of filters used in the GBUAPCD PM2.5 network. The net weight gain of a sample is calculated by subtracting the initial weight from the final weight. Once calculated, the net weight gain can be used with the total flow passed through a filter to calculate the concentration for comparison to the daily and annual NAAQS. Since the method is non-destructive, and due to possible interest in sample composition, the filters will be archived after final gravimetric analyses has occurred.

13.2 Preparation of Samples

Upon delivery of approved 46.2 mm Teflon filters for use in the GBUAPCD network, the receipt is documented and the filters stored in the gravimetric laboratory. Storing filters in the laboratory makes it easier to maximize the amount of time available for conditioning. Upon receipt, cases of filters will be labeled with the date of receipt, opened one at a time and used completely before opening another case. All filters in a lot will be used before a case containing another lot is opened. When more than one case is available to open the "First In - First Out" rule will apply. This means that the first case of filters received is the first case that will be used.

Filters will be taken out of the case when there is enough room for more samples in the pre-sampling weighing section of the filter conditioning storage compartment. Filters will be visually inspected according to the FRM criteria to determine compliance. See Appendix B for inspection procedure for new shipments of filters. Filters will then be stored in the filter conditioning compartment. The minimum conditioning period is 24 hours. Filters will not be left out for excessive periods of conditioning to minimize possible contamination.

13.3 Analysis Method

13.3.1 Analytical Equipment and Method

The analytical instrument used for gravimetric analysis in the FRM or equivalent PM2.5 sampler method (gravimetric analysis) is the microbalance. The GBUAPCD will use a *Sartorius M5P* microbalance, which has a readability* of 1 µg and a repeatability* of 1µg (* equipment performance terms used by balance vendors to characterize their equipment for purchase comparison purposes; see also Appendix B).

The microbalance is calibrated annually by a technician from *Sartorius.*

The gravimetric analysis method (Appendix B) consists of information needed to establish and verify the continued acceptability of the set of primary and secondary mass reference standards, and a new lot of filters, and to establish stable conditions in the weighing room. The three main subparts cover pre-sampling filter weighing (tare weight), post-sampling documentation and inspection, and post-sampling filter weighing (gross weight). The details of the gravimetric

analysis method can be found in the GBUAPCD microbalance standard operating procedure (Appendix B).

13.3.2 Conditioning and Weighing Room

The primary support facility for the PM2.5 network is the filter conditioning and weighing room/gravimetric laboratory. Additional facility space is dedicated for long term archiving of the filters in a freezer. The gravimetric laboratory is used for both pre-sampling weighing and post-sampling weighing of each PM2.5 filter sample. Specific requirements for environmental control of the conditioning/weighing room laboratory are detailed in 40 CFR Part 50 Appendix L[1]

13.3.3 Environmental Control

The GBUAPCD gravimetric laboratory is an environmentally-controlled room with temperature and humidity control. Temperature is controlled at a setpoint of 22°C, within the required range of 20 - 23^{O} C. Humidity is controlled at 35%, within the required 30 - 40% relative humidity range. Temperature and relative humidity are measured and recorded continuously during equilibration. The balance is located on a vibration free table and is protected from or located out of the path of any sources of drafts. Filters are conditioned before both the pre- and post-sampling weighings. Filters must be conditioned for at least 24 hours to allow their weights to stabilize before being weighed.

13.4 Internal QC and Corrective Action for Measurement System

A QC notebook or database (with disk backups) will be maintained which will contain QC data, including the microbalance calibration and maintenance information, routine internal QC checks of mass reference standards and laboratory and field filter blanks, and external QA audits. These data will duplicate data recorded on laboratory data forms but will consolidate them so that long-term trends can be identified. QC charts for the microbalance are calculated from the QC database. These charts enable the analyst to determine any excess drift that could signal an instrument malfunction.

At the beginning of each weighing day, after the analyst has completed zeroing and calibrating the microbalance and measuring the working standard, three laboratory filter blanks established for the current filter lot are weighed. Filter blanks from the most recently completed field blank study are also weighed. After approximately every tenth filter weighing, the analyst will reweigh one working standard. The microbalance is rezeroed as necessary between each weighing. The working standard and blank measurements are recorded in the laboratory QC notebook or database. If the working standard measurements differ from the certified values or the pre-sampling values by more than 3 µg, the working standard measurements will be repeated. If the blank measurements differ from the pre-sampling values by more than 15 µg, the blank measurements will be repeated. If the two measurements still disagree, the Laboratory Manager will be contacted, who may direct the analyst to (1) reweigh some or all of the previously weighed filters, (2) recertify the working standard against the laboratory primary standard, (3)

conduct minor, non-invasive diagnostic and troubleshooting, and/or (4) arrange to have the original vendor or an independent, authorized service technician troubleshoot or repair the microbalance.

Corrective action measures in the PM2.5 FRM system will be taken to ensure good quality data. There is the potential for many types of sampling and measurement system corrective actions. Tables 13-1 (organized by laboratory support equipment) and 13-2 (organized by laboratory support activity) list potential problems and corrective actions needed to support a well run PM2.5 network. Filter weighing will be delayed until corrective actions are satisfactorily implemented.

Table 13-1 Potential Problems/Corrective Action for Laboratory Support Equipment

System	Item	Problem	Action	Notification
Gravimetric Lab	Humidity	Out of Specification	Check HVAC system	Lab Manager
Gravimetric Lab	Temperature	Out of Specification	Check HVAC system	Lab Manager
Balance	Internal Calibration	Unstable	Redo and check working standards	Lab Manager
Balance	Zero	Unstable	Redo and check for drafts, sealed draft guard	Lab Manager
Balance	Working Standards	Out of Specification	Check balance with Primary standards	Lab Manager
Balance	Filter Weighing	Unstable	Check Lab Blank Filters	Document in Log Book

Table 13-2 Filter Preparation and Analysis Checks

Activity	Method and frequency	Requirements	Action if the requirements are not met
Microbalance Use		Resolution of 1 µg, repeatability of 1 µg	Obtain proper microbalance**Table 13-2 Filter Preparation and Analysis Checks**
Activity• **Method and frequency**	**Requirements**	**Action if the requirements are not met**Control of bal. environment	
Use of Mass reference standards	Working standards checked every 3 to 6 months against laboratory primary standards	Standards up to 200 mg, individual standard's tolerance less than 25 µg, handle with smooth, nonmetallic forceps	Obtain proper standards or forceps
Filter handling	Observe handling procedure	Use powder-free gloves and smooth forceps. Replace Po^{210} antistatic strips every 6 months	Discard mishandled filter or old antistatic strip

Filter integrity check	Visually inspect each filter	No pinholes, separation, chaff, loose material, discoloration, or filter nonuniformity	Discard defective filter
Filter identification	Write filter number on filter handling container, and on laboratory data form in permanent ink	Make sure the numbers are written legibly	Replace label or correct form
Pre-sampling filter equilibration	Determine the correct equilibration conditions and period (at least 24 hours) for each new lot of filters. Observe and record the equilibration chamber relative humidity and temperature; enter to lab data form.	Check for stability of laboratory blank filter weights. Weight changes must be <15 µg before and after equilibration. Mean relative humidity between 30 and 40 percent, with a variability of not more than ±5 percent standard deviation over 24 hours. Mean temperature will be held between 20 and 23°C, with a variability of not more than ±2°C standard deviation over 24 hours.	Revise equilibration conditions and period. Repeat equilibration
Initial filter weighing	Observe all weighing procedures. Perform all QC checks	Neutralize electrostatic charge on filters. Wait long enough so that the balance indicates a stable reading.	Repeat weighing
Internal QC	After every tenth filter, reweigh one of the two working standards. Weigh three laboratory filter blanks. Reweigh at least one duplicate filter with each sample batch (duplicate weighing).	The working standard measurements must agree to within 3 µg of the certified values. The blank and duplicate measurements must agree to within 15 µg.	Flag values for validation activities.**Table 13-2 Filter Preparation and Analysis Checks**
Activity• Method and frequency	**Requirements**	**Action if the requirements are not met**Post-sampling inspection, documentation, and verification	Examine the filter and field data sheet for correct and complete entries. If sample was shipped in a cooled container, verify that low temperature was maintained.
Post-sampling filter equilibration	Equilibrate filters for at least 24 hours. Must be within ± 5% RH of pre-sampling weighing conditions.	Mean relative humidity between 30 and 40 percent, with a variability of not more than ±5 percent standard deviation over 24 hours. Mean temperature will be held between 20 and 23°C, with a variability of not more than ±2°C standard deviation over 24 hours.	Repeat equilibration
Post-sampling filter weighing	Observe all weighing procedures. Perform all QC checks.	Neutralize electrostatic charge on filters. Wait 20 seconds after balance indicates a stable reading before recording data.	Repeat weighing

13.5 Filter Sample Contamination Prevention, Preservation, and Holding Time Requirements

This element details the requirements needed to prevent and protect the filter sample from contamination, the volume of air to be sampled, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

13.5.1 Sample Contamination Prevention

The analytical support component of the PM2.5 network has rigid requirements for preventing sample contamination. Filters are equilibrated/conditioned and stored in the same room where they are weighed. Filters are only contacted with the use of smooth nonserrated forceps. Upon determination of its pre-sampling weight, the filter is placed in its cassette and then placed in a protective petri dish. The petri dish is labeled with a uniquely identifying number. The filter is never removed from the filter cassette outside of the weigh room as damage may result to the 46.2 mm teflon filter.

13.5.2 Sample Volume

The volume of air to be sampled is specified in 40 CFR Part 50. Sample flow rate of air is 16.67 LPM. Total sample of air collected will be 24 cubic meters based upon a 24 hour sample.

13.5.3 Temperature Preservation Requirements

The temperature requirements of the PM2.5 network are explicitly detailed in 40 CFR Part 50. In the weighing room laboratory, the filters must be conditioned for a minimum of 24 hours prior to pre-weighing; although, a longer period of conditioning may be required. The weighing room laboratory temperature must be maintained between 20 and 23^{O} C, with no more than a +/- 2^{O} C standard deviation change over the 24 period prior to weighing the filters. During transport from the weighing room to the sample location, there are no specific requirements for temperature control; however, the filters will be located in their protective container and excessive heat avoided. Temperature requirements for the sampling and post sampling periods are detailed in 40 CFR Part 50, Appendix L Section 7.4.10. These requirements state that the temperature of the filter cassette during sampler operation and in the period from the end of sampling to the time of sample recovery shall not exceed that of the ambient temperature by more than 5^{O} C for more than 30 minutes.

The specifics of temperature preservation requirements are clearly detailed in 40 CFR Part 50, Appendix L[1]. These requirements pertain to both sample media before collection and both the sample media and sample after a sample has been collected. Additionally, during the sample collection there are requirements for temperature control. The temperature requirements are detailed in Table 13-3.

Table 13-3 Temperature Requirements

Item	Temperature Requirement	Reference
Weighing Room	20 - 23^{O} C	40 CFR Part 50, Appendix L, Section 8.2.1
Pre-weighed Filter	+/- 2^{O} C standard deviation for 24 hours prior to weighing	40 CFR Part 50, Appendix L, Section 8.2.2
Filter Temperature Control during sampling and until recovery	No more than 5^{O} C above ambient temperature.	40 CFR Part 50, Appendix L, Section 7.4.10
Post Sample Transport	$\leq$ 25^{O}C if weighed within 10 days or $\leq$ 4^{O}C if weighed within 30 days	40 CFR Part 50, Appendix L, Section 8.3.6

13.5.4 Permissible Holding Times

The permissible holding times for the PM2.5 sample are clearly detailed in both 40 CFR Part 50[1] and the U.S. EPA QA Guidance Document 2.12[2]. A summary of these holding times are provided in Table 11-6 in Element 11.5.4.

References

The following documents were utilized in the development of this element:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760. July 18,1997.

2. U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods. March 1998

14.0 Quality Control Requirements

To assure the quality of data from air monitoring measurements, two distinct and important interrelated functions must be performed. One function is the control of the measurement process through broad quality assurance activities, such as establishing policies and procedures, developing data quality objectives, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is the control of the measurement process through the implementation of specific quality control procedures, such as audits, calibrations, checks, replicates, routine self-assessments, etc. In general, the greater the control of a given monitoring system, the better will be the resulting quality of the monitoring data.

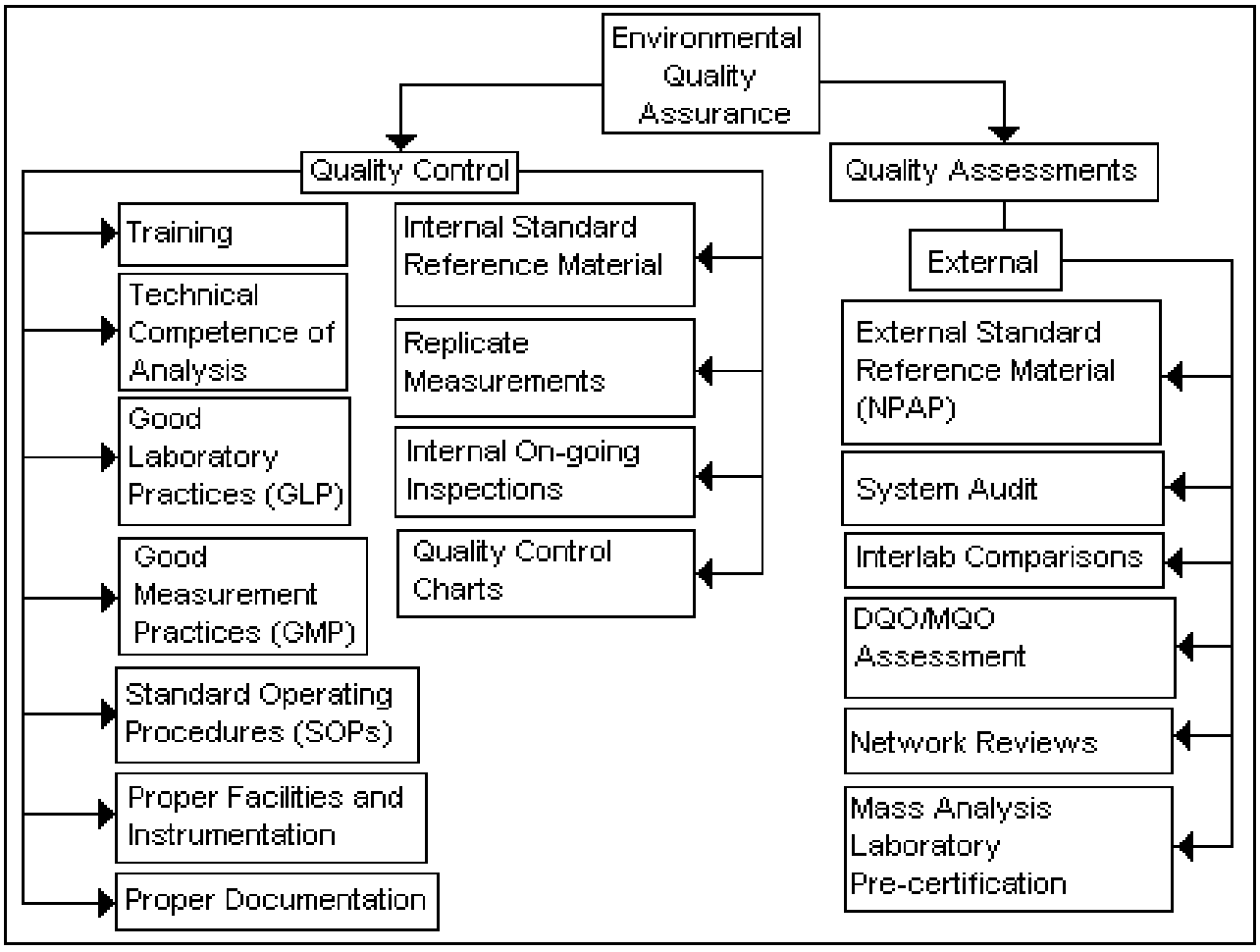

Figure 14.1 Quality control and quality assessment activities

Quality control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer. In the case of the Ambient Air Quality Monitoring Network, QC activities are used to ensure that measurement uncertainty, as discussed in Element 7, is maintained within acceptance criteria for the attainment of the DQO. Figure 14.1 represents a number of QC activities that help to evaluate and control data quality

for the PM2.5 program. Many of the activities in this figure are implemented by the Great Basin APCD and are discussed in the appropriate sections of this QAPP. The other activities in this figure are implemented by the California ARB and/or the U.S. EPA.

14.1 QC Procedures

Day-to-day quality control is implemented through the use of various check samples or instruments that are used for comparison. The measurement quality objectives tables (work in progress) in Element 7 contain a complete listing of these QC samples as well as other requirements for the PM2.5 Program. The procedures for implementing the QC samples are included in the field and analytical methods (Elements 11 and 13, respectively). As Figure 14.2 illustrates, various types of QC samples have been inserted at phases of the data operation to assess and control measurement uncertainties. Tables 14-1 and 14-2 contains a summary of all the field and laboratory QC samples. The following information provides some additional descriptions of these QC activities, how they will be used in the evaluation process, and what corrective actions will be taken when they do not meet acceptance criteria.

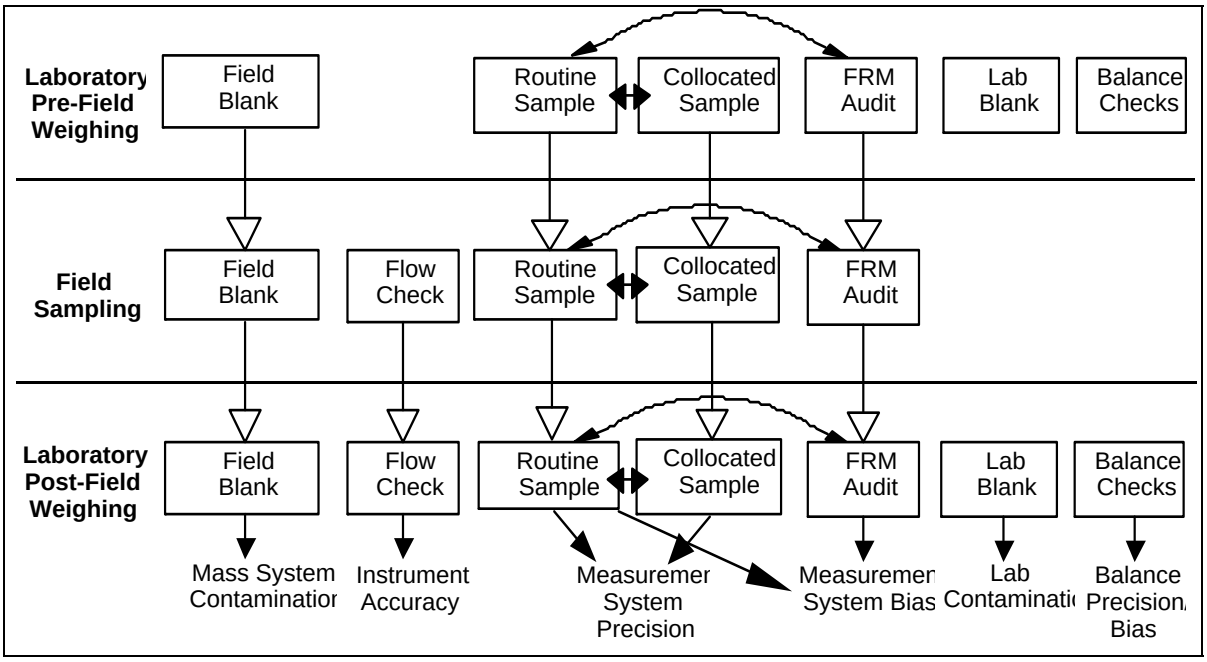

Figure 14-2 PM2.5 Quality Control Sampling Scheme

Table 14-1 Field QC Checks

Requirement	Frequency	Acceptance Criteria	CFR Reference	QA Guidance Document 2.12 Reference	Information Provided
Calibration Standards					
Flow Rate Transfer Std.	1/yr	±2% of NIST-traceable Std.	Part 50, App.L Sec 9.1, 9.2	Sec. 6.3 Sec 4.2 and 6.4	Certification of Traceability
Field Thermometer	1/yr	± 0.1° C resolution ± 0.5° C accuracy	not described not described	" "	Certification of Traceability
Field Barometer	1/yr	± 1 mm Hg resolution ± 5 mm Hg accuracy	not described not described	Sec. 4.3 and 7.3 "	Certification of Traceability
Calibration/Verification					
Flow Rate (FR) mult-point verification	2/yr or if single-point verification failure	± 2% of transfer standard and ±2% of design FR	Part 50, App.L, Sec 9.2 Part 50, App.L, Sec 9.2.5	Sec 6.3 and 6.7 Sec 8.3	Calibration drift and memory effects Calibration drift and memory effects
Calibration FR single-point verification	1/4 weeks every 5 sampling events	± 2% of transfer standard and ± 2% of design FR	And Sec. 9.2.6 Part 50, App.L, Sec 7.4	Sec. 6.6 and Sec. 8.3 Sec. 6.6 and Sec. 8.3	
External Leak Check	every 5 sampling events	<80 mL/min <80 mL/min	" Part 50, App.L, Sec 9.3	Sec. 6.4 Sec. 6.4 and 8.2	Sampler function Sampler function
Internal Leak Check	If multi-point failure	± 2°C of standard	Part 50, App.L, Sec 9.3	"	Calibration drift and memory effects
Temperature Calibration	on installation, then 1/yr	± 2°C of standard ± 4°C of standard	" "	Sec. 6.5 Sec. 8.2	Calibration drift and memory effects
Temp multi-point verification	1/4 weeks on installation, then	±10 mm Hg ±10 mm Hg	" Part 50, App.L, Sec 7.4	not described	Calibration drift and memory effects
One- point temp Verification	1/yr 1/4 weeks	1 min/mo			Calibration drift and memory effects
Pressure Calibration	1/ 4 weeks				Calibration drift and memory effects
Pressure Verification					Calibration drift and memory effects
Clock/timer Verification					Verification to assure proper function
Blanks					
Field Blanks	10% of monitors sampling frequency	±30 µg	Part 50, App.L Sec 8.3	Sec. 7.10	Measurement system contamination
Precision Checks					
Collocated samples	every 6 days	CV ≤ 10%	Part 58, App.A, Sec 3.5, 5.5	Sec. 10.2	Measurement system precision
Audits (*external assessments*)	25% of sites 4/yr	± 10%	Part 58, App A, Sec 3.5.3	Sec 10.3	Measurement system bias
FRM Performance Evaluation	1/yr	± 4% of audit standard and	Part 58, App A, Sec 3.5	Sec 10.2	External verification bias/accuracy
Flow rate audit	1/yr	±5% of design FR		"	
Temperature Audit	1/yr	± 2°C	not described	"	Calibration drift and memory effects
Pressure Audit		±10 mm Hg	not described		Calibration drift and memory effects

Table 14-2 Laboratory QC

Requirement	Frequency	Acceptance Criteria	CFR Reference	QA Guidance Document 2.12 Reference	Information Provided
Blanks					
Lot Blanks	3 filters per lot	±15 µg difference	Part 50, App. L, Sec 8.3	2.12 Sec. 7	Filter stabilization/equilibrium
Lab Blanks	3 per batch	±15 µg difference	"	2.12 Sec. 7.7	Laboratory contamination
Calibration/Verification					
	1/yr	Manufacturers spec.	Part 50, App. L, Sec 8.1	2.12 sec 7.2	Verification of equipment operation
Balance Calibration	1/yr	± 2°C	Not defined	QAPP Sec. 13/16	
Lab Temp. Calibration	1/yr	±2%	"	QAPP Sec. 13/16	Verification of equipment operation Verification of equipment operation
Lab Humidity Calibration					
Accuracy		17			
Balance Audit	1/year		Not defined	2.12 Sec 10.2	Laboratory technician operation
Balance Check	beginning, every 10th sample, end		Part 50, App. L, Sec 8.1	2.12 Sec. 7.9	Balance accuracy/stability
Calibration standards					
Working Mass Stds.	3-6 mo.	tolerance ≤ 25 µg	Not defined	2.12 Sec 4.3 and 7.3	Standards verification
Primary Mass Stds.	1/yr	tolerance ≤ 25 µg	"	"	Primary standards verification
Precision					
Duplicate filter weighings	1 per weighing session	±15 µg difference	Not defined	2.12 Tab 7-1, Sec 7-11 QAPP Sec. 13/16	Weighing repeatability/filter stability

14.1.1 Calibrations

Calibration is the comparison of a measurement standard or instrument with another standard or instrument to report, or eliminate by adjustment, any variation (deviation) in the accuracy of the item being compared[1]. The purpose of calibration is to minimize bias.

For PM2.5, calibration activities follow a two step process:

1. Certifying the calibration standard and/or transfer standard against an authoritative standard, and
2. Comparing the calibration standard and or transfer standard against the routine sampling/analytical instruments.

Calibration requirements for the critical field and laboratory equipment are found in Tables 14-1 and 14-2 respectively; the details of the calibration methods are included in the calibration Element (Element 16) and in the field and laboratory methods Elements (11 and 13, respectively).

14.1.2 Blanks

Blank samples are used to determine contamination arising from principally four sources: the environment from which the sample was collected/analyzed, the reagents used in the analysis, the apparatus used, and the operator/analyst performing the data operation. Three types of blanks will be implemented in the PM2.5 Program:

Lot Blanks - a shipment of 46.2mm filters will be periodically sent from U.S. EPA to the California PM2.5 labs. Each shipment must be tested to determine the length of time it takes the filters to stabilize. Upon arrival of each shipment, three lot blanks will be randomly selected from the shipment and be subjected to the conditioning/pre-sampling weighing procedures. The blanks will be weighed daily for a minimum of five days to determine the length of time it takes to maintain a stable weight reading.

Field Blanks - provide an estimate of total measurement system contamination. By comparing information from laboratory blanks against the field blanks, one can assess contamination from field activities. Details of the use of the field blanks can be found in field SOPs (Appendix E).

Lab Blanks -provides an estimate of contamination occurring at the weighing facility. Details of the use of the lab blanks can be found in lab SOPs (Appendix B).

Lab Blank Evaluation
Three (3) lab blanks will be weighed in each weighing session. The following statistics will be used for data evaluation purposes:

Difference for a Single Check *(d)* - The difference, *d*, for each check is calculated using Equation 1, where *X* represents the weight of the filter measured from its previous weighing and *Y* represents the weight of the filter measured from the current weighing session.

Equation 1 $$d = Y - X$$

Mean Difference for Batch (d_z) - The mean difference d_z for lab blanks within a weighing session batch is calculated using Equation 2 where d_1 through d_n represent individual differences (calculated from Equation 1) and *n* represents the number of blanks in the batch.

Equation 2

$$d_z = \frac{d_1 + d_2 + d_3 ....d_n}{n}$$

Corrective Action- The acceptance criteria for lab blanks is 15 µg difference as determined by Equation 1. However, the mean difference based upon the number of blanks in each batch will be used for comparison against the acceptance criteria. If the mean difference of the laboratory blanks is greater than 15µg, then the laboratory balance will be checked for proper operation and all the lab blanks in the weighing session will be re-weighed. Prior to re-weighing, the laboratory balance will be checked for proper operation. If the blank mean is still out of the acceptance criteria, all samples within the weighing session will be flagged with the appropriate flag, and efforts will be made to determine the source of contamination. If the mean difference of the laboratory blanks is greater than 20µg and 2 or more of the blanks were greater than 15µg, the laboratory weighing will stop until the issue is satisfactorily resolved. The laboratory analyst will alert the Laboratory Manager of the problem. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Lab blanks can be control charted (see Element 14.2). The batch difference calculation (Equation 2) can be used for control charting purposes.

Field Blank Evaluation

Field blanks will be weighed in the same weighing session as associated routine samples from the site. The following statistics will be generated for data evaluation purposes:

Difference for a Single Check *(d)* - The difference, *d*, for each check is calculated using Equation 1, where *X* represents the original weight of the filter and *Y* represents the filter weight after transport to and from the monitoring site including exposure in the sampler.

Equation 1

$$d = Y - X$$

Corrective Action- The acceptance criteria for field blanks is 30 µg difference as determined by Equation 1. If the field blank value is out of the acceptance criteria, efforts will be made to determine the source of contamination. In theory, field blanks should contain more contamination than laboratory blanks. Therefore, if the field blanks are outside of the criteria while the lab blanks are acceptable, weighing can continue on the next batch of samples while field contamination sources are investigated. The laboratory analyst will alert the Laboratory

Manager. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Field blanks can be control charted for each monitoring site (see Element 14.2). The difference calculation (Equation 1) can be used for control charting purposes.

14.1.3 Precision Checks

Precision is the measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. In order to meet the data quality objectives for precision, the GBUAPCD must ensure the entire measurement process is within statistical control. Two types of precision measurements will be made in the PM2.5 Program.

- Collocated monitoring
- Filter duplicates

Collocated Monitoring

In order to evaluate total measurement precision, collocated monitoring will be implemented, as referenced in 40 CFR. Therefore, every method designation ***will***:

.have 25% of the monitors collocated (values of .5 and greater round up).
.have at least 1 collocated monitor (if total number less than 4). The first collocated monitor must be the FRM.
.have 50% of the collocated monitors be FRM monitors and 50% must be the same method designation. If there is an odd number of collocated monitors required, bias in favor of the FRM.

The location of these monitors is described in the "1998 California Particulate Matter Monitoring Network Description", but it is anticipated that these sites will collect concentrations around the NAAQS, or will be sites where higher concentrations are expected.

Evaluation of Collocated Data- Collocated measurement pairs are selected for use in the precision calculations only when both measurements are above 6 µg/m^3. However, all collocated data will be reported to AIRS.

The following algorithms will be used to evaluate collocated data. These algorithms are included in *40 CFR Part 58 Appendix A*. The equation numbers in 40 CFR will also be utilized in this QAPP.

Percent Difference for a Single Check (d_i) - The percentage difference, d_i, for each check is calculated by using Equation 19, where X_i represents the concentration produced from the primary sampler and Y_i represents the concentration reported for the duplicate sampler.

$$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} - 100$$

Equation 19

Coefficient of Variation (CV) for a Single Check (CV_i) - The coefficient of variation, CV_i, for each check is calculated by dividing the absolute value of the percentage difference, d_i, by the square root of two as shown in Equation 20.

$$CV_i = \frac{|d_i|}{\sqrt{2}}$$

Equation 20

Precision of a Single Sampler - Quarterly Basis ($CV_{j,q}$) - For particulate sampler *j*, the individual coefficients of variation ($CV_{j,q}$) during the quarter are pooled using Equation 21, where $n_{j,q}$ is the number of pairs of measurements from collocated samplers during the quarter.

$$CV_{j,q} = \sqrt{\frac{\sum_{i=1}^{n_j} CV_i^2}{n_{j,q}}}$$

Equation 21

The 90 percent confidence limits for the single sampler's CV are calculated using Equations 22 and 23, where $c^2_{0.05,df}$ and $c^2_{0.95,df}$ are the 0.05 and 0.95 quantiles of the chi-square (c^2) distribution with $n_{j,q}$ degrees of freedom.

$$\text{Lower Confidence Limit} = CV_{j,q}\sqrt{\frac{n_{j,q}}{\chi^2_{0.95,\,n_{j,q}}}}$$

Equation 22

$$\text{Upper Confidence Limit} = CV_{j,q}\sqrt{\frac{n_{j,q}}{\chi^2_{0.05,\,n_{j,q}}}}$$

Equation 23

Precision of a Single Sampler - Annual Basis - For particulate sampler *j*, the individual coefficients of variation, CV_i, produced during the calendar year are pooled using Equation 21, where n_j is the number of checks made during the calendar year. The 90 percent confidence limits for the single sampler's CV are calculated using Equations 22 and 23, where $c^2_{0.05,df}$ and $c^2_{0.95,df}$ are the 0.05 and 0.95 quantiles of the chi-square (c^2) distribution with n_j degrees of freedom.

Corrective Action: Single Monitor - The precision data quality objective of 10% coefficient of variation (CV) is based upon the evaluation of three years of collocated precision data. The goal is to ensure that precision is maintained at this level. Therefore, precision estimates for a single pair of collocated instruments, or even for a quarter, may be greater than 10% while the three year average is less than or equal to 10%. Therefore, single collocated pairs with values >10% will be flagged and reweighed. If the value remains between 10-20% the field technician will be alerted to the problem. If the CV is greater than 20% for both the initial and reweigh, all the primary sampler data will be flagged from the last precision check and corrective action will be initiated. Paired CVs and percent differences will be control charted to determine trends (Element 14.2). The laboratory technician will alert the Laboratory Manager of the problem. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Corrective Action: Quarter - Usually, corrective action will be initiated and imprecision rectified before a quarter's worth of data fail to meet the 10% CV criterion. However in the case where the quarter's CV is greater than 20%, the routine data for that monitor for that quarter will be flagged. The problem and solution will be reported and appropriately filed under response and corrective action reports.

Duplicate Laboratory Measurements

During laboratory pre-weighing and post-weighing sessions, a routine filter from the sampling batch will be selected for a second weighing. Equations 1 and 2 will be generated for this information. The difference among the weights of these two filters must be less than 15µg. If this criterion is not met, the pair of values will be flagged. Failure may be due to transcription errors, microbalance malfunction, or that the routine samples have not reached equilibrium. Other QC checks (balance standards and lab blanks) will eliminate microbalance malfunction. If the duplicate does not meet the criterion, a second routine sample will be selected and reweighed as a second duplicate check. If this second check fails the acceptance criteria and the possibility of balance malfunction and transcription errors have been eliminated, all samples in the batch will be equilibrated for another 24 hours and reweighed. Corrective actions will continue until duplicate weights for the batch meet acceptance criteria.

14.1.4 Accuracy or Bias Checks

Accuracy is defined as the degree of agreement between an observed value and an accepted reference value. Four accuracy checks are implemented in the PM2.5 program:

- Collocated monitors
- Flow rate audits
- Balance checks
- FRM performance evaluations

Collocated Monitors

Although the collocated monitors are primarily used for evaluating and controlling precision, they can be used to determine accuracy or bias. By using Equation 19 to determine percent difference, one can track trends or bias between the two instruments without knowing which instrument is producing the "true" value. Use of the FRM performance evaluation information (discussed below) in conjunction with collocation data should help improve the quality of data.

Corrective Action - The percent difference of the paired values will be control charted to determine trends. If it appears that there is a statistically significant bias (> 10% at the 90% confidence level) between the pairs, corrective action will be initiated. The process will include eliminating uncertainties that may be occurring at filter handling, transport and laboratory stages, in order to determine that the bias is truly at the instrument. Corrective actions at the instrument will include multi-point temperature, pressure, and flow rate checks as well as complete maintenance activities. Additional corrective action could include a request for vendor servicing or a request for Region IX to implement an FRM performance evaluation.

Flow Rate Audits

Since the GBUAPCD will be implementing manual, in lieu of continuous sampling devices, we will implement a flow rate audit by the ARB every year. The GBUAPCD will conduct flow audits quarterly. Details of the implementation aspects of the audits are included in Element 11. An audit is made by measuring the analyzer's normal operating flow rate using a certified flow rate transfer standard. The flow rate standard used for auditing will not be the same flow rate standard used to calibrate the analyzer. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. The ARB and the GBUAPCD will report the audit (actual) flow rate and the corresponding flow rate indicated or assumed by the sampler. The procedures used to calculate measurement uncertainty are described below.

Accuracy of a Single Sampler - Single Check (Quarterly) Basis (d_i) - The percentage difference (d_i) for a single flow rate audit *i* is calculated using Equation 13, where X_i represents the audit standard flow rate (known) and Y_i represents the indicated flow rate.

$$d_i = \frac{Y_i - X_i}{X_i} * 100$$

Equation 13

Bias of a Single Sampler - Annual Basis (D_j) - For an individual particulate sampler *j*, the average (D_j) of the individual percentage differences (d_i) during the calendar year is calculated using Equation 14, where n_j is the number of individual percentage differences produced for sampler *j* during the calendar year.

$$D_j = \frac{1}{n_j} * \sum_{i=1}^{n_j} d_i$$

Equation 14

Bias for Each U.S. EPA Federal Reference and Equivalent Method Designation Employed by the GBUAPCD - Quarterly Basis ($D_{k,q}$) - For method designation *k* used by the reporting organization, quarter *q*'s single sampler percentage differences (d_i) are averaged using Equation 16, where $n_{k,q}$ is the number of individual percentage differences produced for method designation *k* in quarter *q*.

$$D_{k,q} = \frac{1}{n_{k,q}} * \sum_{i=1}^{n_{k,q}} d_i$$

Equation 16

Corrective Action - The single sampler accuracy performance goal is ±4% of the audit transfer standard and ±5% of design flow rate. If the audit violates the acceptance criteria, the sample operator will check the sampling instrument for internal and external leaks, ensure that temperature and pressure are within acceptable ranges, and verify the flow rate. A reaudit will be scheduled. If the audit is still unacceptable, a multi-point calibration followed by a one-point verification is required. Routine data, back to an acceptable audit or the most recent multi-point calibration, will be flagged and reviewed to determine validity (see Element 23). In addition, one would expect that the flow rate calibration verification checks that will be implemented every five sampling events (see Element 16) would indicate a drift towards unacceptable accuracy. If a review of the flow rate calibration verification check data does not show a problem, there is a potential that one or both of the flow rate standards need to be recertified.

Balance Checks

Balance checks are frequent checks of the balance working standards (100 and 200 mg standards) against the balance to ensure that the balance is within acceptance criteria throughout the pre- and post-sampling weighing sessions. The GBUAPCD will use ASTM class 1 weights for its primary and secondary (working) standards. Both working standards will be measured at the beginning and end of the sample batch and one standard will be selected for a measure after every 10 filters. Balance check samples can be controlled charted (see Table 14-3) when needed.

Balance Check Evaluation- The following algorithm will be used to evaluate the balance checks:

Difference for a Single Check *(d_y)* - The difference, d_y, for each check is calculated using Equation 3, where *X* represents the certified mass weight and *Y* represents the reported weight .

Equation 3

$$d_y = Y - X$$

Corrective Action - The difference among the reported weight and the certified weight must be within ± 3µg. Since this is the first check before any pre- or post-sampling weighings, if the acceptance criteria is not met, corrective action will be initiated. Corrective action may be as simple as allowing the balance to perform internal calibrations or to sufficiently warm-up, which may require checking the balance weights a number of times. If the acceptance criteria is still not met, the laboratory technician will be required to verify the working standards to the primary standards. Finally, if it is established that the balance does not meet acceptance criteria for both the working and primary standards, and other troubleshooting techniques fail, the *Sartorius* service technician (see Element 15) will be called to perform corrective action.

If the balance check fails acceptance criteria during a run, the 10 filters weighed prior to the failure will be rerun. If the balance check continues to fail, troubleshooting, as discussed above, will be initiated. The values of the 10 samples weighed prior to the failure will be recorded and flagged, but will be remain with the unweighed samples in the batch to be reweighed when the balance meets the acceptance criteria. Any balance check outside the acceptance criteria will be flagged.

FRM Performance Evaluation

The Federal Reference Method (FRM) Performance Evaluation is a quality assurance activity which will be used to evaluate measurement system bias of the PM2.5 monitoring network. The pertinent regulations for this performance evaluation are found in 40 CFR Part 58, Appendix A, section 3.5.3[2]. The strategy is to collocate a portable FRM PM2.5 air sampling instrument with an established routine air monitoring site, operate both monitors in exactly the same manner, and then compare the results of this instrument against the routine sampler at the site. The U.S. EPA will be implementing this program and will inform the GBUAPCD when an evaluation will be conducted. The evaluation will be conducted on a regularly scheduled sampling day and the filters from the evaluation instrument will be sent to a national laboratory in Region 10 for measurement. The comparison of data will be accomplished by U.S. EPA personnel using the Aerometric Information Retrieval System (AIRS) data base. It must be noted that the performance evaluation is an estimate of the uncertainty of the measurement system and not the

instrument. Therefore, biases may be attributed to sample handling, transportation and laboratory activities as well as to the instrument. The statistics used in the assessment are included in 40 CFR Part 58[2].

Corrective Action - The U.S. EPA will notify the GBUAPCD of the evaluation results within 10 days of sampling. The bias acceptance criteria for the data comparison is ± 10% for concentrations over 6µg/m3. If it appears that there is a bias, corrective action will be initiated. The process will include an attempt to determine at what data collection phase(s) the majority of the measurement errors are occurring. This may require that Region IX conduct additional FRM performance evaluations to troubleshoot the process.

14.2 Control Charts

Control charts will not be used extensively by the GBUAPCD, however, the data used to produce them will be available and they will be generated when and if the need arises. The control charts can be used as an "early warning system" to evaluate trends in precision and bias.

Table 14-3 Control Charts

QC Check	Plotting technique
Flow rate calibration verification check	single values plotted
Lab/Field Blanks	mean value of each batch
Flow rate audit	single values plotted
Balance check	mean value of each batch
Collocated monitoring pairs	Percent difference each pair charted by site, coefficient of variation each pair, coefficient of variation of all sites per quarter.

References

1. Taylor, J.K. 1987 Quality Assurance of Chemical Measurements. Lewis Publishers, Chelsea, Michigan. 328pp.

2. U.S. EPA (1997b) Revised Requirements for Designation of Reference and Equivalent Methods for PM2.5 and Ambient Air Quality Surveillance for Particulate Matter-Final Rule. 40 CFR Parts 53 and 58. *Federal Register*, **62**(138):38763-38854. July 18, 1997.

15.0 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

15.1 Purpose/Background

The purpose of this element in the GBUAPCD QAPP is to discuss the procedures used to verify that all instruments and equipment are maintained in sound operating condition and are capable of operating at acceptable performance levels. All instrument inspection and maintenance activities are documented in the GBUAPCD's laboratory and field operations SOPs (Appendix B and Appendix E, respectively).

15.2 Testing

All PM2.5 samplers used in the GBUAPCD's PM2.5 Ambient Air Quality Monitoring Network will be designated federal reference methods (FRM) that have been certified as such by U.S. EPA. Therefore, they are assumed to be of sufficient quality for the data collection operation. Testing of such equipment is accomplished by U.S. EPA through the procedures described in 40 CFR Part 50[1]. Prior to field installation, ARB will assemble and run the GBUAPCD samplers at the acceptance laboratory, adhering to the Acceptance Test procedure in Appendix E. The GBUAPCD field operators will perform external and internal leak checks and temperature, pressure and flow rate multi-point verification checks. If any of these checks are out of specification (see Table 14-1), the GBUAPCD will contact the vendor for initial corrective action. Once installed at the site, the GBUAPCD field operators will run the tests mentioned above. If the sampling instrument meets the acceptance criteria, it will be assumed to be operating properly. These tests will be documented and filed as indicated in Element 9.

15.3 Inspection

Inspection of various equipment and components is provided here. Inspections are subdivided into two Elements: one pertaining to gravimetric laboratory issues and one associated with field activities.

15.3.1 Inspection in Gravimetric Laboratory

There are several items that need routine inspection in the gravimetric laboratory. Table 15-1 details the items to inspect and how to appropriately document the inspection.

Table 15-1 Inspections in the Gravimetric Laboratory

Item	Inspection Frequency	Inspection Parameter	Action if Item Fails Inspection	Documentation Requirement
Laboratory Temperature	Daily	20 - 23^{O} C	1) Check HVAC System	1) Document in laboratory log book 2) Notify Lab Manager
Laboratory Humidity	Daily	30 - 40 %RH	1) Check HVAC System	1) Document in laboratory log book 2) Notify Lab Manager
Dust, damp mop laboratory	Monthly	Visually inspect	Clean Laboratory	Document in Laboratory log book

15.3.2
Field Items

There are several items to inspect in the field before and after a PM2.5 sample has been taken. Table 15-2 details the inspections performed in the field before and after samples are taken.

Table 15-2 Inspection of Field Items

Item	Inspection Frequency	Inspection Parameter	Action if Item Fails Inspection	Documentation Requirement
Sample downtube	Every site visit	Visible particulate	Clean with a clean, lint-free cloth	Document in log book
WINS Impactor well	Every site visit	"Cone" shape of particulate on impactor well	Replace impactor well (including new impactor oil)	Document in log book
Rain collector	Every site visit	>1/3 full	Empty	Document in log book
O-rings	Every site visit	Any damage	Replace	Document in log book
Filter Cassettes	After each sample run	Visible particulate	Check downtube and WINS impactor	Document in log book
Cassette Seals	Each sample	Clean and smooth	Clean with a clean, lint-free cloth, or replace as needed	Document when replaced
In-line filter	Every 6 months	Loaded particulate	Replace	Document in log book
Battery	Every 6 months	Decrease in voltage	Replace	Document in log book

15.4 Maintenance

There are many items that require attention and regular maintenance in the PM2.5 network. This Element describes those items according to whether they are gravimetric laboratory items or field items.

15.4.1
Laboratory Maintenance Items

The successful execution of a preventive maintenance program for the gravimetric laboratory will go a long way towards the success of the entire PM2.5 program. In the Great Basin Unified APCD PM2.5 network, gravimetric laboratory preventive maintenance is handled by GBUAPCD personnel and contractors**.** The laboratory technician takes care of all preventive maintenance associated with the heating, ventilation, and air conditioning system (HVAC). Preventive maintenance for the microbalance is performed by a *Sartorius* service technician contracted by GBUAPCD. Preventive maintenance for the microbalance is scheduled to occur at initial set-up and every 12 months thereafter. In the event that there is a problem with the microbalance that cannot be resolved by GBUAPCD staff, the *Sartorius* service technician can be contacted.

The following table details the gravimetric laboratory maintenance items, replacement frequency, and specifies the party responsible for performing the maintenance.

Table 15-3 Preventive Maintenance in Gravimetric Laboratories

Item	Maintenance Frequency	Responsible Party
Multi-point Microbalance	Yearly Yearly	*Sartorius Service Technician*
Polonium strip replacement	6 Months	*Laboratory Technician*
Comparison of NIST Standards to laboratory working and primary standards	Yearly	*Laboratory Technician*
Cleaning gravimetric laboratory	Monthly	*Laboratory Technician*
HVAC air filter inspection replacement	Monthly 6 Months, or as needed	*Laboratory Technician*
Clean sticky floor mat (just inside gravimetric laboratory)	Weekly	*Laboratory Technician*
HVAC system preventive maintenance	6 Months, or as needed	*Laboratory Technician*
Computer Back-up	Monthly	*Laboratory Technician*
Computer Virus Check	Weekly	*Laboratory Technician*
Computer system preventive maintenance (clean out old files, compress hard drive, inspect)	Yearly	*Laboratory Technician*

15.4.2
Maintenance Items

There are many items associated with appropriate preventive maintenance of the equipment in a successful field program. Table 15-4 details the appropriate maintenance checks of the PM2.5 samplers and their frequency.

Table 15-4 Preventive Maintenance of Field Items

Item	Maintenance Frequency	Location Maintenance Performed
Clean WINS PM2.5 Impactor	Every 5 sample episodes	At Field Office
Clean PM10 Inlet	Weekly	At Site
Inspect Filter Cassettes	Each run	At Site and Lab
Replace In-line filter	6 Months	At Site
Inspect Air Screens (under sampler's rain hood)	Monthly	At Site
Clean filter holding area, internal and external	Weekly	At Site
Sample Pump Rebuild	Every 10,000 hours of operation	At Field Office

References

The following documents were utilized in the development of this Element:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760. July 18,1997.

16.0 Instrument Calibration and Frequency

16.1 Instrumentation Requiring Calibration

16.1.1 Mass Analysis by Gravimetry-Laboratory Microbalance

The laboratory support for Great Basin Unified APCD includes calibration of the *Sartorius M5P* microbalance. As indicated in Element 13, the balance is calibrated (and mass standard check weights recertified) once per year under a service agreement. The service technician performs routine maintenance and makes any balance response adjustments that the calibration shows to be necessary. During the visit by the service technician, both the in-house primary and secondary (working) standards are checked against the service technician's standards to ensure acceptability. All of these actions are documented in the service technician's report, a copy of which is provided to the laboratory manager, which after review, is appropriately filed. The laboratory mass standards are also sent to the manufacturer annually for recertification. The mass standard recertification documents are reviewed by the laboratory manager and filed appropriately.

16.1.2 Flow Rate - Standards Laboratory

The GBUAPCD Laboratory support performs the comparison of the flow rate transfer standard to a NIST-traceable primary flow rate standard and once every three years sends the primary standard to the manufacturer for recertification. The field personnel use a dry gas meter (DGM) for field calibrations of the Andersen Sequential Sampler. The Chinook Engineering Streamline Flowrate Transfer Standard (FTS) is being used for flow rate verifications of all of the District's PM 2.5 samplers and also for calibrations of the Rupprecht & Patashnick Sequential Samplers flow rates. Both of these devices have the advantage of providing volumetric flow rate values directly, without requiring conversion from mass flow measurements or water vapor corrections. In addition, the BIOS graphite piston flowmeter will be used in the GBUAPCD Laboratory as a primary standard, where the absence of wind and relatively low humidity will have less negative effect on flowmeter performance.

Upon initial receipt of any new, repaired, or replaced PM 2.5 sampler, field support staff will perform a multipoint flow rate calibration verification on the sampler flow rate to determine whether initial performance is acceptable. Once sampler flow rates are accepted, the field personnel perform the calibration and verifications at the frequency specified in Element 14. The Laboratory directly performs or arranges to have another party perform the tests needed to recertify the GBUAPCD's standards.

16.1.3 Sampler Temperature, Pressure, Time Sensors-District Laboratory

The GBUAPCD Laboratory arranges support for the field calibration of temperature and pressure sensors by preparing and lab testing the temperature comparison apparatus. Field temperature sensors are compared against an ASTM mercury-in-glass thermometer bearing an NIST certification.

A stationary mercury barometer in the Laboratory is used as a primary standard to calibrate the electronic aneroid barometers that go out in the field as transfer standards.

The GBUAPCD Laboratory verifies the time with the NIST@ Time calibration service in Boulder, Colorado, against which other lab and field devices, including the volumetric flow meter and FRM samplers, are compared.

16.1.4 Field

As indicated in 16.1.3, the following calibrations are performed in the field:

- calibration of DGM and MFM in FRM samplers against the working standards of DGM and MFM, respectively
- calibration of sampler temperature and pressure sensors against the working temperature standard and working pressure standard
- activation temperature of irreversible thermometer indicators, normally located in the coolers in which filters are transported to and from the sampler in the field, will be verified every six months during semiannual calibration procedures. Activation temperature will be compared to working temperature standard along with Micro 8000 temperature sensor and data logger, which is used on at least a quarterly schedule for QA/QC.

The field equipment and calibration instruments will follow the calibration and recertification schedule as listed in Table 16-1.

Table 16-1 Field Equipment Calibration/Certification Schedule

Instrument	Frequency
Andersen Sequential Sampler	Biannual (every 6 months) or if verification check fails
Dry Gas Meter	"
Ambient Temperature Sensor	"
Filter Temperature Sensor	"
Carousel Temperature Sensor	"
DGM Temperature Sensor	"
Ambient Pressure Sensor	"
R&P Sequential Sampler	Biannual or if verification check fails
mass flow meter	"
Ambient Temperature Sensor	"
Filter Temperature Sensor	"
Ambient Pressure Sensor	"
Calibration Standard DGM	Biannual
Calibration Standard FTS orifice	Annual
Calibration Standard Temperature Sensor	Annual
Calibration Standard Tegam (Temperature Calibrator for Andersen)	Annual
Calibration Standard Pressure Sensor	Annual
Temperature Verification Standard	Annual
Pressure Verification Standard	Annual
Clock/Timer Verification Standard	N/A

16.2 Calibration Methods

16.2.1 Laboratory- Gravimetric (Mass) Calibration

The calibration and QC (verification) checks of the microbalance are addressed in Elements 13.3 and 16.1.1 and Appendix B of this QAPP. For the following three reasons, the multipoint calibration for this method will be zero, 100 and 200µg: 1) the required sample collection filters weigh between 100 and 200 mg, 2) the anticipated range of sample loadings for the 24 hour sample period is rarely going to be more than 200 µgs, and 3) the lowest, commercially available check weights that are certified according to nationally accepted standards are only in the single milligram range. Since the critical weight is not the absolute unloaded or loaded filter weight, but the difference between the two, the lack of microgram standard check weights is not considered cause for concern about data quality, as long as proper weighing procedure precautions are taken for controlling contamination, or other sources of mass variation in the procedure (see SOP in the Appendix B).

16.2.2 Laboratory (and Field) -Flow Calibration.

Monthly Maintenance QC Checksheets will be submitted to the Air Monitoring managers with the monthly data to ensure QA/QC checks are being performed per scheduled frequencies listed in Tables 6-4 and 7-4 in Elements 6 and 7, respectively.

Method Summary: After equilibrating the calibration device to the ambient conditions of the sampler, install a filter cassette containing an unused 46.2 mm filter in the sampler. After removing the inlet from the sampler, connect the flow calibration device on the sampler down

tube. If the sampler has not been calibrated before, or if the previous calibration was not acceptable, perform a leak check according to the manufacturer's operational instruction manual, which is incorporated into the SOP in Appendix E.

Otherwise, place the sampler in calibration mode and perform a three-point calibration/verification or a one-point flow rate verification. The field staff will only perform a leak check after calibration or if verification is outside of the acceptance criteria.

Following the calibration or verification, turn off the sampler pump, remove the filter cassette from the filter cassette holder, remove the flow rate calibration device, (and flow adaptor device if applicable), and replace the sampler inlet. If the flow rate is determined to be outside of the required target flow rate, attempt to determine possible causes by minor diagnostic and trouble shooting techniques (e.g., leak checks), including those listed in the manufacturer's operating instruction manual. Do **not** attempt field repairs or flow rate adjustments.

16.2.3 Sampler Temperature Calibration Procedure.

Both the ambient air and filter temperature sensors will be calibrated once per year. The ambient air sensor is located inside the shielded fixture on the outside of the PM2.5 sampler and is easy to unfasten and remove for comparison to a transfer standard for temperature. The three-point verification/calibration will be conducted at the field site.

The filter temperature sensor is located in the (open) space just below the filter cassette. It is threaded through the walls of the filter cassette holding assembly section of the sampler and removal of plastic or metal fittings is required to remove the sensor and its associated wiring. It may be difficult to calibrate this sensor in the field. Be careful when removing the filter temperature sensor- do not gall the fittings since this could start an internal leak after the installation. A sampler leak check must be performed after reinstallation of the filter temperature sensor.

Several steps to follow in calibrating the ambient air temperature sensor are given in the SOP in Appendix E and in the following summary. Refer to the operator's instruction manual for sampler-specific procedures and instructions.

Remove the ambient temperature sensor from the radiation shield. Prepare a convenient container (an insulated vacuum wide mouth thermos bottle) for the hot temperature water bath, ambient temperature water bath and the ice slurry bath. Wrap the sensor(s) and a thermometer together with rubber band, ensure that all the probes are at the same level. Prepare the ambient or ice slurry solution according to the SOP in Appendix E. Immerse the sensor(s) and the attached thermometer in the ambient temperature bath. Wait at least 5 minutes for the ambient thermal mass and the sensor/thermometer to equilibrate. Wait at least 15 minutes for equilibration with

the ice slurry before taking comparative readings.

For each thermal mass, in the order: Cold, Ambient, Hot, make a series of five measurements per temperature bath, taken about one minute apart. If the measurements indicate equilibrium,

average the five readings and record the result as the sensor temperature relative to the thermometer.

A similar process will be used to verify the calibration of continuously-reading temperature sensors used in the gravimetric laboratory.

16.2.4 Sampler Pressure Calibration Procedure. Summarized here and detailed version attached as SOP in Appendix E.

General: According to ASTM Standard D 3631 (ASTM 1977), a barometer can be calibrated by comparing it with a secondary standard traceable to a NIST primary standard.

Precautionary Note: Protect all barometers from violent mechanical shock and sudden changes in pressure. A barometer subjected to either of these events must be recalibrated. Maintain the vertical and horizontal temperature gradients across the instruments at less than 0.1°C/m. Locate the instrument so as to avoid direct sunlight, drafts, and vibration.

A Fortin mercury type of barometer is used in the Laboratory to calibrate and verify the aneroid barometer used in the field to verify the barometric sensors of PM2.5 samplers. Details are provided in 16.4.1, below, and in Appendix E.

16.2.5 Sampler and Standard Volumetric Flow Rate Sensors with Built-in Clocks

Time can be verified over phone lines from NIST (in Boulder, Colorado, directly or through the NIST calibration service in Gaithersberg, MD). See Appendix B for details (or in NIST standardization handbooks and catalogues).

16.2.6 Procedure for Verifying Relative Humidity Control/Monitoring data for the Gravimetric Laboratory Only

A thermometer bearing an NIST-traceable certification is used by laboratory personnel to verify the temperature and a Psychrodyne powered wet bulb/dry bulb psychrometer is used to verify the relative humidity recorded by the Dickson weekly chart recorder and the Vaisala HMP35C sensor used to continuously monitor environmental conditions within the gravimetric laboratory. For details of this procedure, see Appendix B.

16.3 Calibration Standard Materials and Apparatus

Table 16-2 presents a summary of the specific standard materials and apparatus used in calibrating measurement systems for parameters necessary to generate the PM2.5 data required in 40 CFR Part 50, Appendix L, and Part 58.

Table 16-2 Standard Materials and/or Apparatus for PM2.5 Calibration

Parameter M-Material A=Apparatus	**Std. Material**	**Std. Apparatus**	**Mfr. Name**	**Model #**	**Variable Control Settings**
Mass M	Standard Check weight	NA	*Troemmer*	Class 1	NA
Temperature					
M+A	Hg	Thermometer	*Brooklyn*	PM	*
M+A	H20	Thermal mass (Thermos)	*TBD*	TBD	NA
M+A	NA	Thermistor	*TBD*	TBD	*
Pressure					
M+A	Hg	Fortin			*
A	NA	Aneroid	*TBD*		*
Flow Rate					
A	NA	Piston Meter	*BIOS*		*
A		Dry Gas Meter	*TBD*		NA
A		Mass Flow Meter	*TBD*		NA
A		Adapter	*Andersen, R&P*		
A		Orifice Flow Meter	*Chinook Engrg.*		
Relative Humidity			*Environmental*		
A	NA	Sling Psychrometer	*Tectronics Corp.*	Psychro-Dyne	

*- See manufacturer's operating manual an/or instruction sheet

16.4 Calibration Standards

Flow Rate

The flow rate standard apparatus used for flow-rate calibration (field- NIST-traceable, DGM, MFM, and orifice flow meter; Laboratory-NIST-traceable graphite piston flow meter and time monitor) has its own certification and is NIST-traceable. A calibration relationship for the flow-rate standard, such as an equation, curve, or family of curves, is established by the manufacturer (and verified if needed) that is accurate to within 2% over the expected range of ambient temperatures and pressures at which the flow-rate standard is used. The GBUAPCD flow rate standard will be recalibrated every three months in the case of the MFM, every six months for the DGM, and every year in the case of the orifice flow meter.

The actual frequency with which this recertification process must be completed depends on the type of flow rate standard- some are much more likely to be stable than others. The Laboratory will maintain a control chart (a running plot of the difference or % difference between the flow-rate standard and the NIST-traceable primary flow-rate or volume standard) for all comparisons. In addition to providing excellent documentation of the certification of the standard, a control chart also gives a good indication of the stability of the standard. If the two standard-deviation control limits are close together, the chart indicates that the standard is very stable and could be certified less frequently. The minimum recertification frequency is once per year. On the other hand, if the limits are wide, the chart would indicate a less stable standard that will be recertified more often. Also, field staff who conduct field calibrations will track changes from recertification to recertification to assure that performance is not compromised.

Temperature

The operations manuals associated with the sequential GBUAPCD samplers identify types of temperature standards recommended for calibration and provide a detailed calibration procedure for each type that is specifically designed for the particular sampler.

The U.S. EPA Quality Assurance Handbook, Volume IV (EPA 1995), Section 4.3.5.1, gives information on calibration equipment and methods for assessing response characteristics of temperature sensors.

The temperature standard used for temperature calibration will have its own certification and be traceable to a NIST primary standard. A calibration relationship to the temperature standard (an equation or a curve) will be established that is accurate to within 2% over the expected range of ambient temperatures at which the temperature standard is to be used. The temperature standard must be reverified and recertified at least annually. The actual frequency of recertification depends on the type of temperature standard; some are much more stable than others. The best way to determine recertification requirements is to keep a control chart. The ARB will use an ASTM- or NIST-traceable mercury in glass thermometer, for laboratory calibration.

Great Basin Unified APCD Standards

The temperature sensor standards chosen by the lab and field staff and managers are based on standard materials contained in standardized apparatus; each has been standardized (compared in a strictly controlled procedure) against temperature standards the manufacturers obtained from NIST.

The GBUAPCD Laboratory standard is a NIST-traceable glass mercury thermometer from the *Brooklyn Thermometer Company@*, with a certificate summarizing the company's NIST traceability protocol and documenting the technician's signature, comparison date, identification of the NIST standard used, and the mean and standard deviation of the comparison results.

The GBUAPCD field temperature standards are thermocouples with digital readout modules. Each probe is calibrated with an NIST-traceable thermometer before being used in the field.

Pressure

The Fortin mercurial type of barometer works on fundamental principles of length and mass and is therefore more accurate but more difficult to read and correct than other types. By comparison, the precision aneroid barometer is an evacuated capsule with a flexible bellows coupled through mechanical, electrical, or optical linkage to an indicator. It is potentially less accurate than the Fortin type but can be transported with less risk to the reliability of its measurements and presents no damage from mercury spills. The Fortin type of barometer is best employed as a higher quality laboratory standard which is used to adjust and certify an aneroid barometer in the laboratory.

16.4.1 Standards Lab

The GBUAPCD pressure standard is a Fortin-type mercury barometer.

16.4.2 Field

The field working standard is an aneroid barometer with digital readout.

16.5 Calibration Frequency

See Table 14-1 for a summary of field QC checks that includes frequency and acceptance criteria and references for calibration and verification tests of single and sequential sampler flow rate, temperature, pressure, and time. See Table 14-2 for a similar summary of laboratory QC, including frequency of primary and working mass standards and conditioning/weighing room temperature and relative humidity.

The field sampler flow rate, temperature and pressure sensor verification checks include 1-point checks at least monthly and multipoint checks (verification without adjustment unless needed as determined independently and calibration performed by the vendor's authorized service representative) at least annually, as proven by tracking on control charts.

All of these events, as well as sampler and calibration equipment maintenance will be documented in field data records and notebooks and annotated with the flags required in Appendix L of 40 CFR Part 50, the manufacturer's operating instruction manual and any others indicated in Element 22.7.2 of this document. Laboratory and field activities associated with equipment used by the respective technical staff will be kept in record notebooks as well. The records will normally be controlled by the managers, and located in the labs or field sites when in use or at the manager's offices when being reviewed or used for data validation.

References

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3. .EPA (1997a) National Ambient Air Quality Standards for Particulate Matter - Final Rule. 40 CFR Part 50. *Federal Register*, **62**(138):38651-38760. July 18,1997.

4. EPA. 1997b. Ambient air monitoring reference and equivalent methods. U.S. Environmental Protection Agency. 40 CFR Part 53, as amended July 18, 1997.

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17.0 Inspection/Acceptance for Supplies and Consumables

17.1 Purpose

The purpose of this element is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the PM2.5 Program. The Great Basin Unified APCD PM2.5 monitoring network relies on various supplies and consumables that are critical to its operation. By having documented inspection and acceptance criteria, consistency of the supplies can be assured. This Element details the supplies/consumables, their acceptance criteria, and the required documentation for tracking this process.

17.2 Critical Supplies and Consumables

There are many components to the PM2.5 monitoring network. This Element attempts to describe the needed supplies for this PM2.5 monitoring network and includes items for the weighing room laboratory and the field. Table 17.0.1 details the various components.

Table 17.0.1 Critical Supplies and Consumables

Area	Item	Description	Vendor	Model Number
Sampler	Impactor Oil	Tetramethyltetraphenyl-trisiloxane	Dow Corning	
Sampler	37 mm Glass Fiber Filter	For use in impactor well	*To be determined*	
Sampler	Rain Collector	Glass	R & P, Andersen	*To be determined*
Sampler	O-Rings	The O-rings that seal in the filter cassette when it is placed in the sampler.	*To be determined*	
Sampler	In-line Filter	Downstream of sample collection and upstream of sample pump.	R & P, Andersen	*To be determined*
Sampler	Battery	Internal Sampler Battery.	R & P, Andersen	*To be determined*
Sampler	Fuses	In sampler	R & P, Andersen	*To be determined*
Sampler	Floppy Disks	3.5" Pre-formatted	Purchase locally	
Filter	Filters	46.2 mm teflon	Whatman	
Filter	Petri-dish	47 mm with securing ring.	Gelman	
Filter	Filter Cassettes (single)	As per CFR design	R & P, Andersen	#N/A
Filter	Filter Cassette Holder, Protective Containers	For securing cassette	*To be determined*	#N/A
Filter	Sequential Sampler Cassette Holder	For use with Andersen and R&P Samplers	*To be determined*	#N/A
Filter	Filter Handling Containers	For transport to and from the field	*To be determined*	#N/A
Weigh Room	Staticide	Anti-static solution	Cole-Parmer	E-33672-00
Weigh Room	Static Control Strips	Polonium 500µCi	Nuclear Products	110653
Weigh Room	Air Filters	High Efficiency	Purchase Locally	
All	Powder Free Antistatic Gloves	Vinyl, Class M4.5	Fisher Scientific	Small 11-393-85A, Medium 11-393-85A, Large 11-393-85A, Extra Large 11-393-85A
All	Low-lint wipes	4.5" x 8.5" Cleaning Wipes	Kimwipes	34155

17.3 Acceptance Criteria

Acceptance criteria must be consistent with overall project technical and quality criteria. Some of the acceptance criteria is specifically detailed in 40 CFR Part 50. Other acceptance criteria such as observation of damage due to shipping can only be performed once the equipment has arrived on site.

Table 17.0.2 details the acceptance test and limits for procurement of supplies and consumables to be utilized in the GBUAPCD PM2.5 network.

17.4 Tracking and Quality Verification of Supplies and Consumables

Tracking and quality verification of supplies and consumables have two main components. The first is the need of the end user of the supply or consumable to have an item of the required quality. The second need is for the purchasing department to accurately track goods received so that payment or credit of invoices can be approved. In order to address these two issues, the following procedures outline the proper tracking and documentation procedures to follow:

1. Receiving personnel will perform a rudimentary inspection of the packages as they are received from the courier or shipping company. Note any obvious problems with a receiving shipment such as crushed box or wet cardboard.

2. The package will be opened, inspected and contents compared against the packing slip.

3. Supply/consumable will be compared to the acceptance criteria in Table 17.0.2.

4. If there is a problem with the equipment/supply, note it on the packing list, notify the supervisor of the receiving area and immediately call the vendor.

5. If the equipment/supplies appear to be complete and in good condition, sign and date the packing list and send to accounts payable so that payment can be made in a timely manner.

6. Notify appropriate personnel that equipment/supplies are available. For items such as the 46.2 mm Teflon filters, it is critical to notify the laboratory manager of the gravimetric laboratory so sufficient time for de-gassing of the filters can be allowed.

7. Stock equipment/supplies in appropriate pre-determined area.

8. For supplies, consumables, and equipment used throughout the PM2.5 program, document when these items are changed out. If available, include all relevant information such as: model number, lot number, and serial number.

Table 17.0.2 Acceptance Criteria for Supplies and Consumables

Equipment	Acceptance Criteria	Action if Requirements not met
Impactor Oil	Oil identified as Tetramethyltetraphenyl-trisiloxane	Return
37mm Glass Fiber Filter	Filters of the correct size and quality	Return
Rain collector	Not broken	
O-Rings	Of the correct size	Return
In-line Filter	Of the correct size	Return
Battery	Correct size amd voltage	Return
Fuses	Correct size and specification	Return
Floppy disks	Undamaged and pre-formatted	Return
Filters, 46.2mm Teflon	Tested and Accepted by the U.S. EPA with documentation of acceptance in package. Should meet visual inspection and pre-weight (110-160mg) criteria	Call David Lutz, U.S. EPA, (919) 541-5476
Petri dish	Clean and appropriately sized for 46.2 mm filters	Return
Filter Cassettes (single)	Of the correct type and make	Return
Filter Cassette Holder, Protective Container	Of the correct size so that filter cassettes will not move around that could potentially lead to dislodging particulate	Return
Sequential Sampler Cassette Holder	Of the correct type for use with the sequential sampler model	Return
Filter Handling Containers	Clean	Clean
Anti-Static Solution	Of the correct type	Return
Static Control Strips	Manufactured within past 3 months and between 400 and 500µCi of Polonium	Call Vendor
Air Filters	Of the size and quality specified	Return
Powder-Free Anti-static Gloves	Of the size and quality specified	Return
Cleaning Wipes	Of the quality specified	Return

18.0 Data Acquisition Requirements

This Element addresses data not obtained by direct measurement from the PM2.5 Ambient Air Quality Monitoring Program. This includes both outside data and historical monitoring data. Non-monitoring data and historical monitoring data are used by the Program in a variety of ways. Use of information that fails to meet the necessary Data Quality Objectives (DQOs) for the PM2.5 Ambient Air Quality Monitoring Program can lead to erroneous trend reports and regulatory decision errors. The policies and procedures described in this element apply both to data acquired through the Great Basin Unified APCD monitoring program and to information previously acquired and/or acquired from outside sources.

18.1 Acquisition of Non-Direct Measurement Data

The PM2.5 Ambient Air Quality Monitoring Program relies on data that are generated through field and laboratory operations, however, other significant data are obtained from sources outside the GBUAPCD or from historical records. This Element lists these data and addresses quality issues related to the PM2.5 Ambient Air Quality Monitoring Program.

Chemical and Physical Properties Data

Chemical and physical and chemical properties data and conversion constants are often required in the processing of raw data into reporting units. This type of information that has not already been specified in the monitoring regulations will be obtained from nationally and internationally recognized sources. The following sources may be used in the PM2.5 Ambient Air Quality Monitoring Program without prior approval:

- National Institute of Standards and Technology (NIST)
- ISO, IUPAC, ANSI, and other widely-recognized national and international standards organizations
- U.S. EPA
- The current edition of certain standard handbooks may be used without prior approval. Two that are relevant to the fine particulate monitoring program are CRC Press' *Handbook of Chemistry and Physics*, and *Lange's Handbook.*

Geographic Location

Another type of data that will commonly be used in conjunction with the PM2.5 Ambient Air Quality Monitoring Program is geographic information. For the current sites, the GBUAPCD will locate these sites using the global positioning systems (GPS).

Historical Monitoring Information of the GBUAPCD

The GBUAPCD has operated a network of ambient air monitoring stations since the 1970's. Historical monitoring data and summary information derived from that data may be used in conjunction with current monitoring results to calculate and report trends in pollutant

concentrations. In calculating historical trends, it is important to verify that historical data are fully comparable to current monitoring data. If different methodologies were used to gather the historical data, the biases and other inaccuracies must be described in trends reports based on that data. Direct comparisons of PM2.5 with historical TSP or PM10 data will not be reported or used to estimate trends. Dichotomous sampler data (fine portion) may be used to establish trends in PM2.5 concentration; however, evidence must be presented to demonstrate that results of the two methods are comparable.

External Monitoring Data Bases

Users should review available QA/QC information to assure that the external data from other organizations or entities are comparable with ARB and GBUAPCD measurements and that the original data generator had an acceptable QA program in place. It is the policy of the ARB that no data obtained from any other organization or agency shall be used in creating published reports or regulatory actions unless the data were collected under a QA program that meets the requirements of 40 CFR Part 58, and has been approved by the ARB's Quality Assurance Section Manager. Such data that have received this approval may be entered into AIRS.

Data from the U.S. EPA AIRS data base may be used in published reports with appropriate caution. Care must be taken in reviewing/using any data that contain flags or data qualifiers. If data are flagged, such data shall not be utilized unless it is clear that the data still meet critical QA/QC requirements. It is impossible to assure that a data base such as AIRS is completely free from errors including outliers and biases, so caution and skepticism is called for in comparing ARB data with data from other reporting agencies as reported in AIRS.

Lead and Speciated Particulate Data

The ARB has been routinely monitoring airborne lead, as collected in total suspended particulates (TSP), since the 1980's. However, caution is needed in directly comparing this data with the PM2.5 data because of the difference in size fractions.

Existing chemical speciation data for ions and for elements other than lead are also very extensive. Speciation data (30 elements, by XRF analysis) from dichot samples has been obtained by the GBUAPCD, in conjunction with the ARB, for approximately four monitoring locations since the 1980's. These results may be used to provide a historical baseline for the speciation results to be obtained by the PM2.5 Ambient Air Quality Monitoring Program; however, it is unclear whether the quality of these data are sufficient to allow direct comparison with new data.

Meteorological Data From Other Sources

Meteorological data are gathered from other sources such as the U.S. Weather Service sites to provide information required when developing monitoring sites, computing corrections needed to convert from standard conditions to local conditions, and to support analysis and modeling efforts. These data are not reported to AIRS and are clearly identified when used in assessment and modeling efforts.

19.0 Data Management

19.1 Background and Overview

This Element describes the data management operations pertaining to PM2.5 measurements for the SLAMS stations operated by the Great Basin Unified APCD. This includes an overview of the mathematical operations and analyses performed on raw ("as-collected") PM2.5 data. These operations include data recording, validation, transformation, transmittal, reduction, analysis, management, storage, and retrieval.

Data processing for PM2.5 data are summarized in Figure 19.0.1 (NOTE: The ARB Figure 19.0.1 will require alteration or replacement to show the GBUAPCDs data management system). Data processing steps are integrated, to the extent possible, into the existing data processing system used for the GBUAPCD's SLAMS network. All sampling data will be entered into a data management system (DMS) either through manual entry, electronic transfer from the field, or both. The DMS data are stored on a database running on a PC-compatible platform. All PM2.5 mass results are electronically transferred from the microbalance to a dedicated gravimetric laboratory computer, where the final concentrations are calculated. The data from the laboratory are provided to the data management group on diskette and in hardcopy form. The hardcopy data are then manually entered into the database by the data management group as a final QC check. runs on the laboratory's network and is accessible by all chemists and management. This process is shown in Figure 19.0.1.

Each Ambient Air Monitoring Station operated by the GBUAPCD has a Campbell Scientific Incorporated data logger. These data loggers provide data collection for continuous analyzers at each station. There are currently no facilities to remotely acquire the PM2.5 sampler data, however, the GBUAPCD is examining the possibility of upgrading these stations in the future so that sampler status, flow rate, temperatures, etc. can be monitored remotely.

Filter tracking and chain of custody information are entered into the PM2.5 DMS at two main stages as shown in Figure 19.0.1. The systems analysts are able to obtain reports on status of samples using the DMS. All users must be authorized by the Senior Research & Systems Analyst of the data processing group., and receive permission necessary to log on to the DMS. Once permission is received, all data processing privileges are available to the authorized user.

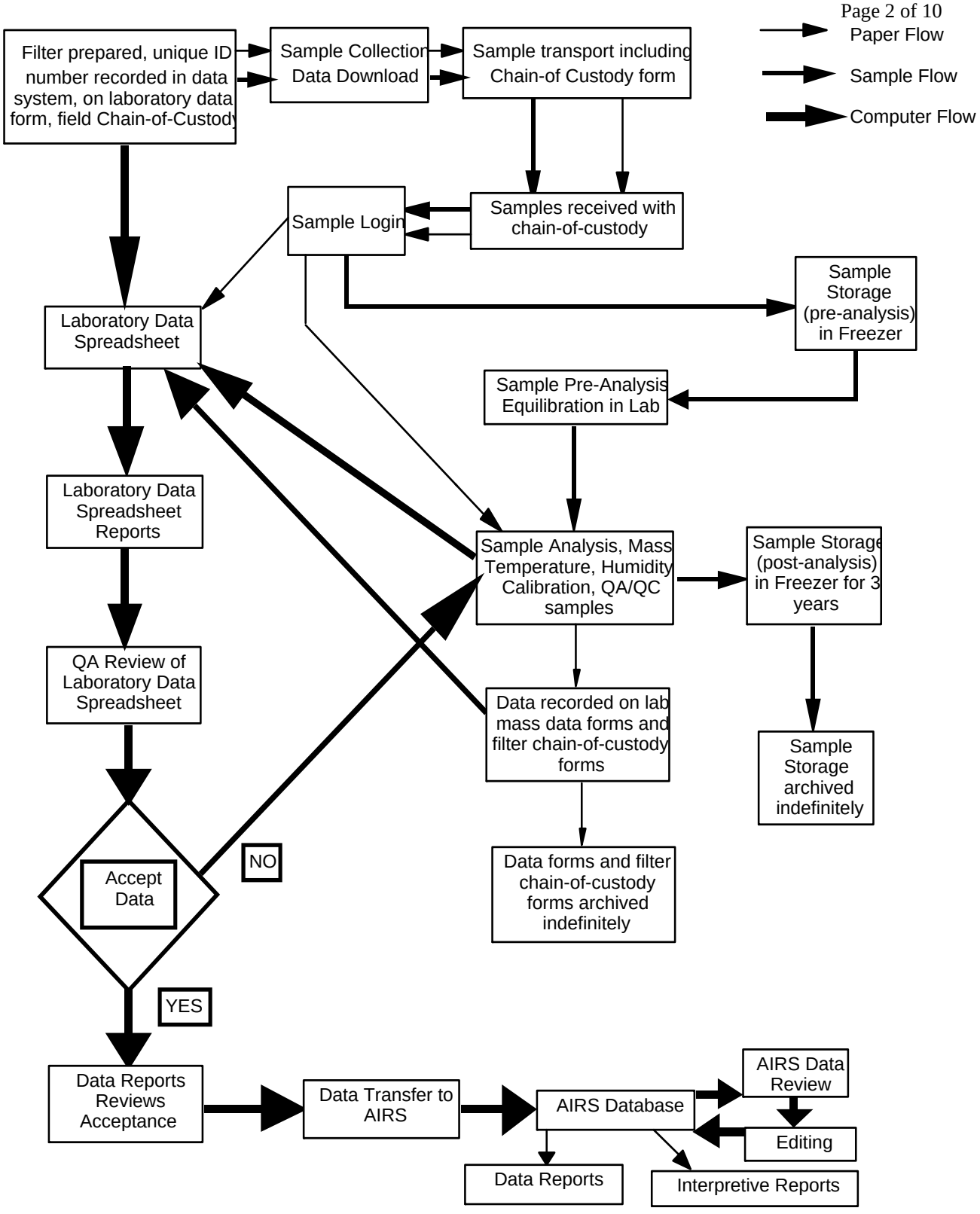

Figure 19.0.1 Draft PM2.5 data flow diagram

19.2 Data Recording

Data entry, validation, and verification functions are all part of the overall data management process. Gravimetric lab sheets shown in Figure 19.0.1 are entered by laboratory personnel. Procedures for filling out the laboratory sheets and subsequent data entry are provided in SOPs listed in Appendix B.

19.3 Data Validation

Data validation involves checking that data processing operations have been carried out correctly and monitoring the quality of the field operations. Data validation can identify problems in either of these areas. Once problems are identified, the data can be corrected or invalidated, and corrective actions can be taken for field or laboratory operations. Numerical data stored in the DMS are never internally overwritten by condition flags. Flags denoting error conditions or QA status are saved as separate fields in the data base, so that it is possible to recover the original data.

The following validation functions are part of the GBUAPCD data management process and are used to ensure quality of data entry and data processing operations:

- **Range Checks** - almost all monitored parameters have simple range checks programmed in. For example, valid times must be between 00:00 and 23:59, etc. The laboratory technician entering the data is notified by the data reviewer when an entry is out of range.
- **Completeness Checks** - When the data are processed certain completeness criteria must be met. For example, each filter must have a start time, an end time, an average flow rate, dates weighed, and operator and technician names. These entries are verified by the laboratory technician and by the data reviewer.
- **Internal Consistency and Other Reasonableness Checks** - Several other internal consistency checks are part of the data management process. For example, the end time of a filter must be greater than the start time. Computed filter volume (integrated flow) must be approximately equal to the exposure time multiplied by the nominal flow. Additional consistency and other checks will be implemented as the result of problems encountered during data screening.
- **Data Retention** - Raw data sheets are retained on file in the GBUAPCD office for a minimum of five years, and are readily available for audits and data verification activities. After five years, hardcopy records and computer backup media are cataloged and boxed for storage. Physical samples such as filters are also cataloged and boxed for storage.
    - **Statistical Data Checks** - Errors found during statistical screening will be traced back to original data entry files and to the raw data sheets, if necessary. These checks shall be run on a monthly schedule and prior to any data submission to AIRS. Data validation is the process by which raw data are screened and assessed before it can be included in the main data base.
- **Sample Batch Data Validation**- which is discussed in Element 23, associates flags that are generated by QC values outside of acceptance criteria, with a sample batch. Batches containing more than one flag may be rerun and/or invalidated.

Table 19.0.1 summarizes the validation checks applicable to the PM2.5 data.

Table 19.0.1 Validation Check Summaries

Type of Data Check	Electronic Transmission and Storage	Manual Checks	Automated Checks
Data Parity and Transmission Protocol Checks	X	X	
Date and Time Consistency	X	X	X
Completeness of Required Fields	X	X	X
Range Checking		X	
Statistical Outlier Checking		X	
Manual Inspection of Charts and Reports		X	
Sample Batch Data Validation		X	

Two key operational criteria for PM2.5 sampling are bias and precision. As defined in 40 CFR Part 58, Appendix A, these are based on differences between collocated sampler results and FRM performance evaluations. The GBUAPCD will inspect the results of collocated sampling during each quarterly data review activity. This data will be evaluated as early in the process as possible, so that potential operational problems can be addressed. The objective of the GBUAPCD will be to optimize the performance of its PM2.5 monitoring equipment. Initially, the results of collocated operations will be control charted (see Element 14). From these charts, control limits will be established to flag potential problems. Multiple collocation results must be accumulated to assess data quality with confidence. However, even limited data can be used for system maintenance and corrective action.

19.4 Data Transformation

Calculations for transforming raw data from measured units to final concentrations are relatively straightforward, and many are carried out in the sampler data processing unit before being recorded. The following relations in Table 19.0.2 pertain to PM2.5 monitoring:

Table 19.0.2 Raw Data Calculations

Parameter	Units	Type of Conversion	Equation
Filter Volume (V_a) *	m^3	Calculated from average Flow Rate (Q_{ave}) in L/min, and total elapsed time (t) in min. multiplied by the unit conversion (m^3/L)	$V_a = Q_{ave} * t * 10^3$
Mass on Filter ($M_{2.5}$)	µg	Calculated from filter post-weight (M_f) in mg and filter pre-weight (M_i) in mg, multiplied by the unit conversion (µg/mg)	$M_{2.5} = M_f - M_i * 10^3$
$PM_{2.5}$ Concentration ($C_{PM2.5}$)	µg/ m^3	Calculated from laboratory data and sampler volume	$PM_{2.5} = \frac{M_{2.5}}{V_a}$

* - most FRM instruments will provide this value from the data logger.

19.5 Data Transmittal

Data transmittal occurs when data are transferred from one person or location to another or when data are copied from one form to another. Some examples of data transmittal are copying raw data from a notebook onto a data entry form for keying into a computer file and electronic transfer of data over a telephone or computer network. Table 19.0.3 summarizes data transfer operations.

Table 19.0.3 Data Transfer Operations

Description of Data Transfer	Originator	Recipient	QA Measures Applied
Electronically Transmit Weighing Data into Laboratory Spreadsheet and write information on laboratory data forms	Laboratory Technician (handwritten data form)	Data Processing Personnel	Entered from hardcopy printouts of spreadsheets into GBUAPCD database
Electronic data transfer	(between computers or over network)	--	Parity Checking; transmission protocols
Filter Receiving and Chain-of-Custody	Field Technician	Laboratory Technician	Filter numbers are verified manually
AIRS data summaries	Systems Analyst	AIRS (U.S. EPA)	Sr. Systems Analyst

The GBUAPCD will report all PM2.5 ambient air quality data and information specified by the AIRS Users Guide (Volume II, Air Quality Data Coding, and Volume III, Air Quality Data Storage), coded in the AIRS-AQS format. Such air quality data and information will be fully screened and validated and will be submitted directly to the AIRS-AQS via electronic transmission, in the format of the AIRS-AQS, and in accordance with the quarterly schedule. The specific quarterly reporting periods and due dates are shown in the Table 19.0.4.

Table 19.0.4 Data Reporting Schedule

Reporting Period	Due Date
January 1-March 31	June 30
April 1-June 30	September 30
July 1-September 30	December 31
October 1-December 31	March 31

19.6 Data Reduction

Data reduction processes involve aggregating and summarizing results so that they can be understood and interpreted in different ways. The PM2.5 monitoring regulations require certain summary data to be computed and reported regularly to U.S. EPA. Other data are reduced and reported for other purposes such as station maintenance. Examples of data summaries include:

- average PM2.5 concentration for a station or set of stations for a specific time period
- accuracy, bias, and precision statistics based on accumulated FRM/FEM data
- data completeness reports based on numbers of valid samples collected during a specified period

The Audit Trail is another important concept associated with data transformations and reductions. An audit trail is a data structure that provides documentation for changes made to a data set during processing. Typical reasons for data changes that would be recorded include the following:

- corrections of data input due to human error
- application of revised calibration factors
- addition of new or supplementary data
- flagging of data as invalid or suspect

- logging of the date and times when automated data validation programs are run

The DMS audit trail is implemented in the GBUAPCD data management process. Audit trail records will include the following fields:

- operator's identity
- date and time of the change
- table and field names for the changed data item
- reason for the change
- full identifying information for the item changed (date, time, site location, parameter, etc.)
- value of the item before and after the change

The audit trail is produced manually and documents changes, therefore, there is the ability to reverse changes after they have been made incorporated into the system.

Audit trail information are moved to backup media after the data are reported to AIRS. All backups and hardcopy manually completed forms will be retained so that any audit trail information can be retrieved for at least five years.

19.7 Data Analysis

The GBUAPCD is currently implementing the data summary and analysis requirements contained in 40 CFR Part 58, Appendix A. It is anticipated that as the PM2.5 Monitoring Program develops, additional data analysis procedures will be developed. The following specific summary statistics will be tracked and reported for the PM2.5 network:

- Single sampler bias or accuracy (based on collocated FRM data, flow rate performance audits, and FRM performance evaluations)
- Single sampler precision (based on collocated data)
- Network-wide bias and precision (based on collocated FRM data, flow rate performance audits, and FRM performance evaluations)
- Data completeness

Equations used for these reports are given in the Table 19.0.5.

Table 19.0.5 Report Equations

Criterion	Equation	Reference
Accuracy of Single Sampler Flow - Single Check (d_i) X_i is reference flow; Y_i is measured flow	$d_i = \frac{Y_i - X_i}{X_i} * 100$	40 CFR 58 Appendix A, Section 5.5.1.1
Bias of a Single Sampler - Annual Basis (D_j)- average of individual percent differences between sampler and reference value; n_j is the number of measurements over the period	$D_j = \frac{1}{n_j} * \sum_{i=1}^{n_j} d_i$	5.5.1.2
Percent Difference for a Single Check (d_i) - X_i and Y_i are concentrations from the primary and duplicate samplers, respectively.	$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} * 100$	5.5.2.1

Coefficient of Variation (CV_i) for a single Check	$CV_i = \frac{\lvert d_i \rvert}{\sqrt{2}}$	5.5.2.2
Pooled Coefficient of Variation, Quarterly Basis ($CV_{j,q}$). The CV_i will only be used when the two measurements are both greater than 6 µg/m3.	$CV_{j,q} = \sqrt{\sum_{i=1}^{n_j} \frac{CV_i^2}{n_{j,q}}}$	5.5.2.3 (a)
Completeness	$\text{Completeness} = \frac{N_{valid}}{N_{invalid}} * 100$	--

19.8 Data Flagging -Sample Qualifiers

A sample qualifier or a result qualifier consists of three or four alphanumeric characters which act as an indicator of the fact and the reason that the data value (a) did not produce a numeric result,
(b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result but for administrative reasons is not to be reported outside the laboratory. Qualifiers will be used both in the field and in the laboratory to signify data that may be suspect due to contamination, special events, or failure of QC limits. Some flags will be generated by the sampling instrument (see Table 6.0.2). Appendix C contains a complete list of the data qualifiers for the field and laboratory activities. Qualifiers will be placed on field and bench sheets with additional explanations in free form notes areas. When sample batch information is entered into DMS and validated, (see Element 23) flags will be applied as necessary. Table 19.0.6 lists the sample batch flags that will be used in the DMS.

Table 19.0.6 Sample Batch Quality Control Flags

Requirement	Acceptance Criteria	Flag
Blanks		
Field Blanks	±30 µg difference	FFB
Lab Blanks	±15 µg difference	FLB
Precision Checks		
Laboratory Duplicate	±15 µg	PAC
Accuracy		
Balance Check	≤ 3 µg	PAC

During the sample validation process, the flags will be used to decide on validating or invalidating individual samples or batches of data. Element 23 discusses this process.

There are several other flags associated with laboratory operations. See Appendix C for a complete list of data qualifiers/flags.

19.9 Data Tracking

The DMS and other GBUAPCD software contain the necessary input functions and reports necessary to track and account for the whereabouts of filters and the status of data processing operations for specific data. Information about filter location is updated at distributed data entry terminals at the points of significant operations. The following input locations are used to track filter location and status:

- Laboratory
- Filter receipt (by lot)
- Filter pre-sampling weighing (individual filter number first enters the system)
- Filter packaged for the laboratory (filter numbers in each package are recorded)
- Laboratory
- Filter Chain-of-Custody (package is opened and filter numbers are logged in)
- Filter post-sampling weighing
- Filter archival

Tracking reports may be generated by any personnel with access to the GBUAPCD computer systems. The following information is available:

- Location of any filter (by filter number)
- List of all filters sent to a specified site that have not been returned
- List of all filters that have not been returned and are more than 30 days past initial weighing date
- List of all filters in the filter archive
- List of all filters that have been received but have not been post-weighed

The laboratory technician is responsible for tracking filter status at least once per week and following up on anomalies such as excessive holding time in the laboratory before reweighing.

19.10 Data and Filter Storage and Retrieval

Data and filter archive policies for the PM2.5 data are shown in Table 19.0.7.

Table 19.0.7 Data and Filter Archive Policies

Data Type	Medium	Location	Retention Time	Final Disposition
Weighing records; chain of custody forms	Hardcopy	Laboratory	3 years	Archived
Laboratory Notebooks	Hardcopy	Laboratory	3 years	Archived
Field Notebooks	Hardcopy	Data Processing	3 years	Archived
PM2.5 MP Data Base (excluding Audit Trail records)	Electronic (on-line)	GBUAPCD	indefinite (may be moved to backup media after 5 years)	Backup tapes retained indefinitely
PM2.5 MP Audit Trail records	Hardcopy	Data Processing	3 years	Archived
Filters	Filters	Laboratory Freezer	3 years	Archived

The PM2.5 data reside on at least two PC-compatible computers in the GBUAPCD's Bishop office.

Security of data in the PM2.5 data base is ensured by the following controls:

- Password protection on the data base
- Regular password changes (quarterly for continuing personnel; passwords for personnel leaving will be canceled immediately)
- Independent password protection on all dial-in lines
- Storage of media including backup tapes in locked, restricted access areas

20.0 Assessments and Response Actions

An assessment, for this QAPP, is defined as an evaluation process used to measure the performance or effectiveness of the quality system, the establishment of the monitoring network and sites and various measurement phases of the data operation.

The results of quality assurance assessments indicate whether the control efforts are adequate or need to be improved. Documentation of all quality assurance and quality control efforts implemented during the data collection, analysis, and reporting phases is important to data users, who can then consider the impact of these control efforts on the data quality (see Element 21). Both qualitative and quantitative assessments of the effectiveness of these control efforts will identify those areas most likely to impact the data quality and to what extent. Periodic assessments of SLAMS data quality are required to be reported to U.S. EPA. On the other hand, the selection and extent of the QA and QC activities used by a monitoring agency depend on a number of local factors such as the field and laboratory conditions, the objectives for monitoring, the level of the data quality needed, the expertise of assigned personnel, the cost of control procedures, pollutant concentration levels, etc.

In order to ensure the adequate performance of the quality system, the California ARB and the GBUAPCD will perform the following assessments:

- Network Reviews
- Systems Audits
- Field and Laboratory Performance Audits
- Data Quality Assessments

20.1 Assessment Activities and Project Planning

20.1.1 Network Reviews

Conformance with network requirements of the Ambient Air Monitoring Network set forth in 40 CFR Part 58 Appendices D and E are determined through annual network reviews of the ambient air quality monitoring system. The network review is used to determine how well a particular air monitoring network is achieving its required air monitoring objective, and how it should be modified to continue to meet its objective. A PM2.5 Network review will be accomplished every year. Since the U.S. EPA Regions are also required to perform these reviews, the GBUAPCD will coordinate its activity with the ARB and Region IX in order to perform the activity at the same time (if possible).

The following criteria will be considered during the review:

- date of last review
- areas where attainment/nonattainment redesignations are taking place or are likely to take place
- results of special studies, saturation sampling, point source oriented ambient monitoring, etc
- proposed network modifications since the last network review

In addition, pollutant-specific priorities may be considered (e.g., newly designated nonattainment areas, "problem areas", etc.).

Prior to the implementation of the network review, significant data and information pertaining to the review will be compiled and evaluated. Such information might include the following:

- network files (including updated site information and site photographs)
- AIRS reports (AMP220, 225, 380, 390, 450)
- air quality summaries for the past five years for the monitors in the network
- emissions trends reports for major metropolitan areas
- emission information, such as emission density maps for the region in which the monitor is located and emission maps showing the major sources of emissions
- National Weather Service summaries for monitoring network area

Upon receiving the information, it will be checked to ensure it is the most current. Discrepancies will be noted on the checklist and resolved during the review. Files and/or photographs that need to be updated will also be identified. The following categories will emphasized during network reviews:

Number of Monitors - For SLAMS, the number of monitors required for PM2.5 depending upon the measurement objectives is discussed in 40 CFR Part 58 with additional details in the *Guidance for Network Design and Optimum Exposure for PM2.5 and PM10* . Element 10 of this QAPP discusses the PM2.5 Network. Adequacy of the network will be determined by using the following information:

- maps of historical monitoring data
- maps of emission densities
- dispersion modeling
- special studies/saturation sampling
- best professional judgment
- SIP requirements
- revised monitoring strategies (e.g., lead strategy, reengineering air monitoring network)

For NAMS, areas to be monitored must be selected based on urbanized population and pollutant concentration levels. To determine whether the number of NAMS are adequate, the number of NAMS operating will be compared to the number of NAMS specified in 40 CFR Part 58, Appendix D. The number of NAMS operating can be determined from the AMP220 report in AIRS. The number of monitors required, based on concentration levels and population, can be determined from the AMP450 report and the latest census population data.

Location of Monitors - For SLAMS, the location of monitors is not specified in the regulations, but is determined by the Regional Office and State agencies on a case-by-case basis to meet the monitoring objectives specified in 40 CFR Part 58, Appendix D. Adequacy of the location of monitors can only be determined on the basis of stated objectives. Maps, graphical overlays, and GIS-based information will be helpful in visualizing or assessing the adequacy of monitor locations. Plots of potential emissions and/or historical monitoring data versus monitor locations will also be used.

During the network review, the stated objective for each monitoring location or site (see Element 10) will be "reconfirmed" and the spatial scale "reverified" and then compared to each location to determine whether these objectives can still be attained at the present location.

Conformance to 40 CFR Part 58 Appendix E - Probe Siting Requirements - Applicable siting criteria for SLAMS, and NAMS are specified in 40 CFR Part 58, Appendix E. The on-site visit will consist of the physical measurements and observations to determine compliance with the Appendix E requirements, such as height above ground level, distance from trees, paved or vegetative ground cover, etc. Since many of the Appendix E requirements will not change within one year, this check at each site will be performed as part of a site survey each time the site is visited.

Prior to the site visit, the reviewer will obtain and review the following:

- most recent hard copy of site description (including any photographs)
- data on the seasons with the greatest potential for high concentrations for specified pollutants
- predominant wind direction by season

A checklist similar to the checklist used by the U.S. EPA Regional offices during their scheduled network reviews will be used. This checklist can be found in the *SLAMS/NAMS/PAMS Network Review Guidance* which is intended to assist the reviewers in determining conformance with Appendix E. In addition to the items on the checklist, the reviewer will also perform the following tasks:

- ensure that the inlet is clean
- check equipment for missing parts, frayed cords, damage, etc
- record findings in field notebook and/or checklist
- take photographs/videotape in 8 directions (at 45° intervals from North, clockwise)
- document site conditions, with additional photographs/videotape

Other Discussion Topics - In addition to the items included in the checklists, other subjects for discussion as part of the network review and overall adequacy of the monitoring program will include:

- installation of new monitors
- relocation of existing monitors
- siting criteria problems and suggested solutions
- problems with data submittals and data completeness
- maintenance and replacement of existing monitors and related equipment
- quality assurance problems
- air quality studies and special monitoring programs
- other issues
    - proposed regulations
    - funding

A report of the network review will be written within two months of the review (Element 21) and appropriately filed (Element 10).

20.1.3 System Audits

A system audit is a thorough and systematic onsite qualitative audit, where facilities, equipment, personnel, training, procedures, and record keeping are examined for conformance to the QAPP. The ARB's Quality Assurance Section (QAS) will conduct the system audit either as a team or as an individual auditor. The QAS will perform three system audit activities that can be accomplished separately or combined :

- Field - handling, sampling, shipping
- Laboratory - Presampling weighing, shipping. receiving, postsampling weighing, archiving, and associated QA/QC
- Data management - Information collection, flagging, data editing, security, upload

Key personnel to be interviewed during the audit are those individuals with responsibilities for: planning, field operations, laboratory operations, QA/QC, data management, and reporting. The audit activities are illustrated in Figure 20.0.1.

To ensure uniformity of the system audit, an audit checklist will be developed and used.

The audit team will discuss deficiencies with key personnel during the debriefing. They will be informed of any air quality data actions (AQDA) that will be issued for deficiencies which may require data invalidation

The QAS will send a copy of the final system audit report to U.S. EPA Region IX. Any corrective action taken will be included in the report.

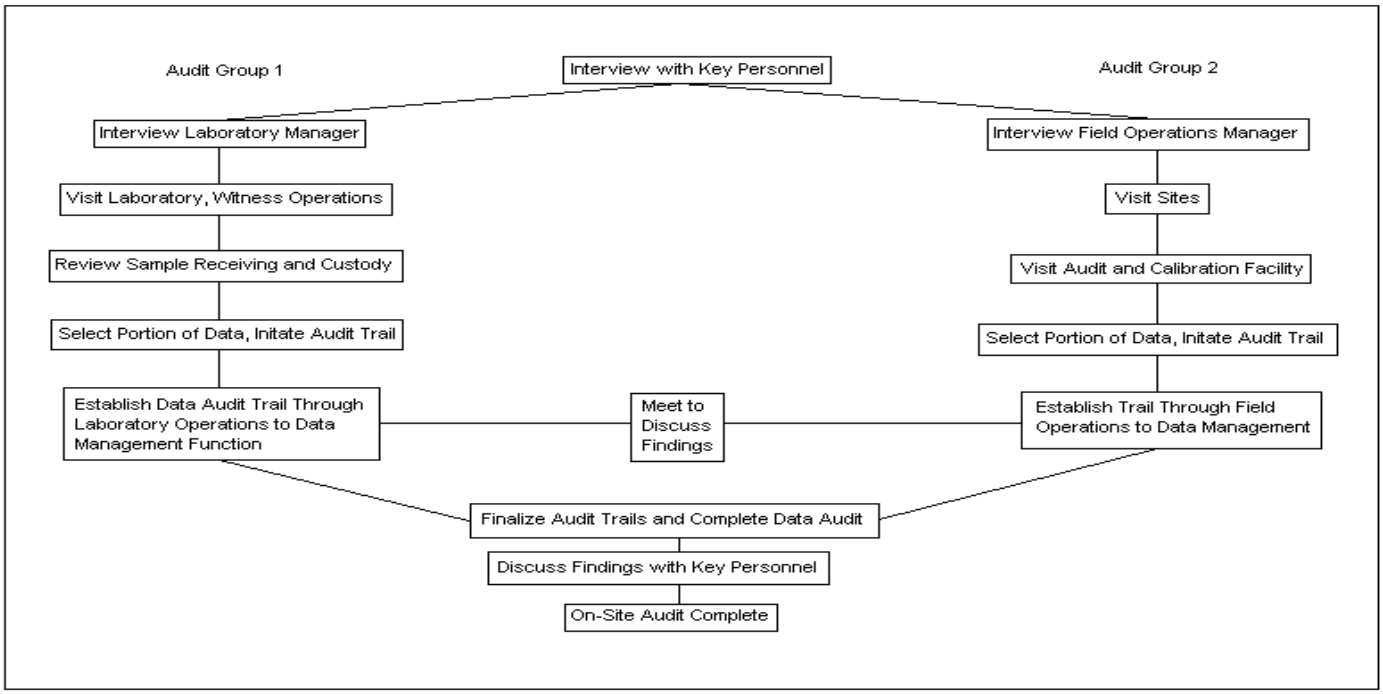

Figure 20.0.1 Audit Activities

Post-Audit Activities - The major post-audit activity is the preparation of the system audit report. The report will include:

- audit title and any other identifying information
- audit team leaders, audit team participants and audited participants
- background information about the project, purpose of the audit, dates of the audit, particular measurement phase or parameters that were audited, and a brief description of the audit process
- summary and conclusions of the audit and corrective action required
- attachments or appendices that include all audit evaluations and audit finding forms

To prepare the report, the audit team will meet and compare observations with collected documents and results of interviews and discussions with key personnel. Expected QA Project Plan implementation is compared with observed accomplishments and deficiencies and the audit findings are reviewed in detail. The system audit report will be submitted to the appropriate departments or agencies.

If the departments or agencies have written comments or questions concerning the audit report, the Audit Team will review and incorporate them as appropriate, and subsequently prepare and resubmit a report in final form following receipt of the written comments. The report will include an agreed-upon schedule for corrective action implementation.

Follow-up and Corrective Action Requirements - The QAS and the audited organization may work together to solve required corrective actions. The audited organization has 30 days to respond to the follow-up and corrective action requirements in the system audit report. The QAS reviews the audited organization's responses to the follow-up and corrective action and works with the audited agency to resolve any discrepancies.

20.1.4 Field and Laboratory Performance Audits

Field and laboratory performance audits reveal how the data are handled, what judgments were made, and whether uncorrected mistakes were made. The audits can often identify the means to correct systematic data reduction errors. The audits will be performed every year and will also be part of the system audit. Thus, sufficient time and effort will be devoted to this activity so that the auditor or team has a clear understanding and complete documentation of data flow. Pertinent audit questions will appear on the system audit check sheets to ensure that the data collected at each stage maintains its integrity. The audits will serve as an effective framework for organizing the extensive amount of information gathered during the audit of laboratory, field monitoring, and support functions within the agency. The audits will have the same reporting/corrective action requirements as the system audit.

20.1.5 Data Quality Assessment

A data quality assessment (DQA) is the statistical analysis of environmental data to determine whether the quality of data is adequate to support the decisions which are based on the DQOs. Data are appropriate if the level of uncertainty in a decision based on the data is acceptable.

The GBUAPCD's Air Quality Data Review Committee has the responsibility to assess the data quality and the suitability of the monitoring network. These functions are done on an annual basis as required under 40 CFR Part 58. Data are processed through data screening programs to determine whether they are suitable for use in attainment/nonattainment decisions. Data flagged during this procedure are subject to further evaluation using statistical techniques to determine possible causes of anomalies. Results of these analyses are forwarded to data collection staff for confirmation of validity or nonvalidity of data. If the data are shown to be invalid, Air Quality Data Review Committee staff will remove the data from all relevant databases. All changes to the data are to be documented in air quality data action reports.

Measurement uncertainty will be estimated for both automated and manual methods. Terminology associated with measurement uncertainty is found within 40 CFR Part 58 Appendix A and includes: (a) Precision - a measurement of mutual agreement among individual measurements of the same property usually under prescribed similar conditions, expressed generally in terms of the standard deviation; (b) Accuracy - the degree of agreement between an observed value and an accepted reference value, accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; (c) Bias - the systematic or persistent distortion of a measurement process which causes errors in one direction. The individual results of these tests for each method or analyzer shall be reported to U.S. EPA.

Estimates of the data quality will be calculated on the basis of single monitors and aggregated to all monitors.

20.2 Documentation of Assessments

Table 20.0.1 summarizes each of the assessments discussed above.

Table 20.0.1 Assessment Summary

Assessment Activity	Frequency	Personnel Responsible	Schedule	Reporting/Resolution
Network Reviews App D App E	 1/ year 1/3 years	 GBUAPCD GBUAPCD	 1/1/2000 1/1/2000	GBUAPCD TO EPA & ARB
System Audits	to be determined	Quality Assurance Section - ARB	1999	MLD Quality Assurance Section to GBUAPCD
Field and Laboratory Performance Audits	1/ year	Quality Assurance Section - ARB	On-going	MLD Quality Assurance Section to GBUAPCD
Data Quality Assessment	1/year	GBUAPCD-Data Review Committee	1/1/2000	GBUAPCD to U.S. EPA Region IX & ARB

21.0 Reports to Management

This Element describes the quality-related reports and communications to management necessary to support SLAMS/NAMS PM2.5 network operations and the associated data acquisition, validation, assessment, and reporting. Unless otherwise indicated, data pertaining to PM2.5 will be included in reports containing monitoring data for other pollutants.

Important benefits of regular QA reports to management include the opportunity to alert the management of data quality problems, to propose viable solutions to problems, and to procure necessary additional resources. Quality assessment, including the evaluation of the technical systems, the measurement of performance, and the assessment of data, is conducted to help insure that measurement results meet program objectives and to insure that necessary corrective actions are taken early, when they will be most effective. This is particularly important in the new PM2.5 network, as new equipment and procedures are being implemented.

Effective communication among all personnel is an integral part of a quality system. Regular, planned quality reporting provides a means for tracking the following:

- adherence to scheduled delivery of data and reports,
- documentation of deviations from approved QA and test plans, and the impact of these deviations on data quality
- analysis of the potential uncertainties in decisions based on the data

21.1 Frequency, Content, and Distribution of Reports

Required reports to management for PM2.5 monitoring and the SLAMS program in general are discussed in various Elements of 40 CFR Parts 50, 53, and 58. Guidance for management report format and content are provided in guidance developed by U.S. EPA's Quality Assurance Division (QAD) and the Office of Air Quality Planning and Standards (OAQPS). These reports are described in the following subelements.

21.1.1 Network Reviews

As required by 40 CFR Part 58 Appendix A, Section 4(a), revised July 18, 1997, the GBUAPCD's Air Quality Data Review Committee has provided a list of all monitoring sites and their AIRS site identification codes and submits the list to the U.S. EPA Region IX Office, with a copy to the Aerometric Information Retrieval System (AIRS)-Air Quality Subsystem (AQS). The AIRS-AQS is U.S. EPA's computerized system for storing and reporting of information relating to ambient air quality data. Whenever there is a change in this list of monitoring sites in a reporting organization, GBUAPCD's Air Quality Data Review Committee will report this change to the U.S. EPA Region IX Office, to AIRS-AQS, and to ARB's MLD Quality Assurance Section and TSD Air Quality Data Review Section.

21.1.2 Quarterly Reports

Each quarter, GBUAPCD will report to AIRS-AQS the results of all precision and accuracy tests it has carried out during the quarter. The quarterly reports will be submitted, consistent with the

data reporting requirements specified for air quality data as set forth in 40 CFR Parts 58.26, 58.35, and 40 CFR Part 58, Appendix A, Section 4.

The data reporting requirements of 40 CFR Part 58.35 apply to those stations designated SLAMS or NAMS. Required accuracy and precision data are to be reported on the same schedule as quarterly monitoring data submittals. The required reporting periods and due dates are listed in Table 21-1.

Table 21-1 Quarterly Reporting Schedule

Reporting Period	Due on or Before
January 1-March 31	June 30
April 1-June 30	September 30
July 1-September 30	December 31
October 1-December 31	March 31 (following year)

Air quality data submitted for each reporting period will be edited, validated, and entered into the AIRS-AQS using the procedures described in the *AIRS Users Guide, Volume II, Air Quality Data Coding.* The GBUAPCD's Technical Services Group and Data Processing Group will be responsible for preparing the data reports, which will be reviewed by the Air Monitoring Specialist and the Senior Systems Analyst before they are transmitted to U.S. EPA.

21.1.3 System Audit Reports

The ARB performs System Audits of the GBUAPCD monitoring system (Element 20) . These reports are issued by the ARB MLD Quality Assurance Section Manager and are reviewed by the ARB/MLD Quality Management and Operations Support Branch Chief and the MLD Chief. These reports will be filed (see Table 9-1) and made available to the U.S. EPA.

External system audits are conducted at least every three years by the U.S. EPA Regional Office as required by 40 CFR Part 58, Appendix A, Section 2.5. Further instructions are available from either the U.S. EPA Regional QA Coordinator or the System Audit QA Coordinator, Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division (MD-14), United States Environmental Protection Agency, Research Triangle Park, NC 27711.

21.1.4 Air Quality Data Action Request

An Air Quality Data Action (AQDA) request is issued by ARB whenever a problem is found such as an operational problem, or a failure to comply with procedures, which could have an effect on data quality. The AQDA request is one of the most important ongoing reports to management because it documents primary QA activities and provides valuable records of QA activities that can be used in preparing other summary reports.

The AQDA request procedure is designed as a closed-loop system. The AQDA request form identifies the originator, who reported and identified the problem, states the problem, and may

suggest a solution. The form also indicates the name of the person(s) who is assigned to correct the problem. The assignment of personnel to address the problem and the schedule for completion will be filled in by the appropriate supervisor. The AQDA request procedure closes the loop by requiring that the recipient state on the form how the problem was resolved and what disposition to take with the data (accept, correct, invalidate). Copies of the AQDA request will be distributed twice: first, when the problem has been identified and the action has been scheduled; and second, when the correction has been completed. The originator, GBUAPCD Air Monitoring Specialist, the field or laboratory supervisor, ARB branch chiefs, and the ARB QA Section Manager will be included in both distributions.

21.1.5 Calibration Summaries

Calibration summaries for laboratory instruments are updated after every new calibration or standardization as defined in the relevant SOP. Control charts can be generated from these data, should the need arise. Analysts are responsible for reviewing these data immediately after it is collected and for taking corrective actions whenever an out-of-specification condition is observed. Calibration reports are to be reviewed at least quarterly by the laboratory supervisor. The supervisors will provide quarterly summary information to the GBUAPCD QA Technician and to the Air Monitoring Specialist. Calibration data are also subject to inspection during audits, and laboratory personnel are responsible for maintaining a readily-accessible file of calibration summaries for each instrument.

21.2 Responsible Organizations

This Element outlines the responsibilities of individuals within the monitoring organization for preparing quality reports, evaluating their impact, and implementing follow-up actions. Changes made in one area or procedure may affect another part of the project. Only by defining clear-cut lines of communication and responsibility can all the affected elements of the monitoring network remain current with such changes. The documentation for all changes will be maintained and included in the reports to management. The following paragraphs describe key personnel involved with QA reporting.

Air Pollution Control Officer

The GBUAPCD Air Pollution Control Officer is ultimately responsible for the quality of the data and the technical operation of the fine particulate monitoring network. The responsibilities for overseeing the air quality data collection and reporting activities are delegated to the Director of Technical Services.

Deputy Air Pollution Control Officer

The Deputy Air Pollution Control Officer is responsible for the data collected from all PM2.5 monitors in the District's monitoring network. These responsibilities include defining and implementing the document management and quality assurance systems for the PM2.5 monitoring network. The responsibility for the collection, validation, and submission of the data collected from all PM2.5 monitors is delegated to the air monitoring specialist. The Deputy also

delegates the responsibility for the submittal of all relevant reports to the air monitoring specialist.

Air Monitoring Specialist

The Air Monitoring Specialist oversees the operation, maintenance, and repair of any PM2.5 monitors in the District. He submits all relevant reports to the Director of Technical Services. The Air Monitoring Specialist, in conjunction with the Senior Systems Analyst is also responsible for the precision and accuracy of all data generated and collected by the District. This position serves as one part of the effort to assure that the data are in compliance with the criteria set by Federal and State Clean Air Acts. These responsibilities are carried out by conducting field performance and system audits, issuing recommendations for data adjustment on instruments, evaluating potential air monitoring sites, and issuing reports on audit results.

Quality Assurance Technician

The quality assurance technician is responsible for the GBUAPCD's internal audit program. These responsibilities include audits of all particulate monitors, meteorological sensors, etc. Operated within the District. Audit reports are generated and provided to management as a "third-party" check on the operation of the monitoring equipment used throughout the District.

Field Technicians

Field technicians are not normally responsible for authoring reports to management. However, they participate in the process by identifying the need for data adjustments and maintaining other quality-related information used to prepare GBUAPCD QA reports and ARB QA reports.

Laboratory Technicians

Individual lab technicians are responsible for authoring appropriate sections of quarterly QC reports to management. They generate control charts, identify the need for data adjustments, and maintain other quality-related information used to prepare QA and QC reports.

Systems/Data Analyst

The District systems/data analyst carefully manages, archives, and distributes the ambient aerometric data collected on behalf of the District's air quality management programs. Specific activities include resolving discrepancies in data, providing for the orderly and efficient transfer of data from data suppliers to the database, and distributing the data to meet customer needs. Further specific duties include the development and implementation of enhancements to the data management systems and to the forms of data distribution and access used to perform the above, and the evaluation of siting issues, including annual network reviews for PM2.5 and other parameters.

22.0 Data Review, Validation and Verification Requirements

This element describes how the Great Basin Unified APCD will verify and validate the data collection operations associated with the PM2.5 ambient air monitoring network. Verification can be defined as confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Validation can be defined as confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Although there are a number of objectives of ambient air data, the major objective for the GBUAPCD PM2.5 network is for comparison to the NAAQS standard and therefore, this will be identified as the intended use. This element will describe the verification and validation activities that occur at a number of the important data collection phases. Earlier elements of this QAPP describe in detail how the activities in these data collection phases will be implemented to meet the data quality objectives of the program. Review and approval of this QAPP by the ARB and U.S. EPA Region IX provide initial agreement that the processes described in the QAPP, if implemented, will provide data of adequate quality. In order to verify and validate the phases of the data collection operation, the GBUAPCD will use various qualitative assessments (e.g., system audits, network reviews) to verify that the QAPP is being followed, and will rely on the various quality control samples, inserted at various phases of the data collection operation, to validate that the data will meet the DQOs described in Element 7.

22.1 Sampling Design

The "1998 California Particulate Matter Monitoring Network Description", which was submitted by ARB's PTSD to U.S. EPA Region IX in June of 1998, describes the sampling design for the PM2.5 network established by the ARB. It covers the number of sites required, their location, and the frequency of data collection. The objective of the sampling design is to represent the population of interest at adequate levels of spatial and temporal resolution. Most of these requirements have been described in the Code of Federal Regulations. However, it is the responsibility of the GBUAPCD to ensure that the intent of the regulations are properly administered and carried out.

22.1.1 Sampling Design Verification

Verification of the sampling design will occur through three processes:

Network Design Plan Confirmation - The Network Design Plan that discusses the initial deployment of the network must be submitted, reviewed and approved by U.S. EPA Region IX prior to implementation. This process verifies the initial sampling design.

Internal Network Reviews - Once a year, the ARB's PTSD Air Quality Data Review Section will perform a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met, and that the sites are meeting the CFR siting criteria (see Element 20).

External Network Reviews - Every three years the U.S. EPA Region IX Office will conduct a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met, and that the sites are meeting the CFR siting criteria.

22.1.2 Sampling Design Validation

The ambient air data derived from the sites will be used to validate the sampling design. This information will be included in network review documentation and appropriately communicated to the U.S. EPA Region IX Office. In addition, the processes described in Element 10 will be used to confirm the network design.

22.2 Sample Collection Procedures

22.2.1 Sample Collection Verification

Sample collection procedures are described in detail in Element 11 and are developed to ensure proper sampling and to maintain sample integrity. The following processes will be used to verify the sampling collection activities:

System Audits - will be required as described in Element 20

System audits will be used to verify that the sample collection activity is being performed as described in this QAPP and the SOPs. Deviations from the sample collection activity will be noted in audit finding forms and corrected using the procedures described in Element 20.

22.2.2 Sample Collection Validation

The sample collection activity is just one phase of the measurement process. The use of QC samples that have been placed throughout the measurement process can help validate the activities occurring at each phase. The review of QC data such as the collocated sampling data, field blanks, the FRM performance evaluation, and the sampling equipment verification checks that are described in Elements 14 and 16 can be used to validate the data collection activities. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated. This investigation could lead to a discovery of inappropriate sampling activities.

22.3 Sample Handling

Elements 11, 12, and 17 detail the requirements for sample handling, including the types of sample containers and the preservation methods used to ensure that they are appropriate to the nature of the sample and the type of data generated from the sample. Due to the size of the filters and the nature of the collected particles, sample handling is one of the phases where inappropriate techniques can have a significant effect on sample integrity and data quality.

22.3.1 Verification of Sample Handling

As mentioned above, system audits will be performed to ensure the specifications mentioned in the QAPP are being followed. The audits will include checks on the identity of the sample (e.g., proper labeling and chain-of-custody records), packaging in the field, and proper storage

conditions (e.g., chain-of-custody and storage records) to ensure that the sample continues to be representative of its native environment as it moves through the data collection operation.

22.3.2 Validation of Sample Handling

Similar to the validation of sampling activities, the review of data from collocated sampling, field blanks, and the FRM performance evaluations, that are described in Elements 14 and 16, can be used to validate the sample handling activities. Acceptable precision and bias in these samples would lead one to believe that the sample handling activities are adequate. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated. This investigation could lead to a discovery of inappropriate sample handling activities that require corrective action.

22.4 Analytical Procedures

Element 13 details the requirements for the analytical methods, which include the pre-sampling weighing activities that give each sample a unique identification, an initial weight, and prepares the sample for the field, and the post-sampling weighing activities, which provide the mass net weight and the final concentration calculations. The methods include acceptance criteria (Elements 13 and 14) for important components of the procedures, along with suitable codes for characterizing each sample's deviation from the procedure.

22.4.1 Verification of Analytical Procedures

As mentioned above, system audits will be performed to ensure the analytical method specifications mentioned in the QAPP are being followed. The audits will include checks on the identity of the sample. Deviations from the analytical procedures will be noted in audit finding forms and corrected using the procedures described in Element 20.

22.4.2 Validation of Analytical Procedures

Similar to the validation of sampling activities, the review of data from lab blanks, calibration checks, laboratory duplicates and other laboratory QC that are described in Elements 14 and 16 can be used to validate the analytical procedures. Acceptable precision and bias in these samples would lead one to believe that the analytical procedures are adequate. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated as described in Element 14. This investigation could lead to a discovery of inappropriate analytical procedures, requiring corrective action.

22.5 Quality Control

Elements 14 and 16 of this QAPP specify the QC checks that are to be performed during sample collection, handling, and analysis. These include analyses of check standards, blanks, spikes, and replicates, which provide indications of the quality of data being produced by specified components of the measurement process. For each specified QC check, the procedure, acceptance criteria, and corrective action are specified.

22.5.1 Verification of Quality Control Procedures

As mentioned above, system audits will be performed to ensure the quality control method specifications mentioned in the QAPP are being followed.

22.5.2 Validation of Quality Control Procedures

Validation activities of many of the other data collection phases mentioned in this subelement use the quality control data to validate the proper and adequate implementation of that phase. Therefore, validation of QC procedures will require a review of the documentation of the corrective actions that were taken when QC samples failed to meet the acceptance criteria, and the potential effect of the corrective actions on the validity of the routine data. Element 14 describes the techniques used to document QC review/corrective action activities.

22.6 Calibration

Element 16, as well as the field (Element 11) and the analytical elements (Element 13) detail the calibration activities and requirements for the critical pieces of equipment for the PM2.5 network.

22.6.1 Verification of Calibration Procedures

As mentioned above, system audits will be performed to ensure the calibration specifications and corrective actions mentioned in the QAPP are being followed. Deviations from the calibration procedures will be noted in audit finding forms and corrected using the procedures described in Element 20.

22.6.2 Validation of Calibration Procedures

Similar to the validation of sampling activities, the review of calibration data that are described in Elements 14 and 16, can be used to validate calibration procedures. Calibration data within the acceptance requirements would lead one to believe that the sample collection measurement devices are operating properly. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated as described in Elements 14 or 16. This investigation could lead to a discovery of inappropriate calibration procedures, or equipment problems requiring corrective action as detailed in the element. Validation would include the review of the documentation to ensure corrective action was taken as prescribed in the QAPP.

22.7 Data Reduction and Processing

22.7.1 Verification of Data Reduction and Processing Procedures

As mentioned above, system audits will be performed to ensure the data reduction and processing activities mentioned in the QAPP are being followed.

22.7.2 Validation of Data Reduction and Processing Procedures

As part of the audits of data quality, discussed in Element 20, a number of sample IDs chosen at random will be identified. All raw data files, including the following will be selected:

- Presampling weighing activity
- Presampling activities and environment
- Sampling activity and sampler download data
- Sampler calibration in effect during sampling period
- Postsampling handling, storage, and transport to lab
- Postsampling storage and weighing by lab
- Corrective action procedures
- Data reduction and entry

This raw data will be reviewed and final concentrations will be calculated by hand to determine if the final vales submitted to AIRS compare to the hand calculations. The data will also be reviewed to ensure that associated flags or any other data qualifiers have been appropriately associated with the data and that appropriate corrective actions were taken.

23. Validation and Verification Methods

Many of the processes for verifying and validating the measurement phases of the PM2.5 data collection operation have been discussed in Element 22. If these processes, as written in this QAPP are followed and the monitoring sites are representative of the boundary conditions for which they were selected, one would expect to achieve the PM2.5 Data Quality Objectives (DQOs). Exceptional field events may occur, however, and field and laboratory activities may adversely affect the integrity of the samples. Additionally, it is expected that some of the QC checks will fail to meet the acceptance criteria. Information on problems that affect the integrity of the data are identified in the form of data qualifiers or flags (Appendix C). It is important to determine how and whether these failures affect the routine data. The review of these routine data and their associated QC data will be verified and validated. It is assumed that if measurement uncertainty will be maintained within the precision and bias DQOs.

23.1 Process for Validating and Verifying Data

23.1.1 Verification of Samples

After a sample batch is processed in the laboratory, a thorough review of the data for completeness and data entry accuracy will be conducted. All raw data that are entered by hand on the data sheets will be entered into the spreadsheet as discussed in Element 19. The entered data are compared with the data forms to minimize transcription errors. The spreadsheet will then flag all data that fall outside the acceptance criteria. The flagged data will be reviewed and reassessed. Details of these activities are discussed in Element 19. The data qualifiers or flags are listed in Appendix C.

23.1.2 Validation

Validation of measurement data will be conducted on three levels: one at the measurement value level, a second at the batch level, and a third at the instrument level. Records of all invalid samples will be filed. Information will include a brief summary of the reason(s) for invalidating the sample along with the associated flags. A portion of this record will be available on the spreadsheet since all filters that are pre-weighed will be recorded whether or not the sample is valid. At least one flag will be associated with an invalid sample, that being the “INV” flag signifying invalidation. Additional flags will usually be associated with the INV flag that help explain the reason for this flag. Free form notes from the field operator or laboratory technician may also be included.

Validation of Measurement Values

Certain criteria based upon Title 40 CFR, U.S. EPA QA Guidance Document 2.12, and field operator and laboratory technician judgment have been developed that will be used to determine whether individual samples or samples from a particular instrument will be invalidated. In all cases the samples will be returned to the laboratory for further examination. When the

laboratory technician reviews the field sheet and chain-of-custody forms he or she will look for flag values. Samples that are flagged for obvious contamination, filter damage, or field accidents will immediately be examined. Upon concurrence of the laboratory technician and the laboratory supervisor, these samples will be invalidated.

Other flags listed in Appendix C may be used alone or in combination to invalidate samples. Since the possible flag combinations cannot be anticipated, the GBUAPCD will review these flags and determine whether single values or values from a site for a particular time period will be invalidated. The GBUAPCD will keep a record of the combination of flags that resulted in invalidating a sample or set of samples. These combinations will be reported to EPA Region IX and the ARB and will be used to ensure that the GBUAPCD evaluates and invalidates data consistently from one batch to the next. These combinations will be programmed into the validation system in order to assist the laboratory in evaluating data. As mentioned above, all data invalidation will be documented. Table 23-1 contains criteria that can be used to invalidate single samples based on single flags.

Table 23-1 Single Flag Invalidation Criteria for Single Samples

Requirement	Flag	Comment
Contamination	9977	Concurrence with lab technician and lab manager
Filter Damage	9976	Concurrence with lab technician and lab manager
Event	See Table C-3	Exceptional, known field event expected to have affected sample Concurrence with lab technician and lab manager
Laboratory Accident	9984	Concurrence with lab technician and lab manager
Field Accident	9976	Concurrence with lab technician and lab manager
Flow Rate Cutoff	9974	Termination of sample collection due to flow rate > 10% design flow rate for 60 seconds.

Due to the nature and holding times of the routine samples, it is critical that the GBUAPCD minimize the amount of data invalidated. Therefore, the GBUAPCD will validate data on single samples, sample batches, and groups of samples from one instrument. Based on the types of QC samples that are included and the field and laboratory conditions that are reported (field/lab flags), the ARB, in conjunction with the national PM2.5 Data Validation Workgroup, is developing a validation template that will be used to determine when routine data will be invalidated and when major corrective actions need to be instituted. Tables 23-2, 23-3, and 23-4 represent the validation template.

Table 23-2 lists those requirements which are critical and must be met. Table 23-3 lists the recommendations that should be met. In instances where acceptance criteria in Table 23-3 are not met, the GBUAPCD will investigate and take corrective action. Data that do not meet these criteria will not necessarily be invalidated. Table 23-4 lists those requirements that should also be met but are of a systemic nature. Data will not necessarily be invalidated if the criteria in Table 23-4 are not met.

Table 23-2 Parameter PM2.5-Critical Frequency and Acceptance Criteria Defined in CFR

Requirement	Frequency	Acceptance Criteria
Filter Holding Times		
Post-Sampling Weighing	all filters	<10 days at 25°C from sample end date
Sampling Period	All data	1380 - 1500 minutes or if <1380 and exceedance of NAAQS
Sampling Instrument		
Flow Rate	every 24 hours of operation “ “	≤5% of 16.67 lpm ≤2% CV no flow rate excursions >5% for > 5 min.
Filter		
Visual Defect Check	All filters	See QA Guidance Document 2.12, Sec. 7.5
Filter Conditioning Environment		
Equilibration	All filters	24 hours minimum
Temp. Range	“	24-hr mean 20-23°C
Temp. Control	“	±2°C standard deviation over 24 hrs
Humidity Range	“	24-hr mean 30-40% RH or ±5% sampling RH but >20% RH
Humidity Control	“	±5% standard deviation over 24 hrs.
Pre/post sampling RH	“	±5% RH
Balance	“	located in filter conditioning environment

Table 23-3 Parameter PM2.5 - Operational Evaluation Indicators

Requirement	Frequency	Acceptance Criteria
Reporting Units	All data	µg/m^3
Detection Limit		
Lower DL	All data	2 µg/m^3 (estimated)
Upper Conc. Limit	All data	200 µg/m^3 (estimated)
Filter Holding Times		
Pre-sampling	all filters	<30 days before sampling
Filter Checks		
Lot Blanks	3 filters per lot	< 15µg change between weighings
Exposure Lot Blanks	3 filters per lot	< 15µg change between weighings
Lab QC Checks		
Field Filter Blank	10% or 1 per weighing session	± 30µg change between weighings
Lab Filter Blank	10% or 1 per weighing session	± 15µg change between weighings
Balance Check	beginning, every 10th sample,	≤ 3µg
Duplicate Filter Weighing	end 1 per weighing session	± 15µg change between weighings
Sampling Instrument		
Filter Temp. Sensor	every 24 hrs. of operation	< 5°C of ambient for <30 min.
Calibration/Verification		
Flow Rate (FR) multipoint calibration	2/yr or if verification failure	± 2% of transfer standard
FR single-point Verification	1/4 weeks	± 2% of transfer standard and ±2%

		of design flow rate
External Leak Check	every 5 sampling events	< 80 ml/min
Internal Leak Check	every 5 sampling events	< 80 ml/min

Table 23-4 Parameter PM2.5 - Systematic Issues

Requirement	**Frequency**	**Acceptance Criteria**
Data Completeness	**quarterly**	**75%**
Accuracy		
FRM Performance Evaluation	25% of sites 4/yr	±10%
Precision		
Collocated Samples	Every 6 days for 25% of sites	CV ≤ 10%
Single Analyzer	1/3 months	CV ≤ 10%
Single Analyzer	1/year	CV ≤ 10%
Reporting Org.	1/3 months	CV ≤ 10%
Calibration & Check Standards		
Flow Rate Transfer Std.	1/year	± 2% of NIST-traceable std.

The samples will be evaluated and a report generated based on the results of validation. If the report indicates invalidation of data, those samples will be reanalyzed and reevaluated. All efforts will be made to take whatever corrective actions are necessary to correct the problem. If, after this secondary or Level II validation, the samples still remain outside the applicable criteria, the samples will be flagged as invalid (INV), depending on the specific acceptance criteria. Each month a summary report of all data that were invalidated along with explanations, will be submitted to the ARB and EPA IX.

Appendix A

Glossary

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS

Acceptance criteria — Specified limits placed on characteristics of an item, process, or service defined in requirements documents. (ASQC Definitions)

Accuracy — A measure of the closeness of an individual measurement or the average of a number of measurements to the true value.

Assessment — The evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer review, inspection, or surveillance.

Audit (quality) — A systematic and independent examination to determine whether quality activities and related results comply with planned operations and whether these operations are implemented effectively and are suitable to achieve objectives.

Audit of Data Quality (ADQ) — A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Authenticate — The act of establishing an item as genuine, valid, or authoritative.

Bias — The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Blank — A sample subjected to the usual analytical or measurement process to establish a zero baseline or background value. Sometimes used to adjust or correct routine analytical results. A sample that is intended to contain none of the analytes of interest. A blank is used to detect contamination during sample handling preparation and/or analysis.

Calibration — A comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

Calibration drift — The deviation in instrument response from a reference value over a period of time before recalibration.

Certification — The process of testing and evaluation against specifications designed to document, verify, and recognize the competence of a person, organization, or other entity to perform a function or service, usually for a specified time.

Chain of custody — An unbroken trail of accountability that ensures the physical security of samples, data, and records.

Check standard — A standard prepared independently of the calibration standards and analyzed exactly like the samples. Check standard results are used to estimate analytical precision and to indicate the presence of bias due to the calibration of the analytical system.

Collocated samples — Two or more portions collected at the same point in time and space so as to be considered identical. These samples are also known as field replicates and should be identified as such.

Comparability — A measure of the confidence with which one data set or method can be compared to another.

Completeness — A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.

Computer program — A sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, a compiler, an interpreter, or a translator to prepare the program for execution. A computer program may be stored on magnetic media and referred to as "software," or it may be stored permanently on computer chips, referred to as "firmware." Computer programs covered in a QAPP are those used for audit results, design analysis, data acquisition, data reduction, data storage (databases), operation or control, and database or document control registers when used as the controlled source of quality information.

Confidence Interval — The numerical interval constructed around a point estimate of a population parameter, combined with a probability statement (the confidence coefficient) linking it to the population's true parameter value. If the same confidence interval construction technique and assumptions are used to calculate future intervals, they will include the unknown population parameter with the same specified probability.

Conformance — An affirmative indication or judgment that a product or service has met the requirements of the relevant specification, contract, or regulation; also, the state of meeting the requirements.

Consensus standard — A standard established by a group representing a cross section of particular government agencies, industry or trade, or a part thereof.

Contractor — Any organization or individual contracting to furnish services or items or to perform work.

Corrective action — Any measures taken to rectify conditions adverse to quality and, where possible, to preclude their recurrence.

Correlation coefficient — A number between -1 and 1 that indicates the degree of linearity between two variables or sets of numbers. The closer to -1 or +1, the stronger the linear relationship between the two (i.e., the better the correlation). Values close to zero suggest no correlation between the two variables.

Data of known quality — Data that have the qualitative and quantitative components associated with their derivation documented appropriately for their intended use, and when such documentation is verifiable and defensible.

Data Quality Assessment (DQA) — The scientific and statistical evaluation of data to determine if data obtained from environmental operations are of the right type, quality, and quantity to support their intended use. The five steps of the DQA Process include: 1) reviewing the DQOs and sampling design, 2) conducting a preliminary data review, 3) selecting the statistical test, 4) verifying the assumptions of the statistical test, and 5) drawing conclusions from the data.

Data Quality Indicators (DQIs) — The quantitative statistics and qualitative descriptors that are used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are bias, precision, accuracy, comparability, completeness, representativeness.

Data Quality Objectives (DQOs) — The qualitative and quantitative statements derived from the DQO Process that clarify a study's technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Data Quality Objectives (DQO) Process — A systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use. The key elements of the DQO process include:

- state the problem,
- identify the decision,
- identify the inputs to the decision,
- define the boundaries of the study,
- develop a decision rule,
- specify tolerable limits on decision errors, and
- optimize the design for obtaining data.

DQOs are the qualitative and quantitative outputs from the DQO Process.

Data reduction — The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collating them into a more useful form. Data reduction is irreversible and generally results in a reduced data set and an associated loss of detail.

Data usability — The process of ensuring or determining whether the quality of the data produced meets the intended use of the data.

Deficiency — An unauthorized deviation from acceptable procedures or practices, or a defect in an item.

Design — The specifications, drawings, design criteria, and performance requirements. Also, the result of deliberate planning, analysis, mathematical manipulations, and design processes.

Detection Limit (DL) — A measure of the capability of an analytical method to distinguish samples that do not contain a specific analyte from samples that contain low concentrations of the analyte; the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. DLs are analyte- and matrix-specific and may be laboratory-dependent.

Distribution — 1) The appointment of an environmental contaminant at a point over time, over an area, or within a volume; 2) a probability function (density function, mass function, or distribution function) used to describe a set of observations (statistical sample) or a population from which the observations are generated.

Document — Any written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results.

Document control — The policies and procedures used by an organization to ensure that its documents and their revisions are proposed, reviewed, approved for release, inventoried, distributed, archived, stored, and retrieved in accordance with the organization's requirements.

Duplicate samples — Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method, including sampling and analysis. See also *collocated sample*.

Environmental conditions — The description of a physical medium (e.g., air, water, soil, sediment) or a biological system expressed in terms of its physical, chemical, radiological, or biological characteristics.

Environmental data — Any parameters or pieces of information collected or produced from measurements, analyses, or models of environmental processes, conditions, and effects of pollutants on human health and the ecology, including results from laboratory analyses or from experimental systems representing such processes and conditions.

Environmental monitoring — The process of measuring or collecting environmental data.

Environmental processes — Any manufactured or natural processes that produce discharges to, or that impact, the ambient environment.

Environmental programs — An all-inclusive term pertaining to any work or activities involving the environment, including but not limited to: characterization of environmental processes and conditions; environmental monitoring; environmental research and development; the design, construction, and operation of environmental technologies; and laboratory operations on environmental samples.

Environmental technology — An all-inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be utilized to remove pollutants or contaminants from, or to prevent them from entering, the environment. Examples include wet scrubbers (air), soil washing (soil), granulated activated carbon unit (water), and filtration (air, water). Usually, this

term applies to hardware-based systems; however, it can also apply to methods or techniques used for pollution prevention, pollutant reduction, or containment of contamination to prevent further movement of the contaminants, such as capping, solidification or vitrification, and biological treatment.

Estimate — A characteristic from the sample from which inferences on parameters can be made.

Field blank — A blank used to provide information about contaminants that may be introduced during sample collection, storage, and transport. A clean sample, carried to the sampling site, exposed to sampling conditions, returned to the laboratory, and treated as an environmental sample.

Financial assistance — The process by which funds are provided by one organization (usually governmental) to another organization for the purpose of performing work or furnishing services or items. Financial assistance mechanisms include grants, cooperative agreements, and governmental interagency agreements.

Finding — An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative, and is normally accompanied by specific examples of the observed condition.

Goodness-of-fit test — The application of the chi square distribution in comparing the frequency distribution of a statistic observed in a sample with the expected frequency distribution based on some theoretical model.

Guidance — A suggested practice that is not mandatory, intended as an aid or example in complying with a standard or requirement.

Guideline — A suggested practice that is not mandatory in programs intended to comply with a standard.

Holding time — The period of time a sample may be stored prior to its required analysis.

Identification error — The misidentification of an analyte. In this error type, the contaminant of concern is unidentified and the measured concentration is incorrectly assigned to another contaminant.

Independent assessment — An assessment performed by a qualified individual, group, or organization that is not a part of the organization directly performing and accountable for the work being assessed.

Inspection — The examination or measurement of an item or activity to verify conformance to specific requirements.

Internal standard — A standard added to a test portion of a sample in a known amount and carried through the entire determination procedure as a reference for calibrating and controlling the precision and bias of the applied analytical method.

Laboratory split samples — Two or more representative portions taken from the same sample and analyzed by different laboratories to estimate the interlaboratory precision or variability and the data comparability.

Limit of quantitation — The minimum concentration of an analyte or category of analytes in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions.

Management — Those individuals directly responsible and accountable for planning, implementing, and assessing work.

Management system — A structured, nontechnical system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for conducting work and producing items and services.

Management Systems Review (MSR) — The qualitative assessment of a data collection operation and/or organization(s) to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that the type and quality of data needed are obtained.

Matrix spike — A sample prepared by adding a known mass of a target analyte to a specified amount of matrix sample for which an independent estimate of the target analyte concentration is available. Spiked samples are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

May — When used in a sentence, a term denoting permission but not a necessity.

Mean (arithmetic) — The sum of all the values of a set of measurements divided by the number of values in the set; a measure of central tendency.

Mean squared error — A statistical term for variance added to the square of the bias.

Measurement and Testing Equipment (M&TE) — Tools, gauges, instruments, sampling devices, or systems used to calibrate, measure, test, or inspect in order to control or acquire data to verify conformance to specified requirements.

Memory effects error — The effect that a relatively high concentration sample has on the measurement of a lower concentration sample of the same analyte when the higher concentration sample precedes the lower concentration sample in the same analytical instrument.

Method — A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

Method blank — A blank prepared to represent the sample matrix as closely as possible and analyzed exactly like the calibration standards, samples, and quality control (QC) samples. Results of method blanks provide an estimate of the within-batch variability of the blank response and an indication of bias introduced by the analytical procedure.

Mid-range check — A standard used to establish whether the middle of a measurement method's calibrated range is still within specifications.

Must — When used in a sentence, a term denoting a requirement that has to be met.

Nonconformance — A deficiency in a characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate; nonfulfillment of a specified requirement.

Objective evidence — Any documented statement of fact, other information, or record, either quantitative or qualitative, pertaining to the quality of an item or activity, based on observations, measurements, or tests that can be verified.

Observation — An assessment conclusion that identifies a condition (either positive or negative) that does not represent a significant impact on an item or activity. An observation may identify a condition that has not yet caused a degradation of quality.

Organization — A company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

Organization structure — The responsibilities, authorities, and relationships, arranged in a pattern, through which an organization performs its functions.

Outlier — An extreme observation that is shown to have a low probability of belonging to a specified data population.

Parameter — A quantity, usually unknown, such as a mean or a standard deviation characterizing a population. Commonly misused for "variable," "characteristic," or "property."

Peer review — A documented critical review of work generally beyond the state of the art or characterized by the existence of potential uncertainty. Conducted by qualified individuals (or an organization) who are independent of those who performed the work but collectively equivalent in technical expertise (i.e., peers) to those who performed the original work. Peer reviews are conducted to ensure that activities are technically adequate, competently performed, properly documented, and satisfy established technical and quality requirements. An in-depth assessment of the assumptions, calculations, extrapolations, alternate interpretations, methodology, acceptance criteria, and conclusions pertaining to specific work and of the documentation that supports them. Peer reviews provide an evaluation of a subject where quantitative methods of analysis or measures of success are unavailable or undefined, such as in research and development.

Performance Evaluation (PE) — A type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory.

Pollution prevention — An organized, comprehensive effort to systematically reduce or eliminate pollutants or contaminants prior to their generation or their release or discharge into the environment.

Population — The totality of items or units of material under consideration or study.

Precision — A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions expressed generally in terms of the standard deviation.

Procedure — A specified way to perform an activity.

Process — A set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Project — An organized set of activities within a program.

Qualified data — Any data that have been modified or adjusted as part of statistical or mathematical evaluation, data validation, or data verification operations.

Qualified services — An indication that suppliers providing services have been evaluated and determined to meet the technical and quality requirements of the client as provided by approved procurement documents and demonstrated by the supplier to the client's satisfaction.

Quality — The totality of features and characteristics of a product or service that bears on its ability to meet the stated or implied needs and expectations of the user.

Quality Assurance (QA) — An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Assurance Program Description/Plan — See *quality management plan*.

Quality Assurance Project Plan (QAPP) — A formal document describing in comprehensive detail the necessary quality assurance (QA), quality control (QC), and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. The QAPP components are divided into four classes: 1) Project Management, 2) Measurement/Data Acquisition, 3) Assessment/Oversight, and 4) Data Validation and Usability. Guidance and requirements on preparation of QAPPs can be found in EPA QA/R-5 and QA/G-5.

Quality Control (QC) — The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality. The system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring the results are of acceptable quality.

Quality control (QC) sample — An uncontaminated sample matrix spiked with known amounts of analytes from a source independent of the calibration standards. Generally used to establish intra- laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system.

Quality improvement — A management program for improving the quality of operations. Such management programs generally entail a formal mechanism for encouraging worker recommendations with timely management evaluation and feedback or implementation.

Quality management — That aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, and assessment) pertaining to the quality system.

Quality Management Plan (QMP) — A formal document that describes the quality system in terms of the organization's structure, the functional responsibilities of management and staff, the lines of authority, and the required interfaces for those planning, implementing, and assessing all activities conducted.

Quality system — A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products, and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC).

Readiness review — A systematic, documented review of the readiness for the start-up or continued use of a facility, process, or activity. Readiness reviews are typically conducted before proceeding beyond project milestones and prior to initiation of a major phase of work.

Record (quality) — A document that furnishes objective evidence of the quality of items or activities and that has been verified and authenticated as technically complete and correct. Records may include photographs, drawings, magnetic tape, and other data recording media.

Recovery — The act of determining whether or not the methodology measures all of the analyte contained in a sample.

Repeatability — The degree of agreement between independent test results produced by the same analyst, using the same test method and equipment on random aliquots of the same sample within a short time period.

Reporting limit — The lowest concentration or amount of the target analyte required to be reported from a data collection project. Reporting limits are generally greater than detection limits and are usually not associated with a probability level.

Representativeness — A measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition.

Reproducibility — The precision, usually expressed as variance, that measures the variability among the results of measurements of the same sample at different laboratories.

Requirement — A formal statement of a need and the expected manner in which it is to be met.

Research (applied) — A process, the objective of which is to gain the knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.

Research (basic) — A process, the objective of which is to gain fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind.

Research development/demonstration — The systematic use of the knowledge and understanding gained from research and directed toward the production of useful materials, devices, systems, or methods, including prototypes and processes.

Round-robin study — A method validation study involving a predetermined number of laboratories or analysts, all analyzing the same sample(s) by the same method. In a round-robin study, all results are compared and used to develop summary statistics such as interlaboratory precision and method bias or recovery efficiency.

Ruggedness study — The carefully ordered testing of an analytical method while making slight variations in test conditions (as might be expected in routine use) to determine how such variations affect test results. If a variation affects the results significantly, the method restrictions are tightened to minimize this variability.

Scientific method — The principles and processes regarded as necessary for scientific investigation, including rules for concept or hypothesis formulation, conduct of experiments, and validation of hypotheses by analysis of observations.

Self-assessment — The assessments of work conducted by individuals, groups, or organizations directly responsible for overseeing and/or performing the work.

Sensitivity — the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest.

Service — The result generated by activities at the interface between the supplier and the customer, and the supplier internal activities to meet customer needs. Such activities in environmental programs include design, inspection, laboratory and/or field analysis, repair, installation, and calibration.

Shall — A term denoting a requirement that is mandatory whenever the criterion for conformance with the specification permits no deviation. This term does not prohibit the use of

alternative approaches or methods for implementing the specification so long as the requirement is fulfilled.

Should — A term denoting a guideline or recommendation whenever noncompliance with the specification is permissible.

Significant condition — Any state, status, incident, or situation of an environmental process or condition, or environmental technology in which the work being performed will be adversely affected sufficiently to require corrective action to satisfy quality objectives or specifications and safety requirements.

Software life cycle — The period of time that starts when a software product is conceived and ends when the software product is no longer available for routine use. The software life cycle typically includes a requirement phase, a design phase, an implementation phase, a test phase, an installation and check-out phase, an operation and maintenance phase, and sometimes a retirement phase.

Span check — A standard used to establish that a measurement method is not deviating from its calibrated range.

Specification — A document stating requirements and referring to or including drawings or other relevant documents. Specifications should indicate the means and criteria for determining conformance.

Spike — A substance that is added to an environmental sample to increase the concentration of target analytes by known amounts; used to assess measurement accuracy (spike recovery). Spike duplicates are used to assess measurement precision.

Split samples — Two or more representative portions taken from one sample in the field or in the laboratory and analyzed by different analysts or laboratories. Split samples are quality control (QC) samples that are used to assess analytical variability and comparability.

Standard deviation — A measure of the dispersion or imprecision of a sample or population distribution expressed as the positive square root of the variance and has the same unit of measurement as the mean.

Standard Operating Procedure (SOP) — A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps and that is officially approved as the method for performing certain routine or repetitive tasks.

Supplier — Any individual or organization furnishing items or services or performing work according to a procurement document or a financial assistance agreement. An all-inclusive term used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, or consultant.

Surrogate spike or analyte — A pure substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them to establish that the analytical method has been performed properly.

Surveillance (quality) — Continual or frequent monitoring and verification of the status of an entity and the analysis of records to ensure that specified requirements are being fulfilled.

Appendix B
Laboratory Mass Analysis

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

STANDARD OPERATING PROCEDURE FOR MASS ANALYSIS OF FINE PARTICULATE COLLECTED ON TEFLON FILTERS

1.0 SCOPE

This document describes the methodology used by the laboratory staff to analyze the mass of fine particulate matter (PM2.5) samples collected on Teflon filters.

2.0 SUMMARY OF METHOD

Individual Teflon filters (46.2 mm in diameter) are weighed on an electronic microbalance before and after field sampling. Particulate matter less than 2.5 µm in aerodynamic diameter is collected from ambient air over a 24-hour period on
one of these filters. The net difference between pre- and post-sampling filter weights is used to calculate the ambient air mass concentration. After final weighing, filters are stored for subsequent analysis.

3.0 INTERFERENCES

3.1 The potential effect of body moisture or oils contacting the filters is minimized by using non-serrated forceps to handle the filters at all times. This measure also moderates interference due to static electricity.

3.2 Teflon filters accumulate a surface electrical charge which may affect filter weight. Static electricity is controlled by treating filters on a “Static Master” static charge neutralizer prior to weighing. Holding filters between two “Static Masters” is required for a minimum of twenty seconds before any filter can be weighed.

3.3 Moisture content can affect filter weight. Filters must be equilibrated for a minimum of 24 hours in a controlled environment prior to pre- and postweighing. During the equilibration period, relative humidity must be maintained at a mean value of 32.5-37.5% and air temperature at a mean of 21-23 degrees Celsius.

3.4 Airborne particulates can adversely affect an accurate mass measurement of the filter. Equilibrating filters should not be placed within airflow paths created by air conditioning ductwork, near computer printers or turbulence created by opening and closing doors. Dust contamination can be further minimized by cleaning the lab bench tops and weighing areas daily, installing “sticky” floor mats at the entrance to the balance room, and wearing clean lab coats over regular clothing.

4.0 APPARATUS

4.1 Sartorius M5P electronic microbalance with a minimum resolution of 0.001 mg (i.e., 1 microgram) and a precision of $\pm$ 0.001 mg, supplied with a balance pan. The microbalance must be positioned upon a marble balance support table.

4.2 Calibration weights, utilized as Mass Reference Standards, should be non-corroding, range in weight from 100 mg to 200 mg and be certified as traceable to National Institute of Standards and Testing (NIST) mass standards. Two sets are needed, one set as a working standard and one set as the primary standard. The weights should be Class 1 category with a tolerance of 0.01mg.

4.3 Radioactive (alpha-particle) Polonium-210 ("StaticMaster") antistatic strips for charge neutralization. At least 2 strips are needed per balance.

4.4 Non-serrated forceps.

4.5 Digital timer/stopwatch or analog clock.

4.6 Filter: Teflon membrane, 46.2 mm in diameter with a polymethylpentene support ring.

4.7 Filter support cassettes.

4.8 Filter equilibration racks.

4.9 Dickson relative humidity/temperature recorder.

4.10 Psychrometer (NIST certified) for calibration of relative humidity readings.

4.11 Humidity calbration kit with three salt solutions: LiCl, $MgCl_2$, NaCl for humidity checks at 11%, 33%, and 75%

4.11 Precision thermometer (NIST certified) for calibration of temperature readings.

4.12 Light box.

4.13 Antistatic, nitrate-free, phosphate-free, sulfate-free, lint-free 100% nylon gloves.

4.14 Plastic petri-slide filter containers.

4.15 Zip-lock plastic bags, 5"x8".

4.16 Disposable laboratory wipes.

4.17 Filter equilibration cabinet(s).

4.18 Metal shipping containers and fiberglass filter cassette magazine(s) (supplied with R & P FRM sequential samplers), metal shipping containers for individual filters (supplied by BGI and other manufacturers for single-filter samplers).

5.0 BALANCE CALIBRATION PROCEDURE

5.1 Prior to any filter weighing, the balance must be calibrated. First, check the balance level and adjust as needed. After connecting the balance to a line source, the liquid crystal display should read "stand-by". Press the on/off key to activate the balance. The balance performs an internal circuitry check which is complete when "CH2" appears in the liquid crystal display (LCD). The LCD then displays an "L", indicating that the internal load weights should be removed (The internal load weights are used only for weighing objects in excess of 1500 or 3000 mg). Press the bottom white key marked with the small white "t" to remove the load weights. The LCD should soon display "0.000" and a stabilization bubble (which appears as a small "o" in the upper right corner of the display). Open the weighing chamber door to allow equilibration to room temperature. To ensure maximum stability, the microbalance must remain on at all times; the display will register "stand-by" when not in use.

5.2 Internal Calibration: After chamber equilibration (usually one minute), close the cover. Once the stabilization bubble in the LCD (hereafter referred to as the "bubble") appears above the "mg", press the "CAL" key. The LCD should soon display "0.000" and the bubble and the "CAL" LED will be illuminated. Press the "CAL" key a second time and the LCD will display a "C" followed by "CC" and then followed by "0.000" and the bubble and "CAL" LED goes out. The balance is now ready for an external calibration check. However, should the display read "CE", an error has occurred and the calibration must be repeated as described above.

5.3 External Calibration Check: Open the chamber door. Place a 100 mg working reference standard calibration weight onto the balance pan with nonmetallic forceps. Close the chamber door and record the date, temperature and relative humidity in a quality control notebook assigned to the microbalance on which the weighing procedure is being performed. After the LCD displays a weight readout and the bubble, wait for 30-45 seconds then record the weight readout in the quality control logbook along with temperature and humidity data and initial. Remove the calibration

weight and tare the balance by tapping the red "T" key to re-register a balance zero reading. Repeat this same procedure with a 200 mg calibration weight. The balance is now ready for weighing the filters. The weight readouts of calibration and filter masses must be documented on the quality control logsheets. External calibration will be performed daily for each day that filters are pre- and/or postweighed.

6.0 FILTER INSPECTION AND EQUILIBRATION

6.1 When the filters initially are brought into the laboratory for preconditioning and preweighing, they should be transferred from their sealed manufacturer's packaging to a filter-handling container such as a glass or plastic petri dish. The filters should be handled only with non-serrated forceps. Vinyl or 100% nylon gloves that are lint-free, ion-free, powder-free and antistatic may be worn by lab personnel when filters are being prepared for conditioning and weighing. These precautions reduce the risk of body moisture or oils coming into contact with the filters and affecting mass measurements. Before the filter is placed in a container, it has to be inspected for defects. This is done by examining a filter on a "light table" or over a dark surface (lab bench top). A filter must be discarded if any defects are found. Specific defects to look for are the following:

1. **Pinhole**--A small hole appearing (a) as a distinct and obvious bright point of light when examined over a light table or screen or (b) as a dark spot when viewed over a dark surface.

2. **Separation of ring--**Any separation or lack of seal between the filter and the filter border reinforcing the ring.

3. **Chaff or flashing**--Any extra material on the reinforcing, polymethylpentene ring or on the heat seal area that would prevent an airtight seal during sampling.

4. **Loose material--**Any extra loose material or dirt particles on the filter.

5. **Discoloration**--Any obvious discoloration tat might be evidence of contamination.

6. **Filter nonuniformity--**Any obvious visible nonuniformity in the appearance of the filter when viewed over a light table or a black surface that might indicate gradations in porosity or density across the face of the filter.

7. **Other--**A filter with any imperfection not described above, such as irregular surfaces or other results of poor workmanship.

6.2 After inspection, filters must be conditioned within an environmentally controlled room for at least 24 hours prior to performing presampling weighing (preweighing). Mean relative humidity must be held to 32.5-37.5% and the mean temperature must be held to 21-23 degrees Celsius. Once per quarter, the hygrothermograph recorder is checked against the laboratory humidity sensor. Once per month the laboratory humidity sensor (Vaisala HMP35C) is calibrated at three points using the salt solutions described above. The relative humidity recording is checked against an NIST- certified psychrometer and the temperature recording is checked against an NIST- certified thermometer once per quarter.

6.3 From each new lot of filters received, take a random sample of 3 filters as "lot blanks" and expose each in a separate container within the controlled room environment. Weigh these "lot blanks" every 24 hours (as explained in Sections 7.6 and 7.7). The filters should be conditioned in an open-sided cabinet that will allow air circulation over the filters while reducing the chance that extraneous airborne material inside the conditioning room will settle onto the filters. If the weight change after 24 hours exceeds 15 micrograms, continue conditioning until the 24-hour weight variation is less than 15 micrograms for each of the 3 "lot blanks". This process should take less than a week. Inscribe information concerning the lot number, balance ID number, and dates of "lot blank" weighings on the Lot Blank Filter Conditioning Mass Data Form. Once the "lot blanks" have generated stable mass values, note the time taken from initial exposure of the filters to balance room conditions until achievement of stable mass. This period is designated as the minimum time needed to condition other filters from the same lot before they can be preweighed and used for routine sampling.

6.4 After the minimum conditioning period has been determined, select a number of filters that can be satisfactorily weighed with an acceptable level of precision within the normal working day (20-40 filters should be an adequate number). Condition the selected filters for at least the time required and set aside for preweighing.

7.0 PRESAMPLING FILTER WEIGHING

7.1 Record the relative humidity and temperature of the conditioning environment in the quality control logbook for the balance. Ensure that 1) the temperature and the relative humidity of the Balance Room have remained (and are currently) within the allowable limits (see Section 3.0) throughout the previous 24 hours and that 2) the selected filters have been conditioned for at least the minimum time needed to attain mass stability, as determined from the lot blanks.

7.2 Clean the microbalance's weighing chamber with a fine brush, if necessary. Clean the surfaces near the microbalance with antistatic solution or methyl

alcohol-moistened disposable laboratory wipes. Clean the forceps used for handling the mass reference weights and the filters with the moistened wipes prior to each weighing session. Ensure that both forceps are thoroughly dry.

7.3 Perform an internal and external calibration of the microbalance (as described in Section 5.0) prior to beginning each daily weighing session. Once the weighing procedure begins however, you only need to tare (i.e., zero) the microbalance before weighing each consecutive filter.

7.4 Obtain the appropriate shipping container(s) designated for use with the sampler at the monitoring site for which filters are to be preweighed, and appropriate filter support cassettes and metal covers or filter cassette magazine, etc. For filters being sent to monitoring sites using R&P samplers use blue polypropylene cassettes with a beveled inner edge on the top ring; for filters being sent to monitoring sites using BGI samplers use white Delrin cassettes without the beveled top ring.

7.5 Boot up the computer, open EXCEL and the appropriate spreadsheet for the filters to be weighed. Enter the site, filter number and initial weight or final weight in the appropriate cells.

7.6 Take each conditioned filter, using forceps and gripping the filter only by the outer polymethylpentene support ring, and hold the filter (support ring side up) between the two static neutralizers. Hold the filter between the static neutralizers for a minimum of 20 seconds prior to weighing.

7.7 Place the filter onto the balance pan and close the cover. Each filter is assigned a **24-Hour Sample Report-Field Data Sheet** (24-Hour Sample Report) that includes the **chain of custody record** and will be used for recording information about the filter sample. After approximately 10 seconds, the bubble will appear over the "mg" on the balance display. Wait an additional 10 seconds after the bubble appears to ensure the balance has stabilized. Record the weight on the computer spreadsheet. Record this mass as a "preweight" value on the 24-Hour Sample Report. Date and initial the 24-Hour Sample Report and enter a date on the "Postweigh by" line that is 30 days from the preweighing date.

7.8 After the weight is entered in the spreadsheet and recorded on the sample report form, you are ready to begin weighing the next filter. If there is a need to re-weigh a filter, however, enter the data on a separate row in the spreadsheet for the reweigh data.

7.9 After the filter is weighed secured it in an appropriate (see Section 7.4) filter support cassette, with the filter's support ring facing up.

7.9.1 BGI Samplers: Fasten the protective metal covers onto the cassette. Label the cassette with the filter ID number and place it in the metal filter-shipping cylinder used for transfer to the sampling site.

7.9.2 R & P Single Filter Samplers: Place filter cassette in an individual metal shipping container. The metal shipping container should be labelled with the filter ID number.

7.9.3 R & P Sequential Filter Samplers: Place filter cassette(s) in a fiberglass filter cassette magazine. Cap the ends of the magazine with the Cap Plugs provided by the manufacturer. Place the loaded magazine into the metal shipping container.

7.9.4 Each filter comes with a unique preprinted number on the support ring. This number must be recorded on the 24-Hour Sample Report as the filter ID Number. Each filter cassette is uniquely numbered as well. The filter cassette ID number must also be recorded on the 24-Hour Sample Report.

7.10 After each filter is weighed, if the microbalance does not return to zero, the microbalance can be zeroed by pressing the red **TARE** key. After it is zeroed, the balance is ready for the next filter.

7.11 After repeating the above steps for 9 individual filters, a field blank should be weighed. Select any conditioned filter and weigh as described above, but select a filter number preceded by the designation **FB** and record this number on the 24-Hour Sample Report. Once this weighing has been completed, recheck the balance by weighing a standard mass. The microbalance is tared and either a 100 mg or a 200 mg mass working reference standard is weighed as a QC check.
NOTE: Each working standard will be checked against the corresponding laboratory primary standard mass at least quarterly. If the standards disagree by more than 3 micrograms, the working standards must be checked by a certified outside contractor and replaced if necessary.

7.12 A duplicate filter must be selected from the previous 9 routine sample filters and weighed as a quality control check. Weigh the filter, as described above, record the weight on the 24-Hour Report as a duplicate mass, and enter it in the spreadsheet. If the duplicate mass varies more than 15 micrograms from the original mass measurement, tare the microbalance and re-weigh the filter. If the variation in mass remains more than 15 micrograms, flag the filter in question and consult with the laboratory supervisor.

7.13 Affix to each filter's 24-Hour Sample Report sheet a filter bar code label corresponding to the filter ID number, and record the site name. The site

operator will add the AIRS site number and other relevant information needed to characterize a specific filter sampled at a specified site. When the preweighed filters are loaded into the sampler, the **chain of custody** portion of the 24-Hour Sample Report will be signed by the field operator and the date and time recorded.

7.14 Stack together all 24-Hour Sample Reports for filters in one filter-shipping cylinder or magazine going to one site, folded so that the site name is readable. Place these in a 5"x8" zip-lock bag and wrap this around the shipping cylinder or magazine, securing in place with a rubber band. In the case of the single-filter samplers, place each individual filter shipping container with the corresponding 24-Hour Sample Report into an 11”x 13” or larger zip-lock bag.

7.15 During the first preweighing session, and as needed during later weighing sessions (consult with the laboratory supervisor), designate five filters to be used as **lab blanks**. Assign a unique identification number LBxxxx to each of five filters and record this on the petri-slide label and in the laboratory QC notebook. Weigh as indicated in Sections 7.6 and 7.7, and additionally record, along with the date, the information in the QC notebook. Initial each weight entry. Replace the filters in their petri-slides and leave open in the cabinet where sample filters are conditioned.

8.0 POSTSAMPLING TRACKING, DOCUMENTATION & INSPECTION

8.1 Upon receipt of filter samples from the field, the laboratory technician will perform the following steps:

1. Remove the attached bag of 24-Hour Sample Reports and check the temperature recorders on the cylinders or in the transport container.
2. On each 24-Hour Sample Report, in the “received by lab” column on the **chain of custody record**, note date, time and temperature at the time of sample arrival in the lab.
3. Inspect the condition of the sample container and filter samples, especially for contamination by moisture during shipping.
4. Keep the 24-Hour Sample Reports with the shipping cylinder, magazine, or single filter shipping containers.
5. The shipping container will be placed in the lab until ready for conditioning.

8.2 The Laboratory Technician will verify acceptance of the filters for postweighing by examining the 24-Hour Sample Report (which includes the **chain of custody**). If field data are missing or not obtainable from the site operator or if a sampler malfunction is evident, “flag” the filter on its 24-Hour Sample Report Sheet and continue processing the next filter. A “flagged” filter is archived and stored in the lab until further consultation

with a lab supervisor determines whether the filter is acceptable or declared invalid.

8.3 When ready to start conditioning of the filters move the shipping cylinder to the gravimetric laboratory. Remove each filter cassette from the shipping container and remove its protective metal covers (if applicable), but keep the filter in its filter support cassette for handling. Use a "light table" to check on the physical appearance of the filter sample area (especially for pinholes). If particulate matter is found on the inside of the metal covers or on the inside of the single-filter transport container after the filter has been removed, note that observation on the 24-Hour Sample Report and "flag" the filter. Consult the lab supervisor to determine whether the filter should be invalidated.

8.4 Remove the filter from the support cassette using the filter cassette separator. Match the filter with the appropriate 24-Hour Sample Report, and with a petri-slide labeled with a barcode number identical to the filter ID number. Antistatic, ion-free, lint-free 100% nylon or vinyl gloves may be worn during filter handling. Inspect the filter for any damage that may have occurred during sampling that was not revealed during the initial inspection. If any damage is found, "flag" the filter and record this on the 24-Hour Sample Report and hold the filter for further consultation by the lab supervisor. If the filter is found to be acceptable for mass analysis, transfer it into the petri-slide and place the cover on loosely.

8.5 After the filters have been inspected and processed as described above, log in each individual filter by transmitting the bar-code filter ID number on the 24-Hour Sample Report provided into the appropriate District spreadsheet. Write the ID number generated from the database onto the 24-Hour Sample Report, the petri-slide label and in a laboratory logbook. Place each filter (in its petri-slide, with the cover underneath or fitted loosely to allow free circulation of air over the filter) onto the filter equilibration rack and place in a well-ventilated cabinet in the gravimetric laboratory. Allow the filters to equilibrate for at least 24 hours. It should be noted that the relative humidity conditions for post-sampling filter mass weighing after conditioning should be within $\pm$ 5% of the pre-sampling conditioning environment.

9.0 POSTSAMPLING FILTER WEIGHING

9.1 After conditioning, remove the racks containing the post-sampling filters from the cabinets and retrieve the 24-Hour Sample Reports. Match up the filter ID numbers on the petri slides and on the 24-Hour Sample Reports and place them on the bench top near the microbalance. Place filters in an orderly fashion on the balance table adjacent to the microbalance.

9.2 Calibrate the microbalance as described in Sections 5.1, 5.2, and 5.3. After calibration, at the start of each weighing session re-weigh the three **lab blank** filters. These are filters that have been conditioned, weighed, then left continually exposed in the cabinets where sample filters are conditioned (see Section 7.15). Record the weight of the lab blanks, and the date, in the QC notebook and initial the record. The average weight change for these filters should not exceed 15 micrograms per day of exposure. If this limit is exceeded consult with the laboratory supervisor before weighing any sample filters. Long-term results can also be used to measure the mass stability of the Teflon filters over time.

9.3 Open the appropriate spreadsheet and find the rows containing the pre-weight information for the filters that have now been exposed. The post-sampling or exposed filter data will be entered in the appropriate columns in the same spreadsheet as the initial or unexposed filter data were entered.

9.4 Begin weighing as described in Sections 7.6 and 7.7, except that when the mass read-out appears on the LCD screen record the value on the 24-Hour Sample Report in the "postweight" space. Then enter the data in the appropriate spreadsheet, and proceed with the next sample. After 9 individual filters have been weighed, which may include field blank filters, it may be necessary to weigh a **check standard** and then reweigh a sample filter. The filter number of the reweighed filter will be the same as the original filter, except for the inclusion of a notation of the duplicate weight in the comments column of the spreadsheet. Record the duplicate weight on the 24-Hour Sample Report. Also record the date of postweighing on the 24-Hour Sample Report.

9.5 If mass difference between the preweight and postweight of a "field blank" filter is greater than 60 micrograms, "flag" that filter and notify the site operator and the lab supervisor. If mass differences between the original and replicate mass read-outs from a postweighed duplicate are greater than 20 micrograms, flag that filter and notify the lab supervisor.

9.6 If, after postweighing, the filter will receive further analysis, return it to the conditioning container, close the container tightly and note on the conditioning container that additional analyses are required. Transfer the filter, along with any special comments on a copy of the 24-Hour Sample Report, to the lab responsible for performing additional analyses.

Appendix C
Data Qualifiers/ Flags

A sample qualifier or a result qualifier is an indicator of the fact and the reason that the subject analysis

(a) did not produce a numeric result,

(b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result, or

(c) produced a numeric result but for administrative reasons is not to be reported outside the laboratory.

An alphanumeric code is used for invalid data. An alphabetic code represents a data flag indicating the data is qualified in some respect and may be invalidated.

Table C-1 Field Qualifiers

Code	Definition	Description
Con.	Contamination	Contamination including observations of insects or other debris
Dam.	Filter Damage	Filter appeared damaged
Time	Elapsed Sample Time	Elapsed sample time out of specification
See Table C-3	Event	Exceptional event expected to have affected sample (dust, fire , spraying etc)
Field Acc.	Field Accident	There was an accident in the field that either destroyed the sample or rendered it unsuitable for analysis.
FAT	Failed Ambient Temperature Check	Ambient temperature check out of specification
FIT	Failed Filter Temperature Check	Filter temperature check out of specification
Flow	Flow Rate	Flow rate 5 min avg out of specification
Temp	Filter Temperature	Filter temperature differential, 30 minute interval out of specification
CalF	Failed Multi-point Calibration Verification	Failed the initial Multi point calibration verification
FPC	Failed Pressure Check	Barometric pressure check out of specification
FCF	Failed Single Point Calibration Verification	Failed the initial single point calibration verification
Leak	Leak suspected	internal/external leak suspected
Sampler Dam.	Sampler Damaged	Sampler appears to be damaged which may have affected filter

Table C-2 Laboratory Qualifiers

Code	Definition	Description
ALT	Alternate Measurement	The subject parameter was determined using an alternate measurement method. Value is believed to be accurate but could be suspect.
BDL	Below Detectable Limits	There was not a sufficient concentration of the parameter in the sample to exceed the lower detection limit in force at the time the analysis was performed. Numeric results field, if present, is at best an approximate value.
Canc.	Canceled	The analysis of this parameter was canceled and not performed.
FBK	Found in Blank	The subject parameter had a measurable value above the established QC limit when a blank was analyzed using the same equipment and analytical method. Therefore, the reported value may be erroneous.
FCS	Failed Collocated Sample	Collocated sample exceeded acceptance criteria limits
FFB	Failed Field Blank	Field blank samples exceeded acceptance criteria limits.
FIS	Failed Internal Standard	Internal standards exceeded acceptance criteria limits.
FLB	Failed Laboratory Blank	Laboratory blank samples exceeded acceptance criteria limits.
FLDup	Failed Laboratory Duplicate	Laboratory duplicate samples exceeded acceptance criteria limits.
FQC	Failed Quality Control	The analysis result is not reliable because quality control criteria were exceeded when the analysis was conducted. Numeric field, if present, is estimated value.
HTE	Holding Time Exceeded	Filter holding time exceeded acceptance criteria limits
ISP	Improper Sample Preservation	Due to improper preservation of the sample, it was rendered not suitable for analysis.
LA	Laboratory Accident	There was an accident in the laboratory that either destroyed the sample or rendered it not suitable for analysis.

Reject	Rejected	The analysis results have been rejected for an unspecified reason by the laboratory. For any results where a mean is being determined, this data was not utilized in the calculation of the mean.
ND	Analyzed But Undetected	Indicates material was analyzed for but not detected

Table C-3 List of Events for PM2.5 Mass Concentrations

Code	Description
A	High Winds
C	Volcanic eruptions
D	Sandblasting
E	Forest fire
F	Structural fire
G	High pollen count
H	Chemical spills and industrial accidents
J	Construction/demolition
K	Agricultural tilling
L	Highway construction
N	Sanding/salting of streets
O	Infrequent large gatherings
P	Roofing operations
Q	Prescribed burning
R	Clean up after a major disaster
S	Seismic activity

Table C-4 AIRS Data Validation Codes

W	Sample flow rate out of limits
X	Filter Temp. Differential 30-min. Interval out of specification
Y	Sample Period out of specification
T	Multiple Flags

GREAT BASIN UNIFIED
AIR POLLUTION CONTROL DISTRICT

AIR MONITORING QUALITY ASSURANCE

PM 2.5 QAPP

APPENDIX E-1
(CARB VOL. II APPENDIX AI)

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

ANDERSEN
RAAS2.5-300 SEQUENTIAL AIR SAMPLER

MONITORING AND LABORATORY DIVISION

NOVEMBER 1998

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GREAT BASIN UNIFIED
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APPENDIX E-1
(CARB VOLUME II APPENDIX AI.1)

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

STATION OPERATOR'S PROCEDURES FOR ANDERSEN RAAS2.5-300 SEQUENTIAL AIR SAMPLER

MONITORING AND LABORATORY DIVISION

NOVEMBER 1998

AI.1.0 GENERAL INFORMATION

AI.1.0.1 Purpose

The purpose of these Standard Operating Procedures (SOP) is to supplement the manufacturer's (Andersen) Operator's Manual by describing modifications in hardware or procedures which may have been implemented by the Air Resources Board (ARB) and the Great Basin Unfied APCD. These modifications are designed to assure compliance with the Federal Reference Method for collection of particulate matter 2.5 microns or smaller (PM2.5) when using the Andersen Reference Ambient Air Sampler (RAAS).

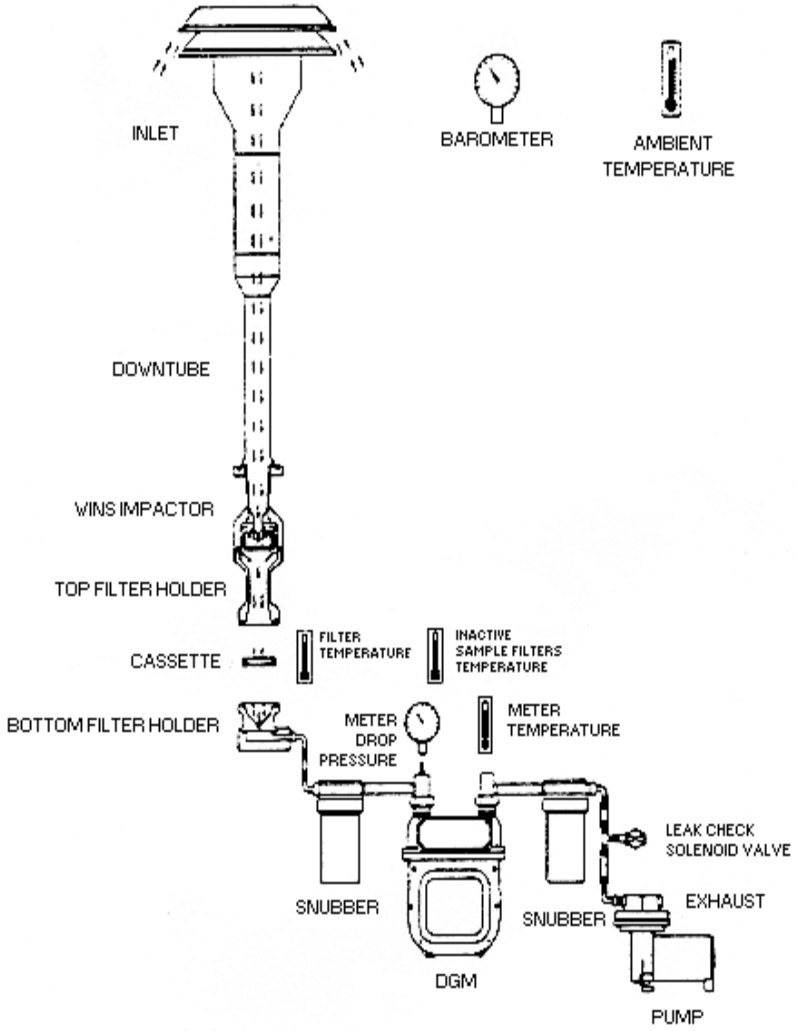
AI.1.0.2 General Description and Theory of Operation

The Andersen RAAS2.5-300 (sequential sampler) was designated in the Federal Register as a FRM for collection of PM2.5(6/98). This sampling system performs all the functions required or recommended in the instrument specification portion of the FRM PM2.5 standard, including: a fixed flow rate of 16.67 liters per minute (LPM) using a specified PM10 inlet, tubing (downtube), secondary size-selective impactor, filter holder, and filter cassette. The sequential sampler uses a filter cassette tray (carousel) which can hold up to eight separate filters in their individual cassettes. Once programmed, this enables the sampler to sample up to eight separate events without operator intervention as well as continue a sampling event on one filter while installing or removing other sample filters (sample cassette exchange).

The sampler draws ambient air through its PM10 inlet, PM2.5 Well Impactor Ninety-Six (WINS), and a 46.2 millimeter (mm) diameter Teflon sample filter which traps the PM2.5 fraction. The sample filter is conditioned and weighed before and after sampling and the resulting difference is the collected PM-2.5 mass. Electronic systems in the sampler are designed to monitor and maintain the flow rate as well as record the elapsed sampling time enabling the sampler to calculate the total sample volume. With this information, the analyzing laboratory will calculate the average PM2.5 concentration of the sampling period.

The Andersen sequential sampler monitors and regulates the flow rate using a dry gas meter, a variable speed pump, and ambient temperature and pressure sensors, all controlled by the sampler's microprocessor and software.

For a more detailed explanation of the sampler's theory of operation, see Section 2: Introduction, of the Operator's Manual and see Figure AI.1.0.1: Schematic of Andersen RAAS2.5 Sequential Air Sampler and Figure AI.1.0.2: Schematic of the WINS Impactor.



The RAAS systems pull ambient air through an inlet, which removes particulate matter of about 10 microns and larger. The air sample is then directed via the downtube to the WINS Impactor, which removes particulate matter of greater than 2.5 mircrons. The remaining particulate is collected using a 47 mm Teflon filter.

Figure AI.1.0.1
Schematic of Andersen RAAS2.5
Sequential Air Sample

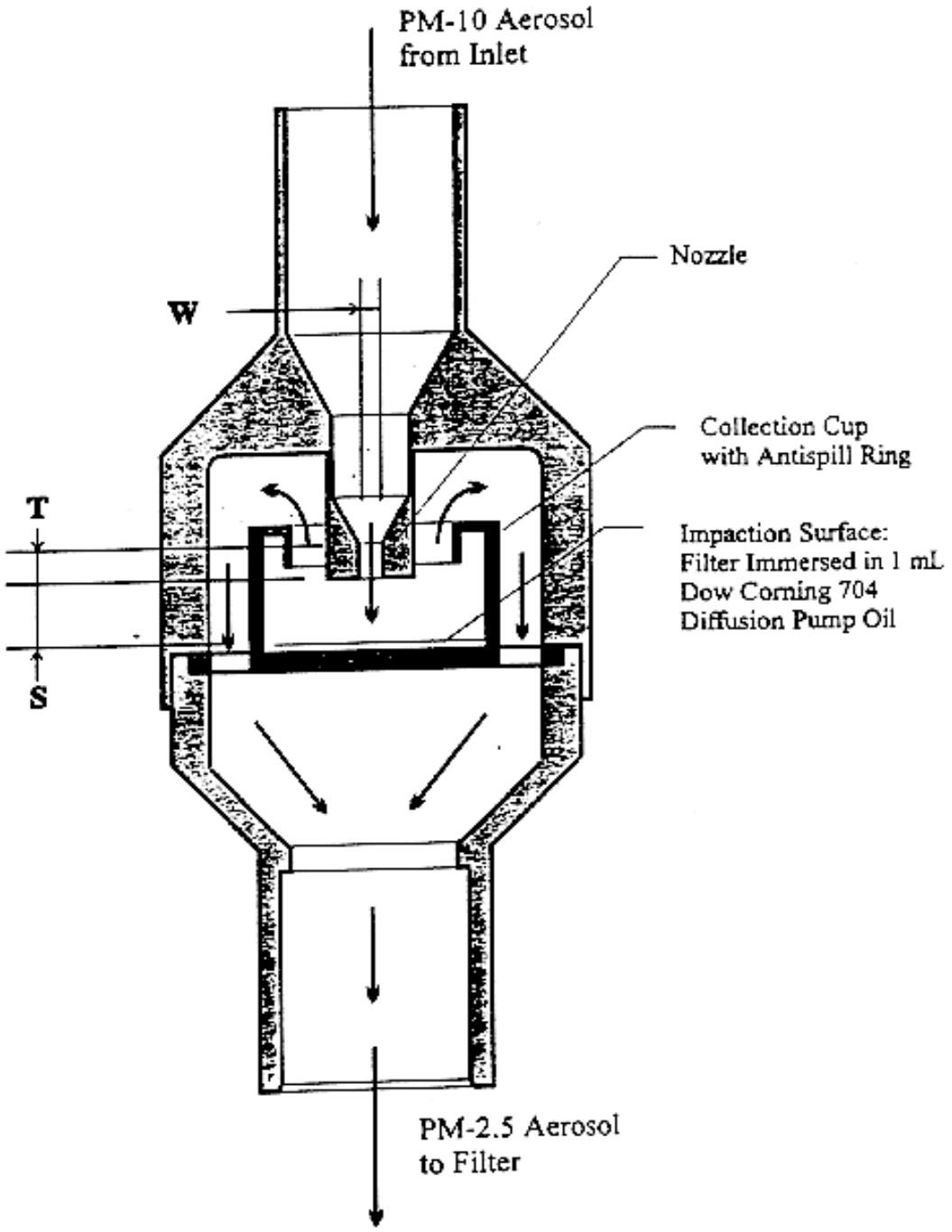


Figure AI.1.0.2

Schematic of the WINS Impactor

AI.1.0.3 Safety

Installation, operation, maintenance, or calibration of the sampler should only be performed by properly trained personnel. High (120 volts A.C.) voltages are used to power the unit and due to typical rooftop installations, the risks of working outdoors at elevation during ambient weather conditions should also be considered. Also read Section 1: Cautions and Notices, in the Operator's Manual.

AI.1.1 INSTALLATION PROCEDURE

AI.1.1.1 Physical Inspection

Each Andersen RAAS2.5-300 Sequential Sampler purchased through the National PM2.5 Sampler Procurement Contract should be supplied with the following supplies:

1 SA642 PM10 Inlet
1 inlet tube
1 stand kit
1 leak check adapter
1 filter bypass leak check disk
1 filter cassette tray
1 filter area cover
1 ambient temperature solar radiation shield
3 sets of impactor wells and anti-spill rings
8 sets of filter cassettes and backing screens
2 sets of inlet O-rings
100 milliliters (ml) of impactor oil
50 (count) of 37 millimeter (mm) diameter glass fiber impactor filters
4 accessories required for the collection, storage, and transport of filter samples
1 DataLink, docking station and power supply, and interconnect cable
8 accessories required for the collection, storage, and transport of filter samples.
Each accessory consisting of a Styrofoam insulated cardboard shipping box, twelve (12) containers of Blue Ice or equivalent, and a metal cylinder capable of holding eight (8) sample filters in cassettes.
1 copy of the Operator's Manual

Upon receipt of the sampler(s), inspect sampler and accessories for shortage and for shipping damage. If shortage or damage is found, immediately notify your supervisor, and/or your agency's shipping department.

AI.1.1.2 Initial Sampler Installation

Follow directions found in Section 3 of the Andersen Operator's Manual for installation instructions and consult with your area specialist/engineer or supervisor to assure that installation site complies with Federal and State siting criteria for FRM PM2.5.

AI.1.1.3 Initial Sampler Set-Up

Follow directions found in Sections 4, 5, and 6 of the Andersen Operator's Manual.

AI.1.2 DATA RETRIEVAL

AI.1.2.1 Introduction

Field personnel will have the responsibility of ensuring PM2.5 sampling information for each filter run is properly retrieved. The sampling information from the Andersen sequential sampler can be obtained either manually or electronically.

The Andersen sequential sampler has a built-in serial communications port that can be used to interface with PC's, modems, and printers. The sampler's communications use N-8-1 protocol (8 stop bits, no parity, 1 stop bit). The sampler is capable of communications over a wide range of baud rates. There are two primary ways to download data from the sampler: Laptop PC or DataLink.

To manually record sample data, field personnel will complete a CARB 24-Hour Field Sample Report (see Figure AI.1.0.3). The 24-Hr sample report will contain all information required by 40 CFR Part 50, Appendix L, Table L-1.

To electronically record sample data, field personnel can download data via an RS-232 data output connection through which digital data will exported to a laptop PC or DataLink unit.

AI.1.2.2 Download Apparatus Using Laptop PC

1. Laptop PC with communications software or terminal program.

2. Serial cable with D-9 male plug with female pins on one end and a D-9 female plug with male pins on the other.

AI.1.2.3 Download Procedure Using Laptop PC

1. Connect the serial cable from the PC to the serial port on the sampler.

2. Open the communications software, configure to operate using the N-8-1 protocol and baud rate set on the Andersen sequential sampler. Enable the file capture portion of the software package(For Procomm click capture icon or type Alt F1).

3. Select the “Data Transfer” menu from the main menu of the Andersen sequential sampler. Select either “Summary”, “Data Log”, or “Pwr Fail Log” depending on the information that is desired to be transmitted. Typically only the summary information will be downloaded. Data Log (5-minute averages) should be downloaded if a problem was encountered during sampling.

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

24-HOUR SAMPLE REPORT - FIELD DATA SHEET

PM 2.5 SAMPLERS

Site ID _____ Sample Date _____

Site Name _____ "Sample by" Date _____

Filter ID _____ Cass ID#: _____ Sampler Model/ID No. _____

SAMPLE SUMMARY

			Amb. Temp.	Amb. Pres.
Elapsed Time	_____	Hr:Min	°C	mm Hg
Strt Date/Time	_____/_____	PST	Average _____	_____
Volume	_____	M3	Maximum _____	_____
Avg. Flow Rate	_____	LPM	Minimum _____	_____
Flow CV	_____	%	Sampler Flag Codes _____	
Local Condition Codes	_____			

A. High Winds
K. Farming Nearby
N. Sanding/Salting Streets
P. Roofing Operation
E. Forest Fire
J. Construction
L. Highway Constr.
Q. Prescribed Burn

Operator Comments _____

CHAIN OF CUSTODY

ACTION	DATE	TIME	FILTER TEMP	NAME
Sample Load				
Sample Removal				
Sample Placed in Cooler				
Sample Shipped to Lab				
Sample Received at Lab				

FOR LABORATORY USE ONLY Postweigh by: _____

	MASS	DUP MASS	DATE	ANALYST
Initial Weight				
Final Weight				

Lavoratory Comments _____

4. After a selection is made, the Andersen sequential sampler system will send the data over the serial connection to the PC. The terminal window of the communications software should show the data being transmitted.

5. After transmission is completed, disable the file capture capability of the communications software to close the capture file. (For Procomm click capture icon or type “Alt F1"). Disconnect serial cable from sampler and PC.

AI.1.2.4 Download Apparatus Using DataLink

1. DataLink unit
2. 9-pin Male to 9-pin female extension cable
3. AC to DC wall transformer for 115 V.
4. Docking station adapter
5. winDataLink software package

AI.1.2.5 Download Procedure Using DataLink

1. The Andersen sequential sampler system must be properly configured in order to use the DataLink. The baud rate of both the DataLink and the Andersen sequential sampler system must be identical. The default setting is 19200 baud. See the Andersen Operator’s Manual for instructions on setting sampler and DataLink baud rate.

2. Connect the DataLink to the serial port on the sampler. Each time the DataLink is attached to an Andersen sequential sampler system a new data file is created.

3. Select the “Data Transfer” menu from the main menu of the Andersen sequential sampler. Select either “Summary”, “Data Log”, or “Pwr Fail Log” depending on the information that is desired to be transmitted.

4. After making a selection, the Andersen sequential sampler system will send data to the DataLink. The green LED of the DataLink will flash while it is receiving data. When the green LED has stopped flashing it is safe to disconnect the DataLink. The DataLink will store this data for later

retrieval. If additional data files are transferred they will be appended to the same data file. If a separate data file is desired for each data file then detach and reattach the DataLink.

AI.1.2.6 Data Upload from DataLink to PC

1. To view data stored on the DataLink, data will need to be uploaded to a desktop PC via the docking station and viewed with the winDataLink software.

2. Locate an available COM port on the desktop PC. Attach the appropriate end of the 9-pin extension cable to the selected COM port. Attach the docking station adapter to the other end of the 9-pin extension cable. Connect the docking station to a 110-120 VAC outlet via the AC to DC wall transformer.

3. winDataLink software will initiate communications with the DataLink. After the software has initialized, users will see a preview screen and a directory pane. The preview pane provides a preview of this.

AI.1.3 DATA SUBMITTAL (FIELD TO LABORATORY)

AI.1.3.1 Introduction

Once field personnel have retrieved sampling information either manually or electronically, the sample run information must be forwarded to the laboratory. If the sampling information was recorded manually, a 24-Hr sample report will accompany the sampled filter(s) to the laboratory. If the sampling information was recorded electronically, the sampling information will be sent to the lab via file transfer protocol. An abbreviated 24-Hr sample report will still accompany the sampled filter(s) to document chain-of-custody and additional sampling information.

AI.1.3.2 Electronic Data Submittal to Laboratory

(*work in progress)*

AI.1.3.3 Sample Chain-of-Custody

The chain-of-custody process begins once the filter is pre-conditioned and inspected by laboratory personnel. After pre-conditioning is complete, filters will be preweighed, placed in cassette filter rings and prepared for shipping. Each filter's unique number will be written on the 24-Hr Sample Report. Laboratory personnel will annotate the preweight of the filter, date and initials on the 24-Hr Sample Report. The 24-Hr sample report and filter(s) will be shipped to the field. Within 30 days of preweighing, the filter will be used for sampling. When the filter is loaded on the sampler, field personnel will document the date, time and initials of person loading the sampler. After sampling, field personnel will document date, time and initials of person removing the sample from the sampler. The temperature of the filter will be documented at this time. If the filter is not being shipped to the laboratory right away, the filter will be place in a freezer for storage until shipping. Field personnel will document date, time and filter temperature when the filter is placed in freezer. When the filter is transported to the laboratory, the date, time, filter temperature, and person transporting the filter will be documented on the 24-Hr Sample Report. When the filter arrives at the laboratory, the date, time, filter temperature, and person receiving the filter will be noted on the 24-Hr sample report. The filter will then be prepared for postconditioning or placed in a freezer for storage until postconditioning. The date, time,

filter temperature, and name of analyst will be documented once postconditioning begins.

AI.1.4 QUALITY CONTROL MAINTENANCE PROCEDURES

AI.1.4.1 General Information

Quality Control (QC) maintenance procedures (checks) are designed to help assure that valid data is produced as a result of proper sampler operation and maintenance in accordance with its federal designation and the manufacturer's operating manual. The maintenance frequency presented in these standard operating procedures should be considered the minimum required even though the actual frequency of performing some of these checks may vary from site to site due to different environmental factors. These may include the sampling schedule, particulate concentrations, or seasonal factors which may require an increase in maintenance frequency. In the event that these checks cannot be performed on schedule, the deferred maintenance should be performed as soon as practical. The QC procedures schedule is presented in Table AI.1.0.1.

When QC checks are performed, the date, results, and any comments should be recorded on the Monthly Quality Control Maintenance Check Sheet for the FRM PM2.5 Filter Sampler (QC checksheet) presented in Figure AI.1.0.4. This document will be forwarded to the supervisor on a monthly basis for subsequent review and filing. It is recommended that a copy be made by the operator and kept at the field site for later reference by the operator or a site visitor.

AI.1.4.2 Daily Checks

During the procedure of unloading the sample cassettes from the sampler, record the sample summary data onto the sample cassette's matching 24-Hr sample report. Also record run date on the QC checksheet.

Review the summary data for reasonableness and for compliance with Measurement Quality Objectives for FRM PM2.5 presented in Table

AI.1.0.2. If questionable summary data is seen, download the five (5) minute data averages using the Andersen DataLink or personal computer (PC) and examine these averages for anomalies. Procedures for downloading these data are presented in Section AI.1.2 (Data Retrieval) of this SOP as well as Section 7: Data Logging, in the Operator's Manual. In the event that anomalies are present in the 5 minute averages, troubleshoot the sampler according to instructions in Section 12: Troubleshooting, of the Operator's Manual and notify your supervisor or area calibrator. Also, visually inspect the PM10 inlet's water collector jar and drain it if water is present.

Quality Control Procedure Schedule for
Federal Reference Method PM2.5 Sampling

	*Daily	Every 5 Samples	Every 25 Samples	Every Month	Every 6 Months	Every 12 Months
Record and Review Run Summary	X					
Inspect or Drain Inlet Water Jar	X					
Service WINS Impactor Well		X				
Perform Leak Check		X				
Disassemble and Clean PM10 Inlet, Downtube and Entire WINS			X	X		
Inspect O-rings and Gaskets			X	X		
Perform Single Point Flow Rate Check			X	X		
Clean Interior of Sampler				X		
Clean Air Intake Filter and Fan				X		
Perform Single Point Check of Ambient Temp and Press Sensors				X		
Verify Sampler Clock Time				X		
Transport Samples with Temp-logger				X		
Run a Field Blank				X		
Perform as-is Three Point Calibration Verification of Flow Rate, Pressure and Temperature Sensors					X	
Verify As-is Condition of Sampler's Interior, Inlet, and WINS Impactor					X	
Perform Multipoint Calibration of Flow Rate, Pressure & Temperature Sensors					X	
Measure Temp of Station Freezer					X	
Calibrate or Re-certify Flowrate, Press and Temp QC Check Standards						X

*or each time sample cassettes are exchanged

Table AI.1.0.1
QC Procedures Schedule for FRM PM2.5 Sampling

CARB MONTHLY QUALITY CONTROL MAINTENANCE CHECK SHEET
FRM PM2.5 FILTER SAMPLER

Site Name: _____ Month/Year: _____
Site Number: _____ Sampler Make & Model: _____
Operator/Agency: _____/_____ Sampler ID Number: _____
Operator Instructions:

At Each Sample Unload: Record and review sample run data; inspect/drain inlet water jar.
Run Days: _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
(if sampling daily, then indicate by 1-10, 21-25, etc.)
Every 5 Runs: Clean or change-out WINS impactor well.
Days WINS Serviced: _____ _____ _____ _____ _____ _____ _____ __
Perform leak check - Results: _____ _____ _____ _____ _____ _____
(<80mL/min for 10 min).
Every 10 Runs: Run a field blank. Date Performed: _____ _____ _____
Monthly or Every 25 Runs: Clean inlet, downtube, entire WINS, interior of sampler, air intake filter and fan.
Inspect o-rings and gaskets; check sampler clock time (<+/-10min).
Perform single point QC check of flow rate, ambient temperature and pressure.
Date Performed: _____ Include temp-logger with samples during transport.
Semiannually: Perform as-is calibration check. Inspect sampler's inlet, WINS, and interior condition.
Perform maintenance or repair wiring and connectors, tubing and connections, pumps and fans.
Perform multipoint calibration of flow rate, temperature and pressure sensors.
Perform leak check and measure temperature of station freezer. Date Last Performed: _____
Annually: Re-certify QC check standards - Certification Date: _____ _____ _____
(flow std) (temp std) (press std)

Sampler Flow Rate, Ambient Temp and Pressure Check Results:

	Flow Rate Standard	Temperature Standard	Pressure Standard
Standard Name/Type:			
Identification Number:			
Correction Factor:			
Std's Indicated Reading:			
Std'sCorrected Reading:			
Sampler's Reading:			
Percent Difference:			
Acceptance Criteria:	≤+/-4% of standard	≤+/-2°C of standard	≤+/-10 mm Hg of std

Operator Comments: _____

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Figure AI.1.0.4
CARB Monthly Quality Control Maintenance Check Sheet
FRM PM2.5 Filter Sampler

Measurement Quality Objectives for FRM PM2.5

Requirement	Frequency	Acceptance Criteria
Filter Holding Times:	all sample filters	
Pre-sampling		<30 days before sampling
Post-sampling (in sampler)		<96 hrs from end of sampling
Post-sampling (during storage and transport)		<10 days at 25°C from end of sampling or <30 days at 4°C from end of sampling
Sampling Period:	all data	1380 to 1500 minutes or MC if <1380 and exceedance of NAAQS
Sampler:	every 24 hrs of operation	
Flow rate		≤5% of 16.67 LPM
Flow rate variability		≤2% CV
		measured ≤5% average for 5 min
Filter temp sensor		≤5°C of amb temp for <30 min
Data Completeness:	quarterly	75%
Filter:	all filters	Visual defect check
Monthly QC Check:	monthly	
Flow rate		+/-4% of standard
Leak check		<80 mL/min for 10 minutes
Ambient temp sensor		+/-2°C of standard
Ambient press sensor		+/-10 mm Hg of standard
Clock/timer		+/-10 min of corrected clock time
Multipoint Calibration:	semiannually or	
Flow rate	when failed monthly check,	+/-2% of transfer (xfer) standard
Leak check	following major repair,	<80 mL/min for 10 minutes
Temperature sensors	or after sampler transport	+/-2°C of xfer standard
Pressure sensors		+/-10 mm Hg of xfer standard
Monthly QC Standards:	annually	
Flow rate standard		+/-2% of NIST-traceable standard
Temperature standard		+/-0.1%C resolution
		+/-0.5%C accuracy
Pressure standard		+/-1 mm Hg resolution
		+/-5 mm Hg accuracy
Calib. Xfer Standards:		
Flow rate xfer standard	dry gas meter annually	+/-2% of NIST-traceable standard
	mass flow meter quarterly	
Temperature xfer standard	annually	+/-0.1°C resolution
		+/-0.5°C accuracy
Pressure xfer standard	annually	+/-1 mm Hg resolution
		+/-5 mm Hg accuracy

Table AI.1.0.2 Measurement Quality Objectives for FRM PM2.5

AI.1.4.3 Every 5 Sampling Runs Checks

Remove the WINS impactor from the sampler and inspect impaction well to determine size of particulate cone which may have formed in the center of the well. A cone taller than two (2) millimeters or a cone with its top broken off indicates a need for more frequent well cleaning to minimize the possibility of particle bounce and re-entrainment of particles larger than 2.5 microns.

Clean or replace impactor well with a newly serviced well according to instructions in Section 11.4 of the Operator's Manual. Record performance of this procedure and pertinent comments onto the sampler's QC checksheet.

After servicing the WINS impactor and reassembling, perform a leak test and record the results on the sampler's QC checksheet. If the results of the leak check do not meet the criteria, troubleshoot the sampler according to Section 12: Troubleshooting, of the Operator's Manual to determine the cause and if a cause cannot be found, notify your supervisor or area calibrator.

AI.1.4.4 Every 25 Sampling Runs Checks

Disassemble and clean the PM10 inlet, sampler downtube, and the entire WINS impactor assembly. Inspect o-rings for abrasions, breaks, tears, deformations or other damage. If necessary, replace o-rings and lubricate them with a light coating of halocarbon or silicone vacuum grease prior to reassembly. Using the same lubricant, also lightly lubricate any aluminum threads and take extra care that the fine threads are not cross-threaded during assembly. After reassembly, perform a leak check according to instructions in Section 9.3 of the Operator's Manual and record the results on the QC checksheet. If the results of the leak check meet the acceptance criteria found in Table AI.1.0.2, perform a single point flow check according to instructions presented in Section 9.4 of the Operator's Manual. If the results of the leak check do not meet the criteria, troubleshoot the sampler according to Section 12: Troubleshooting, of the Operator's Manual to determine the cause and if a cause cannot be found, notify your supervisor or area calibrator.

Perform the flow check using an actual flow rate or volume measuring device having an accuracy of at least +/-2 percent (%) of full scale (0-20 LPM vol-o-flow, mass flow meter, etc.) and which is calibrated or certified annually against a NIST-traceable standard. If the sampler's flow rate measurement is not within +/-4 percent of the standard's measurement, investigate the cause. If

a cause for the flow discrepancy cannot be found, notify your supervisor. Record the date that these procedures were performed and results of the flow check onto the sampler's QC checksheet.

AI.1.4.5 Monthly Checks

Clean the interior of the sampler chassis with a damp cloth. Remove the air intake filter and clean it with soap and water following instructions found in Section 11.3 of the Operator's Manual. Clean air intake fan blades with a damp cloth or brush if necessary.

Perform both a leak check and a flow check, as previously described in Every 25 Sampling Runs Checks, if it has been more than a month since these procedures were last performed. Perform a single point check of ambient pressure and temperature sensors using a temperature and pressure standard which is calibrated or certified annually against a NIST-traceable standard. If the sampler's measurements are not within the acceptance criteria (+/-4% for flow rate, <80 mL/min for leak check, $\pm$10 mm Hg for pressure, and $\pm$2°C for temperature) of the standard's measurements, examine the sampler for obvious causes as well as following instructions in Section 12: Troubleshooting, found in the Operator's Manual. If the cause of the discrepancy cannot be found, notify your supervisor or area calibrator.

Verify that the sampler's clock time is within ten (10) minutes of standard time as compared to a clock standard such as the telephone service time or other corrected clock. If there is a difference of more than 10 minutes, reset the sampler's clock to within one (1) minute of the standard according to instructions given in Section 7.1 of the Operator's Manual. Record the date that these procedures were performed and the results obtained onto the sampler's QC checksheet.

Field blanks will be implemented at 10% of sampling frequency. This procedure will be initiated by the laboratory and will consist of the laboratory sending or designating a sample cassette as a field blank. The operator will treat this sample cassette in the same manner as a regular sample cassette used for sampling with the sole exception that it will not be used to collect sample. The field blank sample cassette is to be loaded and unloaded from the sampler, transported, stored and shipped as usual, but the sampler will not be programmed for a sampling event using this sample cassette. In order for this field blank to be as meaningful as possible in checking for passive

contamination, leave the field blank in the sampler for at least as long as a regular filter cassette stays in the sampler, both before and after the sampling event. Fill-in the appropriate sections of the field blank's 24-Hr sample report and ship blank cassettes alongside valid samples to the laboratory.

AI.1.4.6 Semiannual Checks

Every six (6) months, the area calibrator will inspect the sampler's interior, PM10 inlet, and WINS impactor for cleanliness and condition after an as-is three point calibration verification check has been performed. If any of the sampler's calibrated systems fail to meet the acceptance criteria presented in Table AI.1.0.2, the calibrator must perform a final multipoint (five (5) points) calibration of all systems. The operator may assist the area calibrator in performing all necessary repairs and maintenance prior to the calibrator

performing a final multipoint calibration of flow rate and all temperature and pressure sensors. After the multipoint calibration, the area calibrator will perform a leak check. Using the temperature standard, the area calibrator will also measure the temperature of the site's freezer (if so equipped) and record the results onto the sampler's calibration worksheet or report. The operator will record all maintenance performed and date of calibration onto the sampler's QC checksheet.

AI.1.4.7 Annual Checks

The operator will have their flow rate, temperature, and pressure QC verification check measurement standards re-certified or calibrated against a NIST-traceable standard. The date that these procedures are performed will be recorded onto the sampler's QC checksheet.

AI.1.5 SAMPLE FILTER HANDLING AND SHIPPING PROCEDURE

AI.1.5.1 General Information

The major differences between collection of PM2.5 using the Federal Reference Method (FRM) and current filter sampling for particulates are the additional time and temperature requirements (see *Filter Holding Requirements* presented in Table AI.1.0.2). FRM PM2.5 filters must be used for sampling within 30 days of the date of preweighing by the laboratory. Also, postweighing by the laboratory must be performed within ten (10) days of the end sampling date if the sampled filters have been continuously stored at no more than 25°C since removal from the sampler. If the sampled filters have been continuously stored at 4°C or less since removal from the sampler, the laboratory must conduct postweighing within 30 days of the end sampling date.

Since this latter (30 days at $\leq$4°C) requirement is preferred in order to give sufficient time for field, transport, and laboratory procedures, additional equipment such as a freezer, insulated shipping containers, and chilled medium ("Blue Ice" or equivalent) will be provided to the field operators. In addition, various means and devices to monitor the storage and transport temperatures of the sampled filters will also be provided. This equipment and the following operating procedures are designed to assure compliance with these time and temperature requirements.

AI.1.5.2 Presampling Filter Handling Procedures

The laboratory will supply preweighed sample filters, installed in filter cassettes, to the field/site operator. These sample cassettes, along with their respective 24-Hour sample report, will be shipped inside an insulated shipping container. This container should have external markings which designate that the container is assigned to the site operator as well as that it contains preweighed filters which are available for sampling. These markings are necessary to insure that the correct amount of filters are delivered to the proper site since different sites will be operating under different sampling schedules. Also, additional markings will alert the operator that the shipment contains sample filters since not all shipments of insulated containers will contain sample filters.

Inside the shipping container, the sample cassettes will be further contained inside the Andersen metal cylinder which is designed to hold up to eight

cassettes and which unscrews apart. Open the metal cylinder and confirm that each sample cassette has a cassette ID number written on its side and that this number corresponds to the cassette ID number written in a matching 24-Hr sample report. If it is necessary to take a sample cassette out of the cylinder in order to see its ID number, do not remove the

metal cassette covers in order to minimize the possibility of contamination. If either a cassette or a 24-Hr sample report is received that does not have its matching cassette or 24-Hr sample report, notify the laboratory for further instructions.

Examine the 24-Hr sample report for the date that the sample filter was preweighed. The sample filter must be used within 30 days of this date. Notify the laboratory if this requirement cannot be met as the sample cassettes may still be able to be used as field blanks. Return expired filters and their respective sample report forms to the laboratory noting on the 24-Hr sample report the reason for their return.

Close the metal cylinder leaving the sample cassettes inside, attach the sample report forms and store the cylinder under office environmental conditions until ready for loading into the sampler. If the cylinder will be stored with previously received cylinders, store them in such a way that the first received is the first sampled. When ready for sampling, remove the sample cassette(s) from the cylinder and load the filters into the sampler according to instructions in Section 6: Sampling, and Section 10: PM2.5 Measurement Procedure, of the Operator's Manual. At this time, also fill-in appropriate sections of the sample cassette's matching 24-Hr sample report.

To minimize the possibility of contaminating the sample filter prior to the sampling event, load the sample filter(s) at a time as close as practical to the start of the sampling event. Also, if it appears probable that the surface of the sample filter may be touched during handling, then laboratory grade (non-dusted) latex gloves should be worn.

AI.1.5.3 Postsampling Filter Handling Procedures

Remove sample cassette(s) from the sampler according to instructions in Sections 6 and 10 of the Operator's Manual. Install metal cassette covers onto

cassette and place cassette into metal cylinder with the cassette ID number visible. After filling-in 24-Hr sample report(s), review sample summary data for compliance with Measurement Quality Objectives presented in Table AI.1.0.2. If objectives are not met, investigate the cause and if a cause cannot be found and remedied, notify your supervisor or area calibrator. Note problem in comments section of the 24-Hr sample report as well as on the QC checksheet. After filling-in 24-Hr sample report(s), place report(s) inside a zip-lock plastic bag to avoid condensation damage and attach bag to the exterior of the cylinder with a rubber-band. Store cylinder containing sampled cassettes in cold storage (less than 4°C) until transport to the laboratory. Use a method of storage which assures that the oldest samples will be the first transported to the laboratory.

As previously noted, although the sample cassette(s) may remain in the sampler up to 96 hours (4 days) after the end of the sampling event, remove them from the sampler as

soon as practical. This practice will lessen the possibility of postsampling contamination as well as minimize volatilization of the collected sample.

AI.1.5.4 Shipping and Transport Procedures

When traveling to a satellite PM2.5 site, the operator should bring an insulated shipping container or cooler having chilled medium inside. The container will be used to chill the sampled filters to less than 4°C during the transportation period to the operator's office or the laboratory. The average ambient temperature encountered as well as the amount of time spent during the transport period will determine the amount of chilled medium necessary to maintain sample temperatures within limits. It is recommended that the sampled filters also be contained in a chilled metal cylinder, both to provide additional chilled mass as well as to minimize contamination. If the metal cylinder is not used, the sampled filters should at least be placed inside of a ziplock, static-resistant plastic bag before being put into the insulated container. The 24-Hr sample report(s) should also be placed inside a ziplock bag to avoid condensation damage if they are transported in the container.

If the elapsed time between removal of the sample cassette(s) from the sampler and placing the cassettes into the home office/main station freezer is more than 2 hours, activate both 5°C and 25°C temperature ranges of irreversible temperature indicators and place them in close proximity to the sampled filters during transport. Follow the directions included with the indicators for their proper storage and activation. If the indicators' temperature threshold is not exceeded, they may continue to accompany the samples during transport to the laboratory. If the temperature threshold is exceeded, note this information in the affected sample filter's 24-Hr sample report and attempt to determine the cause of why this temperature was exceeded.

Upon arrival at the operator's office, the operator will fill-in the portion of each 24-Hr sample report's chain of custody section which asks for time, date, and filter temperature. Next, put the 24-Hr sample reports into a ziplock bag and attach the bag to the cylinder containing the samples and place the cylinder into the freezer for storage until ready for transport to the laboratory.

Shipments to the laboratory will be made on a biweekly basis by the station operator. Schedule the delivery early enough in the week to avoid arrival on weekends or holidays.

To prepare the samples for transport, remove the cylinder containing the oldest (earliest sample date) sample cassettes and attached 24-Hr sample reports from the freezer. Open the cylinder and confirm that each sample cassette has a matching 24-Hr sample report having the same cassette ID number. Fill-in the portion of each 24-Hr sample report's chain of custody which asks for date, time and temperature of the samples. If alright, close the cylinder, attach the 24-Hr sample report(s) and place the cylinder in an insulated shipping container having enough chilled medium to assure that the samples arrive at the laboratory at a temperature not exceeding 4°C. The type of insulated shipping container needed and the amount of chilled medium used will depend on the

transit time of shipping as well as the expected ambient temperatures during shipment.

In order to monitor whether the 4°C or the 25°C temperature specifications of the samples are exceeded during shipment, activate and attach both a 5°C and a 25°C irreversible temperature indicator to the cylinder, preferably inside of the ziplock bag containing the 24-Hr sample report(s). Orient the indicators in such a manner that the indicator window is clearly visible upon examination. Place the chilled cylinder into an insulated shipping container and fill the remaining space with chilled medium. Close the shipping container and secure the lid or opening to prevent opening during transport. Hand-carry the container to the analyzing laboratory.

Periodically (every 1 to 3 months depending on need), a miniature temperature sensor with a built-in data logger (temp-logger) will be provided to field operators. The temp-logger will be used to monitor and record the sample temperature from the time the cassettes are removed from the sampler to the start of postweighing conditioning by the laboratory. This practice will provide added assurance that the sample temperatures are within specifications. The temp-logger may also be used to determine at what point the specifications are being exceeded, as perhaps indicated by the irreversible temperature indicators. Initiating this procedure and analyzing the recorded data are the responsibility of the area calibrator. Results of this procedure will be forwarded to the area supervisor, station operator, and filed in the station's site files.

AI.1.6 TROUBLESHOOTING

AI.1.6.1 General Information

If a problem is encountered as a result of the review of the sample summary data which may affect the validity of the sample, download and store the five (5) minute averages. Review the 5 minute averages for operational parameters which may exceed limits of measurement quality objectives defined in Table AI.1.0.2 of these procedures. Also refer to Section 12: Troubleshooting, of the Operator's Manual for a probable cause and remedy. Notify your supervisor or area calibrator if the problem cannot be resolved. If the perceived problem does not affect sample validity, refer to Section 12: Troubleshooting of the Operator's Manual and continue to monitor the problem or correct it. If the problem persists, contact your area calibrator or shop repair specialist.

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

APPENDIX AI.2

CALIBRATION PROCEDURES FOR ANDERSEN RAAS2.5-300 SEQUENTIAL AIR SAMPLER

MONITORING AND LABORATORY DIVISION

NOVEMBER 1998

AI.2.0 BACKGROUND AND GENERAL INFORMATION

AI.2.0.1 Overview

The calibration of the fine particulate matter samplers whose mass has an aerometric diameter of less than 2.5 microns (PM2.5) must be performed on a six month basis. There are several parameters that must be calibrated with this new generation of fine particulate matter samplers. These parameters include flow or volume, temperature, pressure and time. The ARB has chosen two reference method samplers to monitor for PM2.5 at this time. These samplers are the Andersen RAAS2.5-300 Sequential Sampler and the Rupprecht and Patashnick Partisol-FRM Model 2000 PM2.5 single channel sampler. Each sampler has a different principle of flow and, therefore, two calibrations are required for this SOP. Generally, the calibration procedure in Section 8 of the Andersen Operator's Manual is fairly complete, accurate and easy to follow. The primary purpose of the calibration is to determine and/or verify that the volumetric flow of the PM2.5 sampler is at 16.67 liters per minute (LPM), or that the sampler collects a volume of 1 cubic meter of air per hour. Refer to 40 CFR Part 50, Appendix L for further information.

AI.2.0.2 General Information

The calibration of the Andersen sampler should be performed in the following steps:

1) temperature calibration
2) pressure calibration
3) leak test
4) volume calibration
5) verify calibration parameters

All calibration information and data will be recorded on the Andersen Sequential PM2.5 Calibration Data Sheet (Figure AI.2.0.1).

California Air Resources Board
Andersen Sequential PM2.5 Calibration Data Sheet
Page 1 of 2

Site Name _____ Site Elevation _____
Site Number_____ Ambient Temperature _____
Property Number _____ Ambient Pressure _____

Temperature Sensor Calibration

Tegam ID Number _____ Certification Date_____
Ambient Temperature Sensor Gain _____ Offset _____ Zero Reading _____
Filter Temperature Sensor Gain_____ Offset _____ Zero Reading _____
Meter Temperature Sensor Gain _____ Offset _____ Zero Reading _____
Inactive Filter Temp. Sensor Gain _____ Offset _____ Zero Reading _____

Pressure Sensor Calibration

Pressure Standard ID Number _____ Certification Date_____
Pressure Slope _____ Pressure Intercept_____
Meter Pressure Drop _____ Gain _____ Offset_____
Barometric Pressure _____ Gain _____ Offset_____

Leak Test

Channel Number	Leak Flow	Time	Channel Number	Leak Flow	Time
1			5		
2			6		
3			7		
4			8		

Flow Calibration

DGM ID Number Calibration Coefficient Calibration Date

Nominal Flow	Initial Volume	Final Volume	Initial Temp	Final Temp	Time (min)
16.7					
18.3					
15.0					

Sampler DGM Gain_____ Offset_____ Ticks/cc _____

Calibrated by_____ Checked by _____

Figure AI.2.0.1
Andersen Sequential PM2.5 Calibration Data Sheet

California Air Resources Board
Andersen Sequential PM2.5 Calibration Data Sheet
Page 2 of 2

Site_____ Date_____

Temperature Calibration Verification

Temperature Standard ID Number _____ Certification Date_____
Certification Slope _____ Certification Intercept_____

	DGM Temperature Sensor				Avg	Temperature Standard			Avg
Cold	_____	_____	_____	_____	_____	_____	_____	_____	
Ambient	_____	_____	_____	_____	_____	_____	_____	_____	
Hot	_____	_____	_____	_____	_____	_____	_____	_____	

Pressure Verification

Sampler Pressure_____ Pressure Standard_____

Flow Verification

Initial DGM Volume _____ Initial DGM Temperature _____
Final DGM Volume _____ Final DGM Temperature _____
Sampler LPM _____
Percent Difference _____

Time Verification

Time Standard Make _____ Model_____ Cal Date _____ Bias _____
Andersen Sampler Time _____ Time Standard Time_____ Difference _____

Final Time Set

Andersen Sampler Time _____ Time Standard Time _____ Difference _____

Calibrated by _____ Checked by _____

Figure AI.2.0.1 (cont.)
Andersen Sequential PM2.5 Calibration Data Sheet

AI.2.1 CALIBRATIONS

AI.2.1.1 Calibration Transfer Standards and Equipment

The Andersen calibration kit will be used as the calibration transfer standards. The calibration transfer standards and equipment will be as follows:

1. NIST-traceable dry gas meter
2. Tegam temperature calibrator and associated "K" type connector
3. NIST-traceable thermometer
4. NIST-traceable pressure meter
5. Andersen flow adapter
6. Tubing: _ inch OD, thick walled, surgical rubber, 1 meter in length
   1/8 inch OD, surgical rubber, 3 pieces, 1 foot in length, plus a plastic 1/8 inch "tee"
7. Blank filter(s)
8. Source of vacuum/pressure
9. Three (3)Two-liter thick walled beakers, water and ice
10. Hot plate
11. Calibration forms or laptop computer
12. NIST-traceable timer

AI.2.1.2 Certification of Transfer Standards

All transfer standards used for calibrations will be re-certified every 12 months by the ARB standards laboratory.

AI.2.1.3 Temperature Sensor Calibration

The Andersen Sequential Samplers employ epoxy coated bead thermocouples to measure temperature at several locations throughout the sampler. The locations are the outside ambient air, the filter holder assembly, the sampling carousel, and within the dry gas meter. A two-point Tegam calibration will be performed at each of these locations. The dry gas meter thermocouple is used

to determine the volumetric flow rate of the sampler. Therefore, it is essential that this temperature sensor be tested for accuracy. It will be the only temperature probe that will receive a full three-point calibration (subject to discussion and change). From the Main Menu of the Andersen sampler, arrow down until the "Maintenance" item is highlighted. Next, select the "Calibrate" option.

AI.2.1.3.1 Ambient Sensor

To calibrate the ambient temperature sensor, unplug the thermocouple marked "ambient" inside the sampler cabinet. Connect one end of the "K" type connector to the Tegam temperature calibrator, and the other end into the "ambient" thermocouple connection.

Record the Tegam ID number and calibration date on the calibration data sheet or in the laptop calibration procedure. Enter the Sampler ID number, date, and analyst name on the calibration data sheet or in the laptop computer program.

Turn on the Tegam calibrator. Select the "CALIB" mode, the "K" thermocouple, the degrees C scale, and enter -20.0 on the display. The display flashes while setting, and stops flashing when the temperature is entered.

Next, from the Andersen sampler display select the "Ambient" option, and press the Enter key. The sampler will prompt you for the low temperature value. Enter a low temperature value of -20.0 ^{o}C. Press the Cancel key (If -20.0 is already on the display, press the Cancel key). The sampler will now measure the voltage associated with
-20.0 ^{o}C. It takes 100 readings and determines the average for that temperature.

The sampler will now prompt for the high temperature value. Enter 35.0 ^{o}C on the Tegam and 35 ^{o}C on the PM2.5 sampler display. Press the Cancel key. The sampler will now measure the voltage associated with 35 ^{o}C. It takes 100 readings and determines the average voltage for that temperature. When completed, the system will display the Gain, Offset, and current temperature. Change the Tegam to read 0.0 ^{o}C. The reading on the sampler should drop to 0.0 ^{o}C. Enter the Gain, Offset, and Ambient Temperature reading on the calibration data sheet or in the laptop computer program. Press the Cancel key to continue.

The next screen asks if you want to save the calibration. Use the arrow keys to select "Yes", if you want to save the calibration. Be sure to connect the ambient thermistor back into the ambient plug.

AI.2.1.3.2 Filter Sensor

To calibrate the filter temperature sensor, unplug the thermocouple marked "Sample Filter" inside the sampler cabinet. Connect one end of the "K" type connector to the Tegam temperature calibrator, and the other end into the "Filter" thermocouple connection.

Turn on the Tegam calibrator. Select the "CALIB" mode, the "K" thermocouple, the degrees C scale, and enter -20.0 on the display. The display flashes while setting, and stops flashing when the temperature is entered.

Next, from the Andersen sampler display select the "Filter" option, and press the Enter key. The sampler will prompt you for the low temperature value. Enter a low temperature value of -20.0 ^{o}C. Press the Cancel key (If -20.0 is already on the display, press the Cancel key). The sampler will now measure the voltage associated with
-20.0 ^{o}C. It takes 100 readings and determines the average for that temperature.

The sampler will now prompt for the high filter temperature value. Enter 35.0 ^{o}C on the Tegam and 35 ^{o}C on the PM2.5 sampler display. Press the Cancel key. The sampler will now measure the voltage associated with 35 ^{o}C. It takes 100 readings and determines the average voltage for that temperature. When completed, the system will display the Gain, Offset, and current temperature. Change the Tegam to read 0.0 ^{o}C. Enter the Gain, Offset, and Filter Temperature onto the calibration data sheet or in the laptop computer calibration program. The reading on the sampler should drop to 0 ^{o}C. Press the Cancel key to continue.

The next screen asks if you want to save the calibration. Use the arrow keys to select "Yes", if you want to save the calibration. Be sure to plug the filter thermistor back into the filter plug.

AI.2.1.3.3 Meter Sensor

To calibrate the meter temperature sensor, unplug the thermocouple marked "DGM" inside the sampler cabinet. Connect one end of the "K" type connector

to the Tegam temperature calibrator, and the other end into the "DGM" thermocouple connection.

Turn on the Tegam calibrator. Select the "CALIB" mode, the "K" thermocouple, the degrees C scale, and enter -20.0 on the display. The display flashes while setting, and stops flashing when the temperature is entered.

Next, from the Andersen sampler display select the "Meter" option, and press the Enter key. The sampler will prompt you for the low temperature value. Enter a low temperature value of -20.0 ^{o}C. Press the Cancel key (If -20.0 is already on the display, press the Cancel key). The sampler will now measure the voltage associated with
-20.0 ^{o}C. It takes 100 readings and determines the average for that temperature.

The sampler will now prompt for the high meter temperature value. Enter 35.0 ^{o}C on the Tegam and 35.0 ^{o}C on the PM2.5 sampler display. Press the Cancel key. The sampler will now measure the voltage associated with 35.0 ^{o}C. It takes 100 readings and determines the average voltage for that temperature. When completed, the system

will display the Gain, Offset, and current temperature. Change the Tegam to read 0.0 ^{o}C. The reading on the sampler should drop to 0 degrees. Enter the Gain, Offset, and Meter Temperature on the calibration data sheet or in the laptop calibration computer program. Press the Cancel key to continue.

The next screen asks if you want to save the calibration. Use the arrow keys to select "Yes", if you want to save the calibration. Be sure to connect the meter thermistor back into the meter plug.

AI.2.1.3.4 Inactive Filter Sensor

To calibrate the inactive filter (carousel) temperature sensor, unplug the thermocouple marked "Non-Sample Filter" inside the sampler cabinet. Connect one end of the "K" type connector to the Tegam temperature calibrator, and the other end into the "Non-Sampler Filter" thermocouple connection.

Turn on the Tegam calibrator. Select the "CALIB" mode, the "K" thermocouple, the degrees C scale, and enter -20.0 on the display. The display flashes while setting, and stops flashing when the temperature is entered.

Next, from the Andersen sampler display select the "Inactive" option, and press the Enter key. The sampler will prompt you for the low temperature value. Enter a low temperature value of -20.0 ^{o}C. Press the Cancel key (If -20.0 is already on the display, press the Cancel key). The sampler will now measure the voltage associated with
-20.0 ^{o}C. It takes 100 readings and determines the average for that temperature.

The sampler will now prompt for the high filter carousel temperature value. Enter 35.0 ^{o}C on the Tegam and 35.0 ^{o}C on the PM2.5 sampler display. Press the Cancel key. The sampler will now measure the voltage associated with 35.0 ^{o}C. It takes 100 readings and determines the average voltage for that temperature. When completed, the system will display the Gain, Offset, and current temperature. Change the Tegam to read 0.0 ^{o}C. The reading on the sampler should drop to 0 degrees. Enter the Gain, Offset, and Inactive temperature onto the calibration data sheet, or onto the laptop computer calibration program. Press the Cancel key to continue.

The next screen asks if you want to save the calibration. Use the arrow keys to select "Yes", if you want to save the calibration. Be sure to plug the thermistor back into the Non-Sample Filter plug.

AI.2.1.4 Meter Pressure Drop

The Andersen sampler has the capability to determine the pressure drop between the filter and the dry gas meter. This provides useful information about particulate loading and sample validation. To calibrate the meter pressure drop select the "Meter Drop" prompt in the sampler calibration menu. Press Enter. Connect one end of the 1/8 inch surgical rubber tubing to the Ambient/Calibrate port, and the other end to the calibration syringe with the plunger removed. At this point no pressure is applied to the system. Make sure the display reads 0.0 mm Hg. Press Enter. The system will measure and record this pressure as 0.0 mm Hg.

Next, the system will ask for an ambient pressure that is 200 mm Hg above ambient pressure. For example, if the ambient pressure reading is 762 mm Hg, insert the plunger into the syringe and apply force to the plunger until the pressure gauge reads 962 mm Hg. When the pressure gauge reading stabilizes, press the Enter key. The system will now read and record the high filter pressure. When the pressure testing is complete the display will show the Gain and the Offset. Enter the Gain and Offset values into the calibration data sheet.

Press the Cancel key to continue the calibration. The display will now ask you to accept the meter calibration. Select Yes, and press Cancel to save the calibration.

AI.2.1.5 Barometric Pressure Sensor Calibration

The barometric pressure sensor of the Andersen sampler can be calibrated by connecting one end of the 1/8 inch OD surgical tubing with the "tee" to the sampler barometric pressure port, the second end to the calibration barometer, and the third end to a pressure/vacuum source. The Andersen calibration kit provides a 500 cc gas tight syringe. Record the make, model, and calibration date of your calibration pressure sensor on the calibration data sheet.

Select the "Barometer" option from the Calibrate menu and press Enter. The analyzer will ask for a pressure of 600 mm Hg. Pull the stem of the syringe until a vacuum of 600 mm Hg is indicated on the pressure gauge. When the pressure value is stable on the pressure gauge, press the Enter key (Cancel). The system will read 100 pressure measurements.

Next the sampler will ask for a pressure of 800 mm Hg. Push the plunger of the syringe in until the pressure in the sampler is increased to 800 mm Hg. When the value on the pressure gauge stabilizes press the Enter key (Cancel). The system will collect 100 pressure measurements. The calibration screen will now display the Gain, Offset and current barometric pressure. Record the Gain, Offset, and current pressure on the calibration data sheet. Press the Cancel key to continue. Select "Yes" if you want to save the pressure calibration.

AI.2.1.6 Flow Rate Calibration

AI.2.1.6.1 Leak Check

Before calibrating the flow (volume) of the sampler it is important to ensure that the sampling train does not have a leak. The Andersen sampler was designed to perform automatic leak checks.

Remove the Andersen 642 PM10 inlet. Install the leak check adapter to the sampler inlet, and place the valve in the closed position. Insert 46.2mm Teflon filter(s) into each position of the sampling carousel. Each position in the carousel should be tested for leaks.

The leak check procedure is accessed from the Main Menu. Select Leak Check, then Enter to initiate the leak check procedure. Select the channel that you wish to leak check. Press Enter. The carousel will move to the appropriate filter channel and begin the leak test.

The sampler will pump the system pressure down to 200 mm Hg and record the flow through the dry gas meter. When the flow drops below 0.08 liters per minute, a timer is initiated and the flow will be tested for 10 minutes.

Record the channel, leak check flow rate, and the leak check time on the calibration data sheet.

Continue the leak test procedure until all 8 channels have been tested and proven leak tight. If a leak has been located, proceed to the troubleshooting section of the sampler manual.

AI.2.1.6.2 Flow Rate Calibration

The flow rate of the Andersen sequential sampler must be 16.67 LPM in order to correctly select particulate matter smaller than 2.5 microns in diameter. The purpose of the flow rate calibration is to ensure that the sampler draws the correct volumetric air flow rate. Section 8.5 of the Andersen Operator's Manual discusses the sampler flow calibration. The Andersen Sequential sampler is flow rate calibrated by testing the volume at 3 points using a NIST-traceable DGM. The relationship between flow and volume is:

$$\text{Volume} = \text{Flow} \times \text{Time}$$

Volume is reported in cubic meters (M^3). The relationship between cubic meters and liters is:

$$1\ M^3 = 1000 \text{ liters.}$$

In this calibration procedure, the volume is sampled for 30 minutes at 16.67 LPM. The flow rate for the second calibration point is 18.3 LPM for at least 27 minutes, and the flow rate for the third point is 15.0 LPM for at least 33 minutes. The following steps outline the calibration procedure:

1. The Andersen flow rate is tested by placing the leak test adapter at the inlet of the sampler, opening the valve, and attaching the leak test adapter to the

DGM with thick walled _ inch OD surgical rubber tubing. Place a filter(s) in the filter holder(s), select filter position, and make sure the filter has been properly engaged by the automated sampling system. Choose the Dry Gas Meter selection from the Calibrate menu. Press Enter.

2. Record the DGM ID number, calibration date, calibration coefficient, initial reading, and temperature on the calibration data sheet.

3. When prompted, enter the DGM meter calibration coefficient. This value can be found on the calibration report that accompanies the DGM.

4. Next, enter the initial volume on the DGM in M^3. Press the Enter key (Cancel).

5. The Andersen sampler will ask for the DGM temperature. Read the temperature from the thermometer located on top of the DGM, and enter that value into the display. Press the Enter key (Cancel) to continue. The pump will start and draw air through the sampler. The sampler should be run for at least 30 minutes. If the sampler is operated for 30 minutes at 16.67 LPM, it will draw the recommended 0.5 M^3 for this calibration point.

6. After 30 minutes, press the Enter key (Cancel), the pump will stop, and the display will prompt you for the DGM reading. Enter the volume reading into the sampler and press Enter (Cancel). Enter the final volume and temperature on the calibration data sheet, or onto the laptop calibration computer program.

7. Finally, the sampler will ask you for the ending temperature of the DGM in ^oC. Type this value into the sampler display, and press Enter (Cancel).

8. The sampler calibration procedure will prompt you to repeat steps 2 through 7 for flow rates of 18.3 and 15.0 LPM. In each case, operate the pump until greater than 0.5 M^3 of air are drawn through the sampler.

After the three calibration volumes have been entered, the system will display a screen that shows the calibration factor for the dry gas meter. The display will show the number of cc/tick, the system flow rate, and the Reference Coefficient. Press Enter (Cancel) to continue.

The system will ask if you want to save the calibration. Select Yes to save the calibration, and press Enter (Cancel).

AI.2.2 SAMPLER CALIBRATION VERIFICATION

AI.2.2.1 Temperature Verification

Prepare an ice bath in a 2 liter beaker. Place it on a stand in front of the Andersen sampler. Remove the DGM temperature sensor by lifting up on the knurled brass knob. Place the DGM temperature sensor in the ice bath along with the probe of a certified thermometer. Record the Make, Model, ID Number, Certification Date, and Certification Factors onto the calibration data sheet, or into the laptop calibration program.

From the Main Menu, select the Maintenance option. Next select the Monitor option. This screen will display the values for the Ambient, Meter, Filter and Inactive thermocouples.

Mix the ice bath to ensure that the temperature throughout the ice bath is isothermal. If possible connect both temperature sensors together with a rubber band or tie wrap. When the temperature readings are stable, read and record the temperature from both the sampler display for "Meter" and calibration thermometer onto the calibration data sheet. Do this two more times to collect three data sets.

Replace the ice bath with an ambient water bath ($25^{o}C$ +/- $5^{o}C$). Read and record three sets of data at the ambient temperature.

Next, immerse both temperature sensors into a hot water bath ($40^{o}C$ +/- $5^{o}C$). Read and record three sets of data at the "hot" temperature.

Determine the difference from true at each calibration point, and the average temperature difference. Record this information on the calibration data sheet. The temperature of the DGM thermometer must be +/- 2 ^{o}C of true at every calibration point. If not, replace the sensor and repeat the calibration.

Dry off the DGM sensor with a clean towel or Kimwipe, and place it back into the DGM.

AI.2.2.2 Barometric Pressure Verification

From the Main Menu, select the Maintenance option. Next select the Monitor option. This screen will display the values for the Ambient, Meter, Filter, Inactive thermocouples, and Barometer.

Record the Make, Model, ID Number, Certification Date and Certification Factors for the pressure standard on the calibration data sheet, or laptop calibration program . Read and record three sets of pressure readings from the pressure transfer standard and from the particulate matter sampler in mm Hg. If the difference between the sampler barometer and the calibration barometer is greater than +/-10 mm Hg, the sampler barometer must be recalibrated.

AI.2.2.3 Flow Rate Verification

In the flow verification procedure, a volume of air is sampled for 30 minutes at 16.67 LPM. The Andersen volume is tested by placing the leak test adapter at the inlet of the sampler, opening the valve, and attaching the leak test adapter to the DGM with thick walled _ inch OD surgical rubber tubing. Place a filter(s) in the filter holder(s), select a filter position, and make sure the filter has been properly engaged by the automated sampling system.

From the Main Menu Select the "Verify Flow" option. The System can verify the DGM flow by pressing the "." prior to pressing the "Enter" key (Cancel). When prompted, enter the DGM meter calibration coefficient. This value can be found on the calibration report that accompanies the DGM.

Next, enter the initial volume on the DGM in M^3. Press the Enter key (Cancel). The Andersen sampler will ask for the DGM temperature. Read the temperature from the thermometer located on top of the DGM, and enter that value into the display. Press the Enter key (Cancel) to continue. The pump will start and draw air through the sampler. The sampler must run until it collects a volume of at least 0.5 M^3.

After at least 30 minutes press the Cancel key, the pump will stop, and the display will prompt you for the DGM reading. Enter the volume reading in M^3 into the sampler and press Enter (Cancel). The system will now prompt you for the DGM temperature. Enter this temperature data into the sampler display and press Enter (Cancel).

Enter the final sampler volume, the final NIST-traceable DGM volume, and DGM temperature on the calibration data sheet, or onto the laptop calibration computer program.

The flow rate should be 16.67 LPM +/- 2 percent to pass the flow verification test. If the sampler flow rate fails (difference greater than +/- 2 percent) the sampler must be recalibrated.

AI.2.2.4 Clock/Timer Verification

Units of time are used in several aspects of sampler operation. Examples are the start and stop times, volume/flow calculations, run dates, etc. Therefore, it is necessary to document the time setting of the sampler.

Observe the sampler time from the Main Menu, choose “View Run”, then “Current Sample”. Press “Enter” until you reach the last of 3 screens. The last screen will contain the current sampler time. Enter this value onto the calibration data sheet. At the same time, enter the value of your time keeping device. Identify your time keeping device on the calibration data sheet.

Include the make, model, ID number, date last certified, and bias of your clock.

The requirement in 40 CFR Part 50, Appendix L, Section 7.4 states that the sampler must not loose more than 1 minute per month.

If the sampler is greater than 10 minutes from true time, reset the system clock.

To reset the clock, from the Main Menu select “Configure”, then Set Clock. Enter the correct time to +/- 1 minute from true. Enter the corrected time on your calibration data sheet.

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PM 2.5 QAPP

APPENDIX E-2
(CARB VOLUME II,
APPENDIX AJ)

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

RUPPRECHT & PATASHNICK
PARTISOL-FRM MODEL 2000 PM-2.5 AIR SAMPLER

TECHNICAL SERVICES GROUP

OCTOBER 1998

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RUPPRECHT & PATASHNICK
PARTISOL-FRM MODEL 2000 PM-2.5 AIR SAMPLER

FIGURES

AJ.1.0 GENERAL INFORMATION

AJ.1.0.1 Purpose

The purpose of these Standard Operating Procedures (SOP) is to supplement the manufacturer's Operator's Manual by describing modifications in hardware or procedures which may have been implemented by the Monitoring and Laboratory Division of the Air Resources Board. These modifications are designed to assure compliance with the Federal Reference Method for collection of particulate matter 2.5 microns or smaller (PM2.5) when using the Rupprecht & Patashnick (R&P) Partisol-FRM Model 2000 PM-2.5 Air Sampler.

AJ.1.0.2 General Description and Theory of Operation

Read Section 1 of the R&P Operating Manual and see Figure AJ.1...: System Schematic.

AJ.1.0.3 Safety

Installation, operation, maintenance, or calibration of the sampler should only be performed by properly trained personnel. High (120 volts A.C.) voltages are used to power the unit and due to typical rooftop installations, the risks of working outdoors at elevation should also be considered.

AJ.1.1 INSTALLATION PROCEDURE

AJ.1.1.1 Physical Inspection

Each R&P Partisol-FRM Model 2000 PM-2.5 Air Sampler purchased through the National PM2.5 Sampler Procurement Contract should be supplied with the following supplies:

1 Partisol-FRM enclosure with WINS PM-2.5 impactor and filter exchange mechanism
1 1st stage PM10 Inlet
1 sample tube
3 rain hoods and associated hardware
1 flow audit adapter
1 dual filter transport container with cassettes and carriers
1 ambient temperature sensor and cable
3 sets of impactor wells and anti-spill rings
4 sets of filter cassettes and backing screens
2 sets of inlet O-rings
1 bottle (100 milliliters (ml)) of WINS impactor oil
1 box (50 count) of glass fiber impactor filters, 37 millimeter (mm)
1 analog input calibration cable
1 mating cable connector for four-pin user output connector
1 AKCOMM software diskette
1 9-to-9 pin computer cable
2 Operating Manuals
1 Service Manual
1 Quick Start Guide

Upon receipt of the sampler(s), inspect sampler and accessories for shortage and for shipping damage. If shortage or damage is found, immediately notify your supervisor, and/or your agency's shipping department.

AJ.1.1.2 Initial Sampler Installation

Follow directions found in Section 2 of the R&P Operating Manual for installation instructions and consult with your area specialist/engineer or supervisor to assure that installation site complies with Federal and State siting criteria for FRM PM2.5.

AJ.1.1.3 Initial Sampler Set-Up

Follow directions found in Sections 4, 5, and 6 of the R&P Operating Manual.

AJ.1.2 ROUTINE SERVICE CHECKS *(WORK IN PROGRESS)*

CALIFORNIA AIR RESOURCES BOARD
MONTHLY QUALITY CONTROL MAINTENANCE CHECK SHEET
R&P PARTISOL-FRM MODEL 2000 PM-2.5 AIR SAMPLER

Site Name: _____ Month/Year: _____
Site Number: _____ Sampler I.D. Number: _____
Agency: _____ Sampler Serial Number: _____
Operator: _____ Primary, Collocated, Audit, or Other: _____

Maintenance Instructions for Daily Sampling:

After Each Run: Remove sampled filter; Download, record, and review sample data; Inspect WINS impactor and clean if necessary; Install new sample filter; Program sampler for next run.

Weekly: Inspect water collector bottle and drain if necessary; Ship sampled filters along with the sample data to the originating laboratory.

Monthly: Disassemble, clean, and inspect O-rings of PM10 inlet; Clean sampler interior including downtube; Clean or replace air intake filter; Perform flow, temperature, pressure, and clock verification checks and record results; Perform leak check and record results. DATE LAST PERFORMED: _____
FORWARD THIS CHECK SHEET AND COPIES OF ALL SAMPLE FIELD DATA SHEETS TO SECOND LEVEL REVIEWER.

Semiannually: Perform flow, temperature, and pressure calibrations; DATE LAST PERFORMED: _____

Results

ACTION	Indicated	Actual	Sampler	% Difference	Control Limits*
Flow Rate					16.50 to 16.83 L/min
Ambient Temp.					+/-2 Percent
Ambient Press.					+/-2 Percent
Clock Time					+/-1min/mo
Leak Check					<0.08 L/min for 10min

*If check exceeds limits, investigate to determine cause and repeat check at later time or date.
If second check also exceeds limits, request a re-calibration.

Standards

Standard	Make/Model	Serial/I.D.Number	Date Certified	Slope	Intercept
Flow Rate					
Temp.					
Pressure					
Clock					

Figure AJ.1.2.1.1
Monthly Quality Control Maintenance Check Sheet

AJ.1.3 MAINTENANCE PROCEDURES *(WORK IN PROGRESS)*

AJ.1.3.1 General Information

AJ.1.3.2 Sampler Maintenance

AJ.1.3.3 PM10 Inlet Maintenance

AJ.1.3.4 PM2.5 WINS Impactor Maintenance

AJ.1.4 SAMPLE FILTER HANDLING PROCEDURES

AJ.1.4.1 General Information

Federal regulations stipulate specific time frames and environmental conditions for FRM PM2.5 sample filters at various stages in the sampling program. If these time frames and conditions are not met, sample filters may be flagged or invalidated by the receiving laboratory. In addition to these requirements, operators should practice the usual care to prevent or minimize contamination of the sample filters, filter cassettes, or anything else which may come in contact with the sample filters.

AJ.1.4.2 Presampling Filter Handling Procedures

Sample filters must be used within 30 days of the preweighing procedure. Sample filter temperature must be within 5%C of ambient temperature while in the sampler.

AJ.1.4.3 Postsampling Filter Handling Procedures

Sampled filters must be removed from the sampler within 96 hours of the end of sampling and placed in cold storage as soon as practical.

Sampled filters must be kept at a temperature of less than 4°C during storage and shipping which allows the laboratory up to 30 days from the end of sampling for analysis. If this temperature is exceeded but is kept at no greater than 25°C, the laboratory has up to 10 days to analyze.

The storage environment will have its temperature constantly monitored and recorded.

Sampled filters and their GBUAPCD 24-Hour Sample Report-Field Data Sheets (Figure AJ.1.4.3.1), will be transported in an insulated shipping container containing sufficient “Blue Ice” or other chilled medium to assure that sample filters arrive at the laboratory at a temperature no greater than 25°C or preferably 4°C. Other methods may also be employed if they comply with these requirements.

Transport containers will contain a min/max thermometer, temperature data logger, irreversible temperature indicators (3M, 5°C and 26°C) or other suitable means to determine whether temperature requirements of the sample filters have been exceeded during transit. This requirement also applies when sampled filters are being transported from remote or satellite sites to central or main locations.

Sampled filters will be transported to the laboratory biweekly.

CARB 24-HOUR SAMPLE REPORT- FIELD DATA SHEET
FRM PM2.5 SINGLE FILTER SAMPLER

Site Name: _____
Site Number: _____
Agency: _____
Field Operator: _____

Filter I.D. Number: _____
Sampler I.D. Number: _____
Sampler Make & Model: _____
Start Date/Time: _____/_____
End Date/Time: ____
/_____

Sample Summary

Elapsed Time: _____ minutes
Average Flow Rate: _____ L/min
Ambient Temp: _____ %C
Meter Temp: _____ %C

Volume: _____ M3
Flow CV: _____ %
Filter Temp: _____ %C
Barometer: _____ mm Hg

A. No Unusual Conditions
B. Rain or Snow
C. Fog
D. Nearby Smoke or Fire
E. Nearby Construction
F. Sampler Malfunction
G. Other (state)

Sampler Flags: _____ Sampling Conditions: _____

Average Ambient Temp: _____ %C
Maximum: _____ %C
Minimum: _____ %C

Average Filter Temp: _____ %C
Maximum: _____ %C
Minimum: _____ %C

Average Meter Temp: _____ %C
Maximum: _____ %C
Minimum: _____ %C

Average Barometer: _____ mm Hg
Maximum: _____ mm Hg
Minimum: _____ mm Hg

Average Filter Pressure Drop: _____ mm Hg
Maximum: _____ mm Hg
Minimum: _____ mm Hg

Operator Comments: _____

Chain of Custody

ACTION	DATE	TIME	FILTER TEMP %C	FULL NAME
Received from Lab				
Loaded into Sampler				
Placed in Freezer				
Shipped to Lab				
Received by Lab				
Start of Conditioning				

Laboratory

Preweight: _____ mg
Date: _____
Analyst: _____

Postweight: _____ mg
Date: _____
Analyst: _____

Netweight: _____ mg
Sample meets all Validation Criteria (Y/N): _____
Sample Validation Flag(s): _____

Lab Comments: _____

Figure AJ.1.4.3.1
CARB 24-Hour Sample Report-Field Data Sheet

AJ.1.4.4 Filter Blank Handling Procedures

Upon receipt and identification of filter blanks, treat these filters the same as filters to be sampled with the exception that they will not be used to collect samples. They are to be installed in the sampler for the same time period as a filter sample, stored in a cooler and returned to the laboratory with the sampled filters. Fill out the GBUAPCD 24-Hour Sample Report-Field Data Sheet (Figure AJ.1.4.3.1) with exception of run data and submit with rest of Sample Reports.

AJ.1.5 TROUBLESHOOTING

AJ.1.5.1 General Information

If review of the R&P Operating Manual does not result in correction of the problem, notify your area engineer, specialist, and/or repair facility technician.

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APPENDIX E-2.2
(CARB VOLUME II APPENDIX AJ.2)

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

CALIBRATION PROCEDURES FOR R&P PARTISOL-FRM MODEL 2000 PM-2.5 AIR SAMPLER

TECHNICAL SERVICES GROUP

OCTOBER 1998

AJ.2.0 BACKGROUND AND GENERAL INFORMATION

AJ.2.0.1 Introduction

This SOP for the Rupprecht & Patashnick Partisol- FRM Model 2000 PM-2.5 Air Sampler (R&P PM2.5 FRM) is written for a starting point only. The procedures listed are in reference to the R&P FRM Operating Manual and have not been tested or tried at this point. This document is for preliminary purposes only and will most likely change as this program progresses.

AJ.2.0.2 Overview

The calibration of the fine particulate matter samplers whose mass has an aerometric diameter of less than 2.5 microns (PM2.5) must be performed on a six month basis. There are several parameters that must be calibrated with this new generation of fine particulate matter samplers. These parameters include flow or volume, temperature, pressure and time. The ARB has chosen two reference method samplers to monitor for PM2.5 at this time. These samplers are the Andersen RAAS2.5-300 Sequential Sampler and the R&P PM2.5 FRM single channel sampler. Each sampler has a different principle of flow and, therefore, two calibrations are required for this SOP. The following procedures concentrate on the R&P PM2.5 FRM.

The calibration procedure in Section 11 of the R&P Operating Manual is fairly complete, accurate and easy to follow. The primary purpose of the calibration is to determine and/or verify that the volumetric flow of the PM2.5 sampler is at 16.67 liters per minute (LPM), or that the sampler collects a volume of 1 cubic meter of air per hour. Refer to 40 CFR Part 50, Appendix L for further information.

AJ.2.0.3 Apparatus for R&P PM2.5 FRM Single Channel Sampler Calibration

1. NIST-traceable mass flow transfer standard
2. NIST-traceable temperature meter
3. NIST-traceable pressure meter
4. R&P inlet flow adaptor
5. tubing
6. blank filter
7. calibration forms or laptop computer

AJ.2.0.4 General Information

The calibration of the R&P PM2.5 FRM sampler should be performed in the following steps:

1) temperature calibration
2) pressure calibration
3) leak test
4) flow calibration
5) verify calibration parameters

All calibration information and data will be recorded on the Calibration Data Sheet (Figure AJ.2.0.4.1).

California Air Resources Board
R&P PM2.5 FRM Single Channel Sampler
Calibration Data Sheet

Site Name _____ Site Number _____ Sampler Property Number _____
Site Elevation _____ Ambient Temperature _____ Ambient Pressure _____

Temperature Sensor Calibration

Temperature Standard ID Number _____ Certification Date _____
Ambient Temperature Sensor: Ambient Reading _____ Span _____ Offset _____
Filter Temperature Sensor: Ambient Reading _____ Span _____ Offset _____

Pressure Sensor Calibration

Pressure Standard ID Number _____ Certification Date _____
Standard Slope _____ Standard Intercept _____
Barometric Pressure _____ Span _____ Offset _____

Leak Test

External Leak Flow _____ Time _____
Internal Leak Flow _____ Time _____

Flow Calibration

MFM Standard ID Number _____ Certification Date _____
Standard Slope _____ Standard Intercept _____

Nominal Flow	Sampler Flow	Standard Flow	Temperature
16.7	_____	_____	_____
17.5	_____	_____	_____
15.8	_____	_____	_____
18.3	_____	_____	_____
15.0	_____	_____	_____

Sampler Span _____ Offset _____

Calibrated by _____ Checked by _____

Temperature Calibration Verification

Temperature Standard ID Number _____ Certification Date _____
Ambient Temperature Sensor: Ambient Reading _____ Span _____ Offset _____
Filter Temperature Sensor: Ambient Reading _____ Span _____ Offset _____

Pressure Verification

Sampler Pressure _____ Pressure Standard _____

Flow Verification

Sampler Flow _____ MFM Standard Flow: Qstd _____ Qact _____
Percent Difference _____

Time Verification

Time Standard Make _____ Model _____ Certification Date _____ Bias _____
Sampler Time _____ Time Standard Time _____ Difference _____

Final Time Set

Sampler Time _____ Time Standard Time _____ Difference _____

Calibrated by _____ Checked by _____

Figure AJ.2.0.4.1
R&P PM2.5 FRM Single Channel Calibration Data Sheet

AJ.2.1 CALIBRATIONS

AJ.2.1.1 Calibration Transfer Standards and Equipment ***(WORK IN PROGRESS)***

AJ.2.1.2 Certification of Transfer Standards ***(WORK IN PROGRESS)***

AJ.2.1.3 Temperature Sensor Calibration

The R&P PM2.5 FRM Single Channel sampler has two temperature sensors: the ambient and the filter sensors. These two temperature sensors require one temperature data point each to calibrate. To calibrate, the following procedure requires an external calibrated thermometer or other calibrated temperature reading device.

AJ.2.1.3.1 Ambient Sensor

Return the sampler to the "Main Screen." The device must be in the "Stop Operating Mode" to perform an ambient temperature sensor calibration.

1. Press <F5: Setup> and <F2: Calib> when in the Main Screen to access the calibration screen.
2. Determine the current temperature in ^{o}C at the ambient temperature sensor using the external thermometer.
3. Press <F1: Edit> to enter the edit mode, and move the cursor to the "ACT" (actual) column in the row labeled "AmbT."
4. Enter the current temperature in ^{o}C and press <ENTER> to leave the edit mode.
5. Upon receiving the actual temperature, the system's microprocessor automatically computes the span for the ambient temperature sensor. Note this number for future reference.

AJ.2.1.3.2 Filter Sensor

Return the sampler to the "Main Screen." The device must be in the "Stop Operating Mode" to perform a filter temperature sensor calibration.

1. Press <F5: Setup> and <F2: Calib> when in the Main Screen to access the calibration screen.
2. Determine the current temperature in ^{o}C at the location of the sample filter in the FRM using the external thermometer.

3. Press <F1: Edit> to enter the edit mode, and move the cursor to the "ACT" (actual) column in the row labeled "FltT."
4. Enter the current temperature in ^{o}C and press <ENTER> to leave the edit mode.
5. Upon receiving the actual temperature, the system's microprocessor automatically

computes the span for the filter temperature sensor. Note this number for future reference.

AJ.2.1.4 Barometric Pressure Sensor Calibration

Return the sampler to the "Main Screen." The device must be in the "Stop Operating Mode" to perform a barometric pressure sensor calibration.

1. Press <F5: Setup> and <F2: Calib> when in the Main Screen to access the calibration screen.
2. Determine the current ambient barometric pressure in mm Hg.
3. Press <F1: Edit> to enter the edit mode, and move the cursor to the "ACT" (actual) column in the row labeled "Pres."
4. Enter the current pressure in mm Hg and press <ENTER> to leave the edit mode.
5. Upon receiving the actual pressure, the system's microprocessor automatically computes the span for the ambient pressure sensor. Note this number for future reference.

AJ.2.1.5 Flow Rate Calibration

AJ.2.1.5.1 Leak Check

Before calibrating the flow of the sampler it is important to ensure that the sampling train does not have a leak. The leak check should be performed as described in Section 10.2.4 of the R&P Operating Manual.

AJ.2.1.5.2 Flow Rate Calibration

The flow rate of the R&P PM2.5 FRM sampler must be 16.67 LPM in order to correctly select particulate matter smaller than 2.5 microns in diameter. The purpose of the flow rate calibration is to ensure that the sampler draws the correct volumetric air flow rate. Section 11.6 of the R&P PM2.5 FRM Operating Manual discusses the

sampler flow calibration. The R&P PM2.5 FRM sampler is flow rate calibrated by testing the flow rate at 5 points using a NIST-traceable Streamline FTS Flow Transfer Standard.

Return the sampler to the "Main Screen." The device must be in the "Stop Operating Mode" to perform a barometric pressure sensor calibration.

1. Carefully remove the 1st stage inlet from the sampler.
2. Install a filter cassette containing a 46.2 mm filter into the filter holding mechanism.
3. Display the "Flow Calibration Screen" by pressing <F5: Setup>, <F2: Calib> and <F2: FlowCal> when in the Main Screen.
4. Five points will be determined and entered. The sampler will compute the proper value for flow span.

AJ.2.2 SAMPLER CALIBRATION VERIFICATION

AJ.2.2.1 Temperature Sensor Verification

The R&P PM2.5 FRM Single Channel sampler has two temperature sensors: the ambient and the filter sensors. These two temperature sensors require one temperature data point each to calibrate and each sensor requires only one point to verify. To verify the calibration, the following procedure requires an external calibrated thermometer or other calibrated temperature reading device.

AJ.2.2.1.1 Ambient Sensor

Return the sampler to the "Main Screen." The device must be in the "Stop Operating Mode" to perform an ambient temperature sensor calibration verification.

1. Press <F5: Setup> and <F5: Audit> when in the Main Screen to access the audit/verification screen.
2. Determine the current temperature in ^{o}C at the ambient temperature sensor using the external thermometer.
3. Verify that the value for the temperature displayed as "Ambient Temp" in the Audit Screen is within +/-2 ^{o}C of the external thermometer.

4. If the ambient temperature sensor reading is not within +/-2 ^{o}C of the external thermometer, the ambient temperature sensor must be re-calibrated.

AJ.2.2.1.2 Filter Sensor

Return the sampler to the "Main Screen." The device must be in the "Stop Operating Mode" to perform an ambient temperature sensor calibration verification.

1. Press <F5: Setup> and <F5: Audit> when in the Main Screen to access the audit/verification screen.
2. Determine the current temperature in ^{o}C at the location of the sample filter in the FRM using the external thermometer.
3. Verify that the value for the temperature displayed as "Filter Temp" in the Audit Screen is within +/-2 ^{o}C of the external thermometer.
4. If the filter temperature sensor reading is not within +/-2 ^{o}C of the external thermometer, the filter temperature sensor must be re-calibrated.

AJ.2.2.2 Barometric Pressure Verification

Return the sampler to the "Main Screen." The device must be in the "Stop Operating Mode" to perform a barometric pressure sensor calibration verification.

1. Press <F5: Setup> and <F5: Audit> when in the Main Screen to access the audit/verification screen.
2. Determine the current ambient barometric pressure in mm Hg.
3. Verify that the value for the "Ambient Pres" in the Audit Screen is within 10 mmHg of the measured ambient pressure.
4. If the sampler ambient pressure is not within 10 mmHg of the measured ambient pressure, the barometric pressure sensor must be re-calibrated.

AJ.2.2.3 Flow Rate Verification

Return the sampler to the "Main Screen." The device must be in the "Stop Operating Mode" to perform a flow rate calibration verification.

1. Press <F5: Setup> and <F5: Audit> when in the Main Screen to access the audit/verification screen.
2. Install a filter cassette containing a 46.2 mm filter into the filter holding mechanism.
3. Carefully remove the 1st stage inlet from the sampler.
4. Attach the flow rate verification device to the sampler.
5. Turn on the pump by pressing <F2: Pump>, and then turn on the sample flow valve by pressing <F1: Valve>.
6. Determine the flow in units of actual (volumetric) LPM using the flow rate verification device.
7. Verify that the value for the flow rate displayed in the "Flow Rate" field of the Audit Screen is within +/-4% of the flow rate verification device.
8. If the flow rate reading is not within +/-4% of the flow rate verification device, a flow rate calibration must be performed.

AJ.2.2.4 Clock/Timer Verification

Units of time are used in several aspects of sampler operation. Examples are the start and stop times, volume/flow calculations, run dates, etc. Therefore, it is necessary to document the time setting of the sampler.

Observe the sampler time from the Main Screen. Enter this value onto the calibration data sheet. At the same time, enter the value of your time keeping device. Identify your time keeping device on the calibration data sheet.

Include the make, model, ID number, date last certified, and bias of your clock.

The requirement in 40 CFR Part 50, Appendix L, Section 7.4 states that the sampler must not loose more than 1 minute per month.

If the sampler is greater than 12 minutes from true time, reset the system clock.

To reset the clock, from the Main Screen select <F5: Setup>, then select <F1: Edit>. Enter the correct time to +/- 1 minute from true. Enter the corrected time on your calibration data sheet.

GREAT BASIN UNIFIED
AIR POLLUTION CONTROL DISTRICT

AIR MONITORING QUALITY ASSURANCE

STANDARD OPERATING PROCEDURES

FOR

AIR QUALITY MONITORING

APPENDIX E-3
(CARB VOLUME II,
APPENDIX AK)

ACCEPTANCE TESTING
FOR
FRM PARTICULATE MATTER 2.5 MICRON (PM2.5) SAMPLERS

TECHNICAL SERVICES GROUP

OCTOBER 1998

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APPENDIX AK

ACCEPTANCE TESTING FOR FRM PARTICULATE MATTER 2.5 MICRON (PM2.5) SAMPLERS

FIGURES

AK.1.0 ACCEPTANCE TEST PROCEDURE

AK.1.0.1 General Information

Federal Reference Method samplers for sampling of particulates of 2.5 microns and smaller (FRM 2.5) will be acceptance tested by the technical staff of the Great Basin Unified APCD and/or the Air Resources Board (ARB) Monitoring and Laboratory Division (MLD). Samplers may be supplied by various manufacturers. Samplers may be of a single filter, manual operation design, or may be of a sequential design utilizing rotating filter holder trays or filter cartridge magazines. Before beginning acceptance testing of the samplers, read the operator's manual supplied with each sampler.

Initiate an acceptance test log and an acceptance test mini-report (Figure AK.1.0.1.1) for each sampler. Record the dates of the individual test, problems, contacts with the manufacturer, and any other pertinent information on the acceptance test log.

AK.1.0.2 Physical Inspection

Unpack the sampler and check for physical damage if this has not already been done. Verify that the sampler is complete and includes two service manuals and all options and parts required by the purchase order. Refer to the packing list as necessary. Note any broken or missing parts.

Open access doors, or remove panels or covers as applicable to each individual model of sampler to make the following checks:

1. Verify that the cabinet and all connnections are weatherproof. Visually inspect the gaskets and seals for pin holes and/or damage.

2. Make sure that all circuit boards are properly seated in their connectors by removing and reinserting each board.

3. Check for correct power cord phasing; standard wiring configuration has the black wire connected to the brass terminal of the plug, white to the copper terminal, and green to earth ground.

4. Completely assemble the sampler; including the inlet head, WINS Impactor, and analyzer accessories following the procedures in the manufacturer's manual. Verify that the cabinet support structure is capable of keeping the sampler secure, steady and upright.

ACCEPTANCE TEST DATA SHEETS
FRM 2.5 SAMPLER

Manufacturer_____ Model _____ Serial No_____
Type: Sequential Multi-Channel _____ Single Channel _____

Testing performed by_____ Date Test Initiated _____
Test data reviewed by_____ Date Accepted _____

PHYSICAL INSPECTION				
	DATE			
	Completed	Passed	Failed	Final OK
Shipping Damage				
Two operator manuals				
Power cable phasing				
Internal Wiring				
Switch, lamps, controls				
PC board(s) seated				
Assembly				
OPERATIONAL TESTING				
Programming				
Power Failure / Memory				
Leak Check Test				
Calibrate Sample Flowrate				
Filter exchange mechanism				
Operation test “run”				
Data download				
ENVIRONMENTAL CHAMBER TEST				
16 Hour test run				
Flowrate Stability				
Temperature				

Comments, and corrections of failures: _____

Figure AK.1.0.1.1
Acceptance Test Data Sheets

AK.1.0.3 Operational Checks

When the FRM PM2.5 sampler is completely assembled initate operational testing as outlined below. Record the results of each test on the acceptance test data report for each sampler.

1. Basic Operation

Apply electrical power to the sampler (120 vac @ 60Hz) and turn on the sampler. Verify that all switches and controls, the internal fan and sampler delivery motor operate properly.

2. Programming:

   Program the sampler using the keypad and display. Verify programming and operation of the sampler by automatically initiating and terminating a short operational sample run.

3. Power failure / memory test:

   Interrupt power to the sampler for 3 to 5 minutes. Verify that the sampler restarts, maintains memory, and continues to operate properly after power is resored.

4. Leak check test:

   Perform a leak check on the sample train per the manufacturer's operator's manual. Verify the system's integrity.

5. Flowrate control / calibration:

   Adjust, set or calibrate the sample flowrate through the sampler using a certified mass flow meter (MFM) of the proper range or the calibration apparatus supplied by the manufacturer.

6. a. Filter exchange mechanism test (sequential multi-channel samplers):
   Operate the automatic channel/filter change mechanism for each channel to verify smooth and proper operation.

   b. Filter holder mechanism (single channel sampler):
   Install a filter into the holder apparatus to ensure proper operation of the mechanism and to check for proper sealing of the gasket(s).

7. Operational test run:

Program the sampler to perform a complete sample "run" for at least four hours.

8. Data download test:

   Connect a laptop (or equivalent) computer or data recovery link provided by the manufacturer to the RS-232 communications port on the sampler and download the operational data resulting from the operational test run (#6 above). Print the data and attach it to the sample report form.

AK.1.0.4 In Situ Temperature and Voltage Stability Tests

Install the FRM PM2.5 sampler at the sampling site or in a comparable setting. Connect a certified MFM to the sample inlet of the FRM PM2.5 sampler under test. Place the MFM near the sampler to measure and record the sample flowrate through the sampler.

Place a thermocouple in the filter holder in FRM PM2.5 sampler and bring the thermocouple leads outside the sampler housing to measure and record the temperature at the sample filter.

Program the FRM PM2.5 sampler to operate continuously during this test.

Enter the test results on the acceptance test data sheet and label the forms with the date of test, Manufacturer, Model and Serial Number of the sampler, parameter identification, temperature and voltage data. Clear, precise notations should be entered on the forms indicating when the tests were started and ended, pertinent information regarding sample flow, voltages, temperatures, and any unusual conditions observed. Any additional pertinent information should be attached to the final acceptance reports.

Verify that the FRM PM2.5 sampler operates properly with no malfunctions during and after the field testing.

AK.1.0.5 Post Acceptance Test Documentation:

Review and assemble all acceptance test data and documentation and submit it to the designated acceptance test data reviewer. After the review of the data are complete and approved, the FRM PM2.5 sampler will be delivered to the monitoring site for installation.