WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Washoe County Air Quality Monitoring Program Quality Assurance Project Plan

December 9, 2019

Public Health
Prevent. Promote. Protect.

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Public Health
Prevent. Promote. Protect.

VISION

A healthy community

MISSION

To protect and enhance the well-being and quality of life for all in Washoe County.

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:_____________________________Date:_______________

Name: ____

Title: ____

Signature:_____________________________Date:_______________

Name: ____

Title: ____

Signature:_____________________________Date:_______________

Name: ____

Title: ____

Signature:_____________________________Date:_______________

Name: ____

Title: ____

Signature:_____________________________Date:_______________

QAPP Revision History

Revision Number	Date	Responsible Party	Description of Change
0	12-31-2012	Julie Hunter	New Document
1	11-1-2019	Julie Hunter/Craig Petersen/Brendan Schnieder	Changes throughout document due to new guidance and network modifications.

Acronyms and Abbreviations

AADT	Annual Average Daily Trip
ANP	Annual Network Plan
ASTM	American Society for Testing and Materials
AQI	Air Quality Index
AQMD	Washoe County Health District - Air Quality Management Division
AQMP	Air Quality Monitoring Program
AQS	Air Quality System
BAM	Beta Attenuation Monitor
°C	Degrees Celsius
CAA	Clean Air Act
CARB	California Air Resources Board
CBSA	Core-Based Statistical Area
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
CMSA	Consolidated Metropolitan Statistical Area
CO	Carbon Monoxide
COC	Chain of Custody
CSA	Consolidated Statistical Area
CSN	Chemical Speciation Network
CV	Coefficient of Variation
DART	Data Analysis and Processing Tool
DMS	Data Management System
DPI	Digital Pressure Indicator
DQI	Data Quality Indicator
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
FTP	File Transfer Process
Hg	Mercury
ICV	Initial Calibration Verification
$\mu g/m^3$	micrograms per cubic meter
µm	micrometers
mg	milligrams
mm	millimeters
MSA	Metropolitan Statistical Area
MQO	Measurement Quality Objective
NAAQS	National Ambient Air Quality Standards
NCore	National Core multi-pollutant Monitoring Station
NIST	National Institute of Standards and Technology
nm	nano-meters
NO_2	Nitrogen Dioxide
NOy	Reactive Oxides of Nitrogen

NPAP	National Performance Audit Program
O_3	Ozone
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter less than or equal to 2.5 microns in aerodynamic diameter
PM_{10}	Particulate Matter less than or equal to 10 microns in aerodynamic diameter
PMcoarse	PM_{10} minus $PM_{2.5}$
POC	Parameter of Occurrence
ppm	parts per million
PSI	Pounds per Square Inch
QAPP	Quality Assurance Project Plan
QA	Quality Assurance
QC	Quality Control
RH	Relative Humidity
RTC	Regional Transportation Commission
RTI	Research Triangle Institute
SASS	Speciation Air Sampling System
SD	Standard Deviation
SIP	State Implementation Plan
SLAMS	State and Local Air Monitoring Station
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedures
SPM	Special Purpose Monitoring
SRP	Standard Reference Photometer
STN	Speciation Trends Network
TAPI	Teledyne-Advanced Pollution Instrumentation, Inc.
UV	ultra-violet
WCHD	Washoe County Health District

Section 1: Quality Assurance Plan Identification and Approval

Agency: Washoe County Health District, Air Quality Management Division
Title: *Washoe County Air Quality Monitoring Program*
Quality Assurance Project Plan Version 2

The *Quality Assurance Project Plan for the Washoe County Health District, Air Quality Management Division* is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

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Section 3: Distribution/Notification List

Copies of the Quality Assurance Project Plan (QAPP) for the Washoe County Health District (WCHD) Air Quality Management Division (AQMD) have been distributed to the following individuals listed in Table 3-1. An electronic copy of the QAPP will be stored on the AQMD Local-Area Network (LAN) and is available on the AQMD website that can be found at OurCleanAir.com.

Table 3-1 Quality Assurance Project Plan Distribution List

Name	Location	Position	Contact Information
Francisco Vega	1001 East 9th Street Reno, NV	Division Director AQMD	fvega@washoecounty.us (775) 784-7211
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The QAPP will be distributed to other personnel and operators beyond this list, in accordance with the organizational chart(s) presented in Section 4 of this QAPP.

Section 4: Project/Task Organization

The Washoe County Health District is organized into five divisions: Administrative Health Services, Air Quality Management, Community & Clinical Health Services, Environmental Health Services, and Epidemiology & Public Health Preparedness. The Health Officer has the responsibility of overseeing these divisions. The Health Officer delegates the authority and responsibility to manage each program to the respective Division Director. Figure 4-1 shows the organizational chart for the AQMD.

4.1 Air Quality Management Division

The Air Quality Management Division is comprised of four branches; Monitoring, Planning, Permitting, and Enforcement. The Monitoring Branch is responsible for data collection, quality assurance and data processing for the AQMD Ambient Air Quality Monitoring Program. The AQMD is a small organization with 19 full time equivalent positions, of which seven are dedicated to the ambient air monitoring and air quality planning branches. The AQMD is the Primary Quality Assurance Organization (PQAO) for Washoe County, operating independently from the Air Quality Division within Nevada Division of Environmental Protection (NDEP). The AQMD operates under a Quality Management Plan (QMP) approved by EPA Region 9. Quality assurance (QA) independence is accomplished by the Senior Air Quality Specialist in the Planning Program serving as the Quality Assurance Manager (QA Manager).

4.2 Local Organizations

EPA Region 9 is the resource for clarification of federal monitoring requirements and guidance. EPA reviews and provides comments on AQMD's assessments. Depending on its significance, comments are addressed immediately or during the next submittal of an assessment or the next Technical Systems Audit (TSA). The Monitoring and Planning Supervisor is the primary point of contact to the EPA Region 9 office.

The AQMD and Nevada Division of Environmental Protection informally collaborate on monitoring issues including instrumentation and data management. Collaboration is on an as needed basis.

Two tribes are located within the boundaries of Washoe County - the Reno-Sparks Indian Colony (RSIC) and the Pyramid Lake Paiute Tribe (PLPT). The AQMD has provided technical assistance to the RSIC in ambient air monitoring, air quality planning, and air quality permitting. The 2019 Annual Monitoring Plan recognizes the existing RSIC and PLPT air monitoring networks.

4.3 AQMD Roles and Responsibilities

All staff within the Monitoring Program are responsible for the quality of the data collected by the program, if there is a disagreement regarding data verification or validation activities, and/or Corrective Actions, the Division Director is responsible for making the final decision. The roles and responsibilities of the key players in the Monitoring Program are listed below.

Division Director: Under administrative direction, the Division Director plans, organizes and directs the Air Quality Management Program. This position reports directly to the Health Officer of the WCHD. The Division Director's responsibilities include:

- maintaining oversight of AQMD activities
- assigning, directing and reviewing AQMD staff and supervisors;
- developing regulatory proposals for consideration by the District Board of Health;
- reviewing budgets, contracts, grants and proposals;
- final approval of Corrective Action and QA reports;
- final approval of QAPP and QMP;
- final approval of SOPs;
- final approval of all monitoring assessment reports;
- final approval of annual data certification;
- interacting with public and media regarding division regulations, strategies, trends and emergencies; and
- direct interaction with the Health Officer on the declaration of air pollution episodes or when air pollution levels reach unhealthful levels.

Monitoring and Planning Supervisor: The Monitoring and Planning Supervisor reports to the Division Director of the AQMD. The Supervisor's responsibilities include:

- assign, direct and review monitoring and planning staff;
- primary point of contact with EPA Region 9 Office;
- interacting with the public and media regarding air quality information;
- supervising technical and support staff;
- preparing reports for submission to the Environmental Protection Agency (EPA) Region 9;
- ensuring all activities are performed as prescribed in the standard operating procedures (SOPs) and QAPP;
- review and approve Corrective Action and QA reports;
- review and approve QAPP and QMP;
- review and approve of SOPs;
- review and approve annual data certification;
- ensuring staff have resources necessary for maintenance and upkeep of sites and network instrumentation; and
- review and approve all monitoring assessment reports.

Senior Air Quality Specialist – Monitoring: Under direction of the Monitoring and Planning Supervisor, the Senior Air Quality Specialist is the lead worker of the air quality monitoring program. The Senior Air Quality Specialist's responsibilities include:

- providing lead direction in the monitoring program and laboratory activities;
- collecting, calculating and reviewing air quality data
- ensuring proper installation, calibration and adjustment of network instrumentation
- responsible for the discontinuation or replacement of network instrumentation
- instrument preventative maintenance;
- authority to stop work and resume work at monitoring sites if needed;

- acquiring resources and inventory for the maintenance and upkeep of sites and network instrumentation;
- providing quality assurance (QA) and data validation of air quality data;
- performing quarterly audits of PM instrumentation;
- QC monthly air quality data;
- providing Corrective Action and QA reports to the QA Manager;
- maintaining instrument traceability documentation;
- reviewing environmental data prior to submittal;
- assessing data quality and flagging data when appropriate;
- annual data certification;
- reporting network problems and corrective actions to the supervisor;
- participating in training and certification activities;
- oversees training;
- reviewing and revising SOPs;
- manages documents and records, including SOP documents and tracking;
- conducts annual siting evaluations;
- develop the 5-year Network Assessment; and
- reviewing all monitoring assessment reports.

Senior Air Quality Specialist (QA Manager) – Planning: The QA Manager reports to the Division Director of the AQMD. The Supervisor's responsibilities include:
supervising technical and support staff in the planning program;

- preparing reports for submission to the EPA Region 9;
- ensuring all activities are performed as prescribed in the SOPs and QAPP;
- review and approve Corrective Action and QA reports;
- review, revise and approve QAPP and QMP;
- lead documents and records manager (records custodian), including the QAPP and QMP;
- review and approve of SOPs;
- review and approve annual data certification;
- manages required reading forms;
- review and approves quarterly audit report forms;
- performs data quality audits;
- ensuring QAPP, QMP and SOPs revisions are distributed to staff;
- review and approve AMP reports; and
- review all monitoring assessment reports.

Air Quality Specialist (Data Manager) – Planning: Under direction of the Monitoring and Planning Supervisor, the Air Quality Specialists' responsibilities include:

- manage AirVision data collection software;
- daily review of air quality data;
- raw data editing;
- manual method data entry;
- precision and accuracy data entry;
- submitting data to the Air Quality System (AQS);

- providing QA and data validation/verification of air quality data;
- performs data quality audits;
- reviewing environmental data prior to submittal;
- annual data certification;
- manages field and laboratory records, documents and data forms;
- participating in training and certification activities;
- providing monitoring team with monthly flagged data for review;
- participating in the Emissions Inventory;
- assisting in the preparation of reports for the AQMD;
- writing and revising SOPs;
- develop the Annual Network Plan (ANP); and
- review monitoring assessment reports.

Air Quality Specialist (Lab Manager) – Monitoring: Under direction of the Senior Air Quality Specialist, the Air Quality Specialist's responsibilities include:

- collecting, calculating and reviewing air quality data;
- ensuring proper installation, calibration and adjustment of network instrumentation;
- instrument preventative maintenance;
- authority to stop work and resume work at monitoring sites if needed;
- acquiring resources and inventory for the maintenance and upkeep of sites and network instrumentation;
- ensuring the laboratory is within proper specifications;
- sample custodian;
- ensuring primary standards are returned for recalibration and recertification;
- inspection, preparation and weighing of manual method filters;
- maintaining instrument traceability documentation;
- QC monthly data;
- providing QA and data validation of air quality data;
- performing quarterly audits of instrumentation;
- reviewing environmental data prior to submittal;
- assessing data quality and flagging data when appropriate;
- reporting network problems and corrective actions to the supervisor;
- participating in training and certification activities;
- writing and revising SOPs; and
- assisting in the preparation of reports for the AQMD.

Air Quality Specialist – Monitoring: Under direction of the Senior Air Quality Specialist, the Air Quality Specialist's responsibilities include:

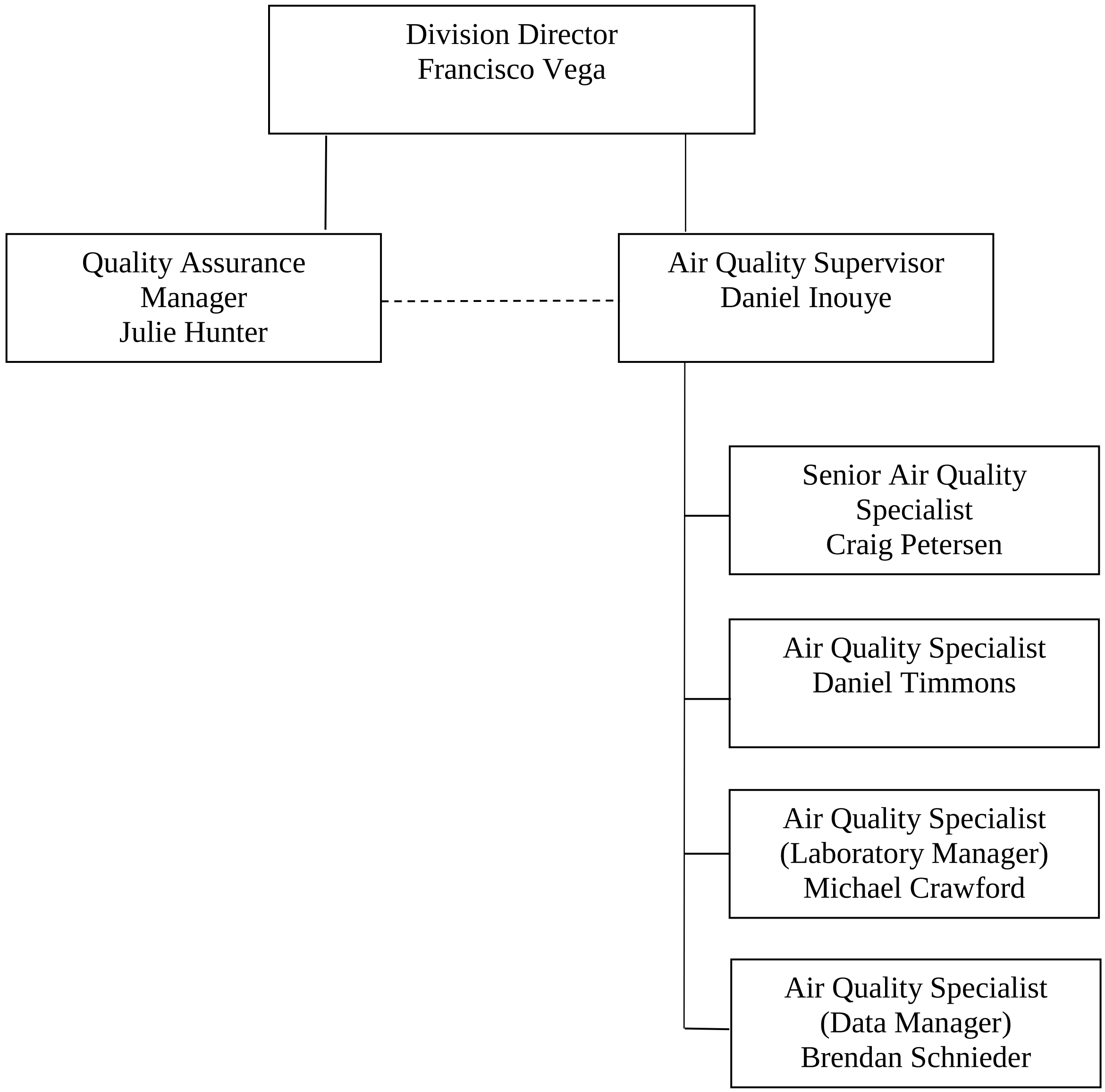
- collecting, calculating and reviewing air quality data;
- ensuring proper installation, calibration and adjustment of network instrumentation;
- instrument preventative maintenance;
- authority to stop work and resume work at monitoring sites if needed;

- acquiring resources and inventory for the maintenance and upkeep of sites and network instrumentation;
- maintaining instrument traceability documentation;
- QC manual method filter weighing;
- QC monthly data;
- providing QA and data validation of air quality data;
- performing quarterly audits of instrumentation;
- reviewing environmental data prior to submittal;
- assessing data quality and flagging data when appropriate;
- reporting network problems and corrective actions to the supervisor;
- participating in training and certification activities;
- writing and revising SOPs; and
- assisting in the preparation of reports for the AQMD.

Air Quality Specialist Trainee: Under direction of the Senior Air Quality Specialist, the Air Quality Specialist Trainee's responsibilities include:

- collecting, calculating and reviewing air quality data;
- ensuring proper installation, calibration and adjustment of network instrumentation;
- instrument preventative maintenance;
- acquiring resources and inventory for the maintenance and upkeep of sites and network instrumentation;
- inspection, weighing and QC of manual method filters;
- providing QA and data validation of air quality data
- performing quarterly audits of instrumentation;
- reviewing environmental data prior to submittal;
- assessing data quality and flagging data when appropriate;
- reporting network problems and corrective actions to the supervisor;
- writing and revising SOPs; and
- participating in training and certification activities.

Figure 4-1 AQMD Organizational Chart



Section 5: Problem Definition/Background

5.1 Problem Definition

The Clean Air Act (CAA) was signed into law in 1970 and was last amended in 1990. The CAA requires the EPA to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants considered harmful to public health and the environment. These commonly found air pollutants (also known as "criteria pollutants") are found all over the United States. They are particle matter [particles with an aerodynamic diameter of 10 micrometers or less] (PM_{10}), [particles with an aerodynamic diameter of 2.5 micrometers or less] ($PM_{2.5}$) ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead. EPA calls these pollutants "criteria" air pollutants because they are regulated by developing human health-based and/or environmentally based criteria (science-based guidelines) for setting permissible levels.

The Clean Air Act established two types of national air quality standards. ***Primary standards*** set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. ***Secondary standards*** set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. Table 5-1 lists the NAAQS for the criteria pollutants and the limits for each of these pollutants established by the EPA. The AQMD monitors all criteria pollutants, with the exception of Lead (Pb). The AQMD operates 7 State and Local Air Monitoring Stations (SLAMS), including one National Core multipollutant monitoring station (NCore) station.

On October 17, 2006, as published in the Federal Register, the United States Environmental Protection Agency (EPA) provided final rule revisions to ambient monitoring regulations as contained in 40 CFR, Parts 53 and 58. Included in these revised rules are the requirements for establishing NCore sites as a goal of the National Ambient Air Monitoring Strategy (NAAMS). Each state is required to operate at least one NCore site beginning January 1, 2011. The NCore sites must measure, at a minimum, $PM_{2.5}$ using continuous and integrated/filter-based samplers, speciated $PM_{2.5}$, $PM_{10-2.5}$, SO2, CO, nitrogen oxide (NO), reactive oxides of nitrogen (NO_y), O_3, Pb, wind speed, wind direction, relativity humidity and ambient temperature. Due to the population size in Washoe County, the only pollutant AQMD currently does not monitor for at the NCore station is Pb.

The goal of the NCore is the use of highly sensitive commercial air pollutant monitors for the characterization of the precursor gases CO, SO2, and total reactive oxides of nitrogen (NOy) in a new national core monitoring network (NCore). The use of such precursor gas analyzers in the NCore network will still allow determination of compliance with the NAAQS, but will provide measurements at much lower detection limits that were previously achievable by monitors. This capability for accurate measurements at low concentrations will support long-term epidemiological studies, track pollutant trends, reduce uncertainties in data for modeling of air pollution episodes, and support source apportionment and observational analyses.

The Reno3 monitoring station is designated as the networks NCore station as part of this nationwide multi-pollutant network that integrates several advanced measurement systems for particles, pollutant gases and meteorology. The NCore network addresses the following objectives:

- Timely reporting of data to public by supporting AirNow, air quality forecasting, and other public reporting mechanisms;
- Support for development of emission strategies through air quality model evaluation and other observational methods;
- Accountability of emission strategy progress through tracking long-term trends of criteria and non-criteria pollutants and their precursors;
- Support for long-term health assessments that contribute to ongoing reviews of the NAAQS;
- Compliance through establishing nonattainment/attainment areas through comparison with the NAAQS;
- Support to scientific studies ranging across technological, health, and atmospheric process disciplines; and
- Support to ecosystem assessments recognizing that national air quality networks benefit ecosystem assessments and, in turn, benefit from data specifically designed to address ecosystem analyses.

EPA's national quality system requires that any organization collecting environmental data must develop, implement and maintain an approved QAPP. The QAPP is a formal document describing the necessary QA/QC activities that will be implemented throughout a project to ensure that the results of work performed will satisfy performance criteria. This document presents the AQMD's Monitoring Program's QAPP. The purpose of the QAPP is to describe requirements, procedures and guidelines for Washoe County's Air Quality Monitoring Program and includes detailed SOPs to be followed in all air monitoring projects. The QAPP is designed to achieve a high percentage of valid data samples (>95%) while maintaining integrity and accuracy. Based on the NAAQS "Form", 3 years of data are required to fulfill the monitoring program requirements. This QAPP clearly states QA protocols and QC criteria required to successfully implement and maintain the AQMD Ambient Air Monitoring Program. This QAPP establishes procedures that continue to maintain the existing network. The QAPP and associated SOPs will be reviewed annually, and signed, dated and recorded by the QA Manager.

Table 5-1 National Ambient Air Quality Standards

Pollutant	Primary Standard		Secondary Standard		Form
	Averaging Time	Level	Averaging Time	Level	
O_3	8-hour	0.070 ppm	Same as primary		Fourth highest daily maximum concentration, averaged over 3 years
$PM_{2.5}$	24-hour	35 µg/m^3	Same as primary		98th percentile of daily max, averaged over 3 years
	Annual	12.0 µg/m^3	Annual	15.0 µg/m^3	Annual mean, averaged over 3 years
PM_{10}	24-hour	150 µg/m^3	Same as primary		Not to be exceeded more than once per year on average over 3 years
CO	1-hour	35 ppm	None		Not to be exceeded more than once per year
	8-hour	9 ppm	None		
NO_2	1-hour	100 ppb	None		98th percentile, averaged over 3 years
	Annual	53 ppb	Same as primary		Annual Mean
SO_2	1-hour	75 ppb	3-hour	0.5 ppm	1°: 99th percentile of daily maximum concentration, averaged over 3 years
					2°: not to be exceeded more than once per year
*Pb	Rolling 3-month average	0.15 µg/m^3	Same as primary		Not to be exceeded

*The AQMD is currently not required to monitor for Lead (Pb)

5.2 Historical Background

Ambient air monitoring has been conducted in Washoe County since the 1960's. The AQMD through the WCHD took over the monitoring network in accordance with NRS 439 in 1972 as detailed in the 1986 *Amendment of Interlocal Agreement Concerning the Washoe County Health District*. The Truckee Meadows portion of southern Washoe County has historically had problems with wintertime PM and CO. Strong temperature inversions would trap pollution from: 1) residential wood burning, 2) on-road motor vehicles, and 3) street sanding and sweeping. In the 1980's, HA87 was designated "non-attainment" for the 24-hour PM_{10} and 8-hour CO NAAQS. Local and state air quality strategies, such as the AQMD's Wood Stove program, improved PM and CO levels. HA87 is currently designated "attainment" for all NAAQS. Long-term ambient air monitoring continues in Washoe County to ensure compliance with the NAAQS.

Although PM and ozone design values continue to improve, Washoe County continues to experience air pollution episodes such as:

- Wildfire PM and ozone
- Springtime ozone interstate transport
- High wind PM
- Haboob PM

Data related to these episodes are flagged in AQS. Exceptional Event Demonstrations are prepared and submitted to EPA for extreme episodes.

5.3 Document Review Cycle

The QAPP and associated SOPs will be reviewed on an annual basis. The annual review will be documented and tracked with the review date, revision, individual(s) completing the review and description of changes, if applicable. See Table 5-2 for the QAPP Tracking Sheet. Refer to Section 9, Table 9-2 for the SOP Tracking Sheet.

Table 5-2 QAPP Tracking Sheet

Revision No.	Responsible Party	Review Date	Revision Date	Description of Change	Approval Date
0	QA Manager		12-31-2012	New Document	02-12-2013
1	QA Manager Senior AQ Specialist Data Manager	09-05-2019	12-09-2019	Changes throughout document due to new guidance and network modifications	
2	QA Manager Senior AQ Specialist Data Manager	01-01-2021			

Section 6: Project/Task Description

The purpose of this section is to describe AQMD's monitoring network. Monitoring networks must be designed to meet three basic monitoring objectives:

- To provide air pollution data to the general public in a timely manner.
- Support compliance with ambient air quality standards and emissions strategy development.
- Support for air pollution research studies.

In order to support the air quality management work indicated in the three basic air monitoring objectives, a network must be designed with a variety of types of monitoring sites. Monitoring sites must be capable of informing managers about many things including the peak air pollution levels, typical levels in populated areas, air pollution transport, and air pollution levels near specific sources. The six general site types are described as sites located to:

- determine the highest concentrations expected to occur in the area covered by the network;
- measure typical concentrations in areas of high population density;
- determine the impact of significant sources or source categories on air quality;
- determine general background concentration levels;
- determine the extent of regional pollutant transport among populated areas; and
- measure air pollution impacts on visibility, vegetation damage, or other welfare-based impacts.

6.1 Description of Work to be Performed

This QAPP was developed to ensure that Washoe County's air monitoring network collects ambient air quality and meteorological data for NAAQS criteria pollutants, that meet or exceed AQMD and EPA quality assurance (QA) requirements. The AQMDs monitoring network operates under the EPA ambient air monitoring regulations 71 FR61236-61328. Ambient air data is collected for NAAQS compliance and EPA regulatory decision-making. The data collected is entered into the EPA Air Quality System (AQS) database. Locations of the National Core Multi-pollutant Monitoring Station (NCore) station and State and Local Air Monitoring Stations (SLAMS) are shown in Figure 6-1. Pollutants monitored by the AQMD in the Ambient Air Quality Monitoring Network include:

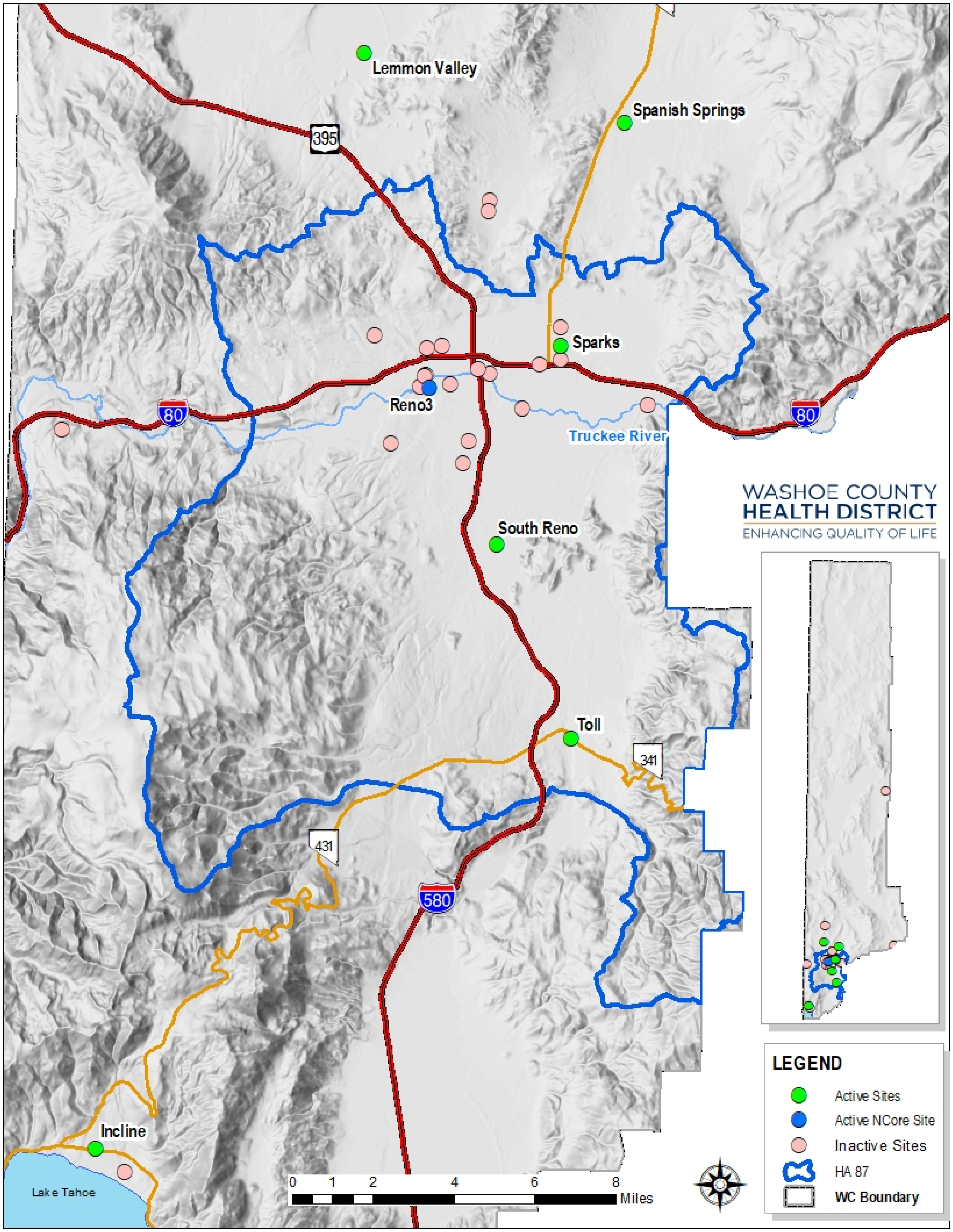
- Criteria Gases (O3, CO, NO_2, SO_2)
- Non-Criteria Gases (NO, NOx, NOy)
- Criteria PM (PM_{10}, $PM_{2.5}$)
- Non-Criteria PM (PM2.5 Speciation; PM_{course})
- NCore (Trace level CO and SO_2, NOy)
- Meteorology (wind speed, wind direction, ambient temperature, RH)

The work required to collect and report data in the NCore and SLAMS network includes:

- ensuring a properly sited monitoring network;

- deploy and maintain accurate and reliable ambient air monitoring instruments, laboratory instruments, data capture software and meteorological equipment;
- develop and maintain SOP for instrument operation, preventative maintenance and calibrations;
- establish criteria for QA/QC checks for all operations;
- criteria for data editing, flagging and review;
- data verification, validation, data reporting to AQS;
- data certification; and
- develop, review and perform assessments.

Figure 6-1 Washoe County State and Local Air Monitoring Stations and National Core Multi-pollutant Monitoring Station



6.2 Field and Laboratory Activities

AQMD personnel will perform activities that support the successful operation of the air quality monitoring network. All duties performed will be such that the data quality provided meets or exceeds AQMD and EPA requirements. Field and laboratory activities include:

- collecting, calculating and recording ambient air quality data;
- ensuring proper instrument installation, calibration and adjustment;
- instrument preventative maintenance;
- restocking consumables at monitoring sites;
- relocation of monitoring sites when applicable;
- performing audits of network instrumentation;
- ensuring proper laboratory specifications;
- inspection, weighing and QC of manual method filters;
- restocking and preparing consumables for field use;
- shipping and receiving chemical speciation filter packs;
- performing laboratory equipment audits;
- data review, editing, and flagging; and
- data validation, reporting and certification.

6.3 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. In this document, assessment is used to denote any audit, performance evaluation, management systems review, peer review, inspection, or surveillance. Section 20 will discuss the details of AQMD's assessments. Information on the parties implementing the assessments and their frequency is provided in Table 6-1.

Table 6-1 Assessment Schedule

Assessment Type	Assessment Agency	Frequency
Annual Network Plan	AQMD	Annually
Network Assessment	AQMD	Every 5 years
Technical Systems Audit	EPA Region 9 AQMD	Every 3 years
Internal Performance Audits	AQMD	Quarterly
NPAP Audit	EPA designated contractor	25% of sites 4 times/year
PEP Audit	EPA designated contractor	25% of sites 4 times/year
Data Certification	AQMD	Annually
QMP/QAPP Review	AQMD	Annually
SOP Review	AQMD	Annually
Annual Trends Report	AQMD	Annually

6.4 Project Records

AQMD will establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision, and maintenance of documents and records. Table 6-2 lists the categories and types of records and documents which are applicable to document control for AQMD ambient air quality information. Information on key documents in each category is explained in more detail in Section 9.

Table 6-2 Critical Documents and Records

Categories	Document/Record Type
Site Information	Annual Monitoring Network Plan Network description Site characterization Site maps Site pictures
Environmental Data Operations	Quality Assurance Project Plans Standard Operating Procedures Field and laboratory notebooks Sample handling/chain of custody records Inspection/Maintenance Records
Raw Data	All original data (routine and QC data) Data entry forms QA data
Data Reporting	Air quality index (AQI) report Annual SLAMS reports Data/summary reports AQS reporting Trends report
Data Management	Data algorithms Data management plans and flowcharts Data Management Systems
Quality Assurance	Network review Quality Assurance Reports Technical Systems Audits Corrective action forms Control Charts Site audits AMP Reports
Management and Organization	State Implementation Plans (SIP) Personnel qualifications and training Organizational structure/flowcharts Quality Management Plan Grant Allocations EPA Directives

Section 7: Quality Objectives and Criteria for Measurement Data

7.1 Data Quality Objectives

The Data Quality Objectives (DQO) process is a series of logical steps that guides managers or staff to a plan for the resource-effective acquisition of environmental data. It is both flexible and iterative, and applies to both decision-making (e.g., compliance/non-compliance with a standard) and estimation (e.g., ascertaining the mean concentration level of a pollutant). The DQO process is used to establish performance and acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the study. This formal 7-step process is described in the EPA document *Guidance on Systematic Planning Using the DQO Process (EPA QA/G-4, February 2006)*. The AQMD has adopted those established by the EPA.

DQOs are qualitative and quantitative statements of the overall level of uncertainty that a decision-maker is willing to accept in results or decisions derived from environmental data. DQOs provide the statistical framework for planning and managing environmental data operations consistent with the data user's needs.

DQOs are qualitative and quantitative statements that:

- clarify the intended use of the data;
- define the type of data needed; and
- specify the tolerable limits on the probability of making a decision error due to uncertainty in the data.

The AQMD data quality objectives include determining the:

- highest concentrations expected to occur in the area covered by the network;
- representative concentrations in areas of high population density;
- impact on ambient pollution levels of significant sources or source categories;
- general background concentration levels;
- extent of regional pollutant transport among populated areas; and
- welfare-related impacts in rural and remote areas (such as visibility impairment and effects on vegetation).

7.1.1 Intended Use of Data

Data collected by the AQMD SLAMS and NCore station will be used to:

- establish a historical baseline concentration of natural and anthropogenic air pollutants;
- monitor the current dynamic concentrations of these air pollutants;
- evaluate compliance with the NAAQS;
- monitor progress made toward meeting ambient air quality standards;
- activate emergency control procedures that prevent or alleviate air pollution episode;
- provide data upon which long term control strategies can be reliably developed;
- observe pollution trends throughout the region;
- provide a database for researching and evaluating effects;

- accountability of emission strategy progress through tracking long-term trends of criteria and non-criteria pollutants and precursors; and
- support of long-term health assessments that contribute to ongoing review of NAAQS.

7.1.2 Type of Data Needed

The data compiled is a combination of meteorological and criteria pollutant data. The criteria pollutants, established by EPA, include CO, Lead, NO_2, PM, O_3 and SO_2 and are all monitored, with the exception of lead, at the designated SLAMS and NCore sites. Specific information on the sampling design, including how to identify monitoring locations, is presented in Section 10.

7.1.3 Tolerable Error Limits

In the development of the EPA model QAPP for PM2.5, EPA utilized the formal DQO process (see: *Guidance on Systematic Planning using the Data Quality Objectives Process*2) to specify tolerable limits on the probability of making a decision error due to uncertainty in the data. The ambient air quality monitoring program has established the acceptable precision, as measured by coefficient of variation (CV), and acceptable bias for each pollutant as listed below:

- *Measurement Uncertainty for Automated and Manual PM Methods.* The goal for acceptable measurement uncertainty is defined for precision as an upper 90 percent confidence limit for the coefficient of variation (CV) of 10 percent and ±10 percent for total bias.
- *Measurement Uncertainty for Automated O_3 Methods.* The goal for acceptable measurement uncertainty is defined for precision as an upper 90 percent confidence limit for the CV of 7 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 7 percent.
- *Measurement Uncertainty for CO*. The goal for acceptable measurement uncertainty for precision is defined as an upper 90 percent confidence limit for the CV of 10 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 10 percent.
- *Measurement Uncertainty for NO_2*. The goal for acceptable measurement uncertainty is defined for precision as an upper 90 percent confidence limit for the CV of 15 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 15 percent.
- *Measurement Uncertainty for SO_2*. The goal for acceptable measurement uncertainty for precision is defined as an upper 90 percent confidence limit for the CV of 10 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 10 percent.

7.2 Measurement Quality Objectives

Data quality indicators (DQIs) are quantitative and qualitative characteristics associated with the collected data (i.e., calculated statistics). 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. 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. The MQOs for the AQMD's monitoring program will be defined in terms of the following DQIs:

- **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. This agreement is calculated as either the range, the standard deviation or the coefficient of variation.
- **Bias -** The systematic or persistent distortion of a measurement process which causes errors in one direction. Bias is determined by estimating the positive and negative deviation from the true value as a percentage of the true value.
- **Accuracy** - The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (imprecision) and systematic error (bias) components which are due to sampling and analytical operations. Bias is determined by analyzing a reference material or reanalyzing a sample of know concentration as percent recovery or percent bias.
- **Completeness** - A metric quantifying the amount of valid data obtained from a measurement system compared to the amount that were expected to be obtained under correct, normal conditions. Completeness is measured by comparing the number of valid measurements completed with those established by the project's quality criteria (DQIs and/or performance/acceptance criteria
- **Sensitivity** - The capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest. Sensitivity is measured by determining the minimum concentration that can be measured by a method (MDL) an instrument detection limit, and/or laboratory quantitation limit.
- **Comparability** - The qualitative term that expresses the measure of confidence that one data set can be compared to another and can be combined for the decisions to be made. Comparability can be measured by comparing sample collection and handling methods, sample preparation and analytical procedures, holding times, stability and QA protocols.
- **Representativeness** - A measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point or for a process condition or environmental condition. Representativeness is a qualitative term that should be evaluated to determine whether in situ or other measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the media and phenomenon measured or studied.

MQOs should be established at various measurement phases in order to meet the DQOs. For each of the DQOs listed above, acceptance criteria have been developed by the EPA and are listed in the Data Validation Template in the *Quality Assurance Handbook for Air Pollution Measurement Systems Volume II, Appendix D.* and the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: meteorological Measurements Version 2.0. The AQMD has adopted the EPA's Data Validation Templates for the specific pollutants described in this QAPP. The NCore site utilizes trace-level monitors and monitors are detailed in the SOPs. More detailed descriptions of these MQOs and how they will be used to control and assess measurement uncertainty are described in other elements, as well as in the SOPs of this QAPP. Table 7-1 lists the Data Validation Template and the associated AQMD SOP in the appendix of this QAPP. The QA Handbook for Air Pollutions Measurement Systems Volume II, Appendix D with Data Validation Templates are included in this QAPP as an attachment.

Table 7-1 Data Validation Template and SOP Reference

Data Validation Template	SOP
Ozone	Appendix G
CO	Appendix F Appendix H
*NO_2, NOx, NO	Appendix I
SO_2	Appendix J
$PM_{2.5}$ Filter Based Local Conditions	Appendix E Appendix M
Continuous $PM_{2.5}$ Local Conditions	Appendix D
PM_{10c} for $PM_{10\text{-}2.5}$ Low-Volume, Filter Based Local Conditions	Appendix E Appendix M
PM_{10} Low Volume STP Filter-Based Local Conditions	Appendix E Appendix M

*Note: NO_Y is operated utilizing the same MQOs and Data Validation Template as NOx

7.3 Real-Time Reporting

In order for the public to get real-time air quality data, AQMD utilizes its DMS (AirVision) to send data via an hourly file transfer process (FTP) to AirNow. All hourly gaseous, particulate, and meteorological data are sent to AirNow within 10 minutes after the top of an hour. erroneous data such as data affected by calibrations, maintenance, and checks are invalidated by the site operator doing the activity. This invalidation is reflected in AirVision in the form of a general maintenance flag which is then reflected in AirNow as invalidated. Power failures invalidate data automatically before it is sent to AirNow.

The Quality Control Criteria in AirNow also ensures erroneous data is not reported publicly. Defaults are used for the Rate of Change, Sticking Hours, Sticking Value, and Max Suspect. Max Severe and Minimum Drift are both customized for all hours using the maximums and minimums that are acceptable according to each of those instruments' max/min limits. Despite, AirNow's QC Criteria and AirVision manual and auto data invalidation, Sonoma Technology Inc., can override any real-time data QC criteria at their discretion.

Section 8: Training

Training and education are crucial to a monitoring program that strives for reliable and comparable data. To ensure that monitoring activities are performed within established standards and regulations, AQMD requires personnel to be trained in the procedures and protocols of air quality monitoring. Training is aimed at increasing the effectiveness of employees and the organization. Ongoing training occurs as often as training is offered from vendors, every other year EPA offered conferences and as needed based on the installation of new instrumentation and equipment. AQMD training includes, but is not limited to (see Table 8-1 for staff training and date of completion):

- required reading of AQMD's QAPP – (documented and signed on a required reading form);
- required reading of the SOPs – (documented and signed on a required reading form);
- required reading of AQMD's Annual Network Plan and 5 – Year Assessment Plan;
- required vendor-based training for new and existing equipment;
    - Teledyne Level 1
    - Teledyne Level 2
    - MetOne Instruments
- EPA offered conferences and seminars;
- AQS conferences and seminars;
- webinar based courses and seminars;
- on-the-job training with an Air Quality Specialist and/or Senior Air Quality Specialist; and
- pertinent courses and seminars identified by personnel.

AQMD monitoring staff and new monitoring personnel are provided with the training necessary to perform their individual monitoring tasks. The majority of training is on-the-job training, consisting of shadowing an Air Quality Specialist and/or the Senior Air Quality Specialist for several weeks to get familiar with the network. New staff will then be shadowed by senior staff before performing monitoring tasks on their own. The Senior Air Quality Specialist makes the determination that staff is sufficiently trained and demonstrates proficiency in each skill and can perform assigned monitoring tasks and run assigned monitoring sites and laboratory tasks. The Senior Air Quality Specialist maintains training records and required reading forms for all monitoring staff. On the job training activities with an Air Quality Specialist and/or the Senior Air Quality Specialist consist all day-to-day field activities, laboratory activities, data review, and verification and validation activities and includes, but is not limited to:

- daily monitoring site checks;
- hands on weekly and bi-weekly checks with all instrumentations;
- hands on instrument preventative maintenance;
- daily, weekly, monthly and quarterly laboratory activities;
- proper instrument installation, calibration and adjustment of networks instrumentations;
- calculating and reviewing air quality data;
- acquiring resources and inventory for the maintenance and upkeep of sites and network instrumentation;

- performing quarterly audits of all instrumentation;
- ensuring proper traceability of standards;
- reporting network problems and corrective actions to the supervisor; and
- data review, control charts and monthly QC checks.

The lab manager will be specifically trained in the following activities before fully executing the responsibilities of the position:

- routine laboratory checks and maintenance;
- inspection, weighing and QC of manual method filters;
- filter concentration calculations;
- proper preparation of filters;
- maintenance of the laboratory equipment; and
- ensuring proper traceability of standards.

The data manager will be specifically trained in the following activities before fully executing the responsibilities of the position:

- manage AirVision;
- daily data review;
- raw data editing;
- manual method data entry;
- QA data entry;
- AQS data submittal;
- generate AQS reports;
- QA data validation;
- assess data quality and flagging;
- data validation and verifications; and
- data certification.

Table 8-1 Training Tracking Sheet

Name/Position	Training	Training Date
Craig Petersen/ Senior Air Quality Specialist	CARB Methods Conference	03/11/02
	CSN Data Validation	04/30/02
	CARB BAM 1020	08/20/02
	National AQ Conference	02/02/03
	AQS Conference	05/24/04
	TAPI Level 1	02/09/05
	Monitoring Conference	11/06/06
	TAPI Level 2	04/02/07
	National AQ Conference	04/06/08
	Precursor Gas Workshop	08/06/08
	Monitoring Conference	11/02/09
	AirVision Transition	10/20/11
	MOVES Workshop	12/05/11
	NASA ARSET Webinar	05/09/12
	EI Webinar	05/30/12
	NASA ARSET	06/11/12
	EI Conference	08/13/12
	A&WMA AQ Tech Conference	11/18/13
	Met One	04/14/14
	Monitoring/AQS Conference	08/11/14
	Monitoring/AQS Conference	08/08/16
	TAPI Level 2	12/03/17
	Monitoring/AQS Conference	08/13/18
Daniel Timmons/ Air Quality Specialist	A&WMA AQ Tech Conference	11/18/13
	TAPI Level 2	06/13/16
	Met One	04/14/14
	PQAO	01/23/17
	National AQ Conference	01/23/18
Michael Crawford/ Air Quality Specialist	TAPI Level 2	06/13/16
Brendan Schnieder/ Air Quality Specialist	Monitoring/AQS Conference	08/11/14
	DART Webinar	06/01/16
	Monitoring/AQS Conference	08/08/16
	DART Webinar	09/13/16
	DART Webinar	09/13/16
	DART Webinar	01/12/17

Name/Position	Training	Training Date
	DART Webinar	11/15/17
	AirNow Webinar	03/19/18
	DART Webinar for CSN Validators	07/25/18
	Monitoring/AQS Conference	08/13/18
	DART for CSN Data Review	12/06/18

Section 9: Documentation and Records

The following section describes AQMD documents and records procedure for the Ambient Air Quality Monitoring Program. The documents and records pertaining to all data required to be collected, and all other documents deemed important and necessary to support the program and the data reported to EPA, are listed in Table 9-1.

Table 9-1 Controlled Documents and Records

Category	Document/Record Type
Site Information	Annual Monitoring Network Plan Network description Site characterization Site maps Site pictures
Environmental Data Operations	Quality Assurance Project Plans Standard Operating Procedure SOPs Field and laboratory notebooks Sample handling/chain of custody records Inspection/Maintenance Records
Raw Data	All original data (routine and QC data) Data entry forms QA data
Data Reporting	Air quality index (AQI) report Annual SLAMS reports Data/summary reports AQS reporting Trends report
Data Management	Data algorithms Data management plans and flowcharts Data Management Systems
Quality Assurance	Network review Quality Assurance Reports Technical Systems Audits Corrective action forms Control Charts Site audits AMP Reports
Management and Organization	State Implementation Plans (SIP) Personnel qualifications and training Quality Management Plan Organizational structure/flowcharts Quality Management Plan Grant Allocations EPA Directives

9.1 Information Included in Documents and Records

9.1.1 Electronic Data

All electronic data collected is retrieved using an Agilaire AirVision data management system. All electronic field forms are stored on the agency LAN on the Monitoring drive. All documents and records will be retained for three years in accordance with the statute of limitations stated in 40 CFR 31.42. All electronic data collected that is stored on the agency LAN is on a Washoe County server that is backed up daily by the Washoe County IT department. The Data Manager is the designated record custodian for all data collected electronically.

9.1.2 Routine Data

AQMD maintains records in appropriate files that allow for the efficient archival and retrieval of ambient air quality data collected on a routine basis. Table 9-2 includes all documents and records that are collected and filed on a routine basis.

9.1.3 Quarterly Data Submittal

AQMD shall submit quarterly data to EPA through the AQS data repository system as specified in 40 CFR Part 58. Data will be submitted no more than 90 days following the end of each calendar quarter. Quarterly data submittal shall contain the following summary data:

- AQS site identification code;
- measurement scale associated with the parameter of occurrence (POC);
- monitoring method code;
- results of all precision, accuracy and bias tests performed throughout the quarter;
- all raw ambient air quality data obtained from instruments;
- all raw meteorological data; and
- location, date, pollution source and duration of incidents of ambient level exceedances.

9.1.4 Annual Summary Reports

AQMD shall submit to the EPA an annual monitoring network plan that provides for the establishment and maintenance of a network consisting of SLAMS and NCore stations in accordance with 40 CFR Part 58.10. The report will be submitted July 1 of each year for the data collected from the previous year. The annual monitoring network plan shall contain the following information for each existing and proposed site:

1. The AQS site identification number;
2. The location, including street address and geographical coordinates;
3. The sampling and analysis method(s) for each measured parameter;
4. The operating schedules for each monitor;
5. Siting criteria evaluations as described in 40 CFR Part 58 Appendix E;
6. Any proposals to remove or move a monitoring station within a period of 18 months following plan submittal;

7. The monitoring objective and spatial scale of representativeness for each monitor as defined in 40 CFR Part 58 Appendix D;
8. The identification of any sites that are suitable and sites that are not suitable for comparison against the annual $PM_{2.5}$ NAAQS as described in 40 CFR Part 58.30;
9. The MSA, CBSA, CSA or other area represented by the monitor;
10. The designation of any Pb monitors as either source-oriented or non-source-oriented according to Appendix D of 40 CFR Part 58;
11. Any source-oriented monitors for which a waiver has been requested or granted by the EPA Regional Administrator as allowed for under paragraph 4.5(a)(ii) of Appendix D to 40 CFR Part 58;
12. Any source-oriented or non-source-oriented site for which a waiver has been requested or granted by the EPA Regional Administrator for the use of Pb-PM_{10}monitoring in lieu of Pb-TSP monitoring as allowed for under paragraph 2.10 of Appendix C to 40 CFR Part 58; and
13. The identification of required NO_2 monitors as either near-road or area-wide sites in accordance with Appendix D, Section 4.3 of 40 CFR Part 58.

9.1.5 QAPP and SOP Documents

Revisions and updates to the QAPP and associated SOPs will be distributed to the Distribution List (Table 3-1, Section 3). Staff will be notified of revisions to the QAPP and specific SOPs. Staff can access these documents on the agency's LAN to review the documents, and upon review staff will be required to sign the required reading form, when applicable, and submit the form to the QA Manager. Upon revisions of the QAPP and SOP, the QAPP and SOP Tracking Sheet (Table 5-2, Section 5) will be updated by the QA Manager and retained on the agency's LAN. All outdated/old documents will be retained on the agency's LAN. SOPs are reviewed and revised by monitoring staff. Upon completion of revisions the QA Manager will review and approve the SOP, with final approval from the Division Director. Revisions to SOPs are completed when instrumentation is replaced or operation of the instrument changes via vendor manufactures recommendations. SOPs for instruments that are no longer in use (greyed out in Table 9-3) are tracked in the tracking sheet above and kept but are not required for review by staff. Table 9-3 lists the SOP tracking sheet with current revisions. Any procedural updates and/or changes and significant monitoring information will be communicated during daily monitoring field staff briefings and monthly monitoring and planning meetings.

9.2 Data Reporting Format and Document Control

All raw data required for calculations, submission to the AQS database, and QA/QC data shall be collected electronically or on data forms. All hardcopy information shall be filled out in indelible ink. Corrections are to be made by inserting a single line through the incorrect entry and an initial and date next is to be written next to the corrected entry.

Electronic field form cells are "locked" in the calculation cells to avoid altering the equations. After completions of the field form, the form is converted to pdf. Reasonability checks are performed on each form prior to and after data entry. If errors are identified during review, the error will be fixed electronically, and the form converted to pdf and saved as a new file identifying that it is a corrected version with the editor's initials. Data collected from AirVision has a login and password to secure the data. Permissions are assigned within AirVision by the Data Manager to ensure data is not unintentionally modified or deleted. The Data Manager is the only person that can edit the raw data.

All electronic data are stored on the agency LAN, that is backed up daily by the Washoe County Technical Services (TS) Department. All hardcopy data is stored with the Data Manager or in an off-site Washoe County retention storage facility.

9.2.1 Logbooks

Instrument Logbooks – Logbooks will be used for each instrument at each site. Each instrument logbook will be labeled with the instrument's manufacturer, model number and serial number. All field logbooks will stay with their respective instruments even if the instrument is relocated to another site. Information recorded in the instrument field logbooks will include routine operations, inspection and maintenance operations, and any other information deemed necessary by the site operator. If an instrument is taken out of service, the logbook will be archived in the AQMD office.

Laboratory Logbooks – Laboratory logbooks will be used in the laboratory to document $PM_{2.5}$ and PM_{10} activities. Information recorded in the lab logbooks include lab maintenance, audit activities and filter inspection, equilibration, weighing and QC checks. Additional information deemed necessary by the laboratory operators shall also be included in the lab notebook. Laboratory instrumentation logbooks will be kept separately for each balance. Activities including balance maintenance and repair will be noted in these notebooks. A specific Radnet logbook will be maintained in the laboratory for Ludlum activities. Additional information on the Radnet program is in Appendix O.

9.3 Data Reporting Archiving and Retrieval

All documents will be retained for three years in accordance with the statute of limitations stated in 40 CFR 31.42. 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 must be retained until completion of the action and resolution of all issues which arise from it. AQMD monitoring staff, Lab Manager, Data Manager and QA Manager are responsible for maintaining records according to their individual responsibilities on the agency's LAN. Monitoring site agreements are maintained by Administrative Health Services, including Interlocal Agreements and Right of Entry. Refer to each SOP for the specific location of all hardcopy and electronic record location and back-up procedures and record locations. Document, record retention and location of documents are listed in Table 9-2.

Table 9-2 Documentation and Record Retention

Record Type	Retention Period	Disposition/ Notes	Type/ Location
Data			
Ambient Air Monitoring Data	Permanent	None	Electronic/ LAN
Meteorological Monitoring Data	Permanent	None	Electronic/ LAN
Data Files for Submittal	Permanent	None	Electronic/ LAN
Annual Data Certifications	15 years	Delete/Destroy	Electronic/ LAN
Monthly Data Review	5 years	Delete/Destroy	Hardcopy/ Data Manager
Station Data Exception Logs	5 years	Delete/Destroy	Hardcopy/ Data Manager
Data Relating to Legal Action	Until Action is Complete	Delete	Electronic/ LAN
Record Type	**Retention Period**	**Disposition/ Notes**	**Type/ Location**
QA/QC			
Quarterly Audits (Gas, PM, Met)	15 years	Delete/Destroy	Electronic and Hardcopy/ LAN and Data Manager
EPA Audit Reports (PEP and NPAP)	15 years	Delete/Destroy	Electronic/ LAN
Calibration Cylinder Certifications	15 years	Delete/Destroy	Electronic/ LAN
O_3 Transfer Standard Verifications	15 years	Delete/Destroy	Electronic/ LAN
Annual Multi-point QC Checks (NCore Gas)	5 years	Delete/Destroy	Electronic/ LAN
Semi-Annual Multi-point QC Checks (Gas)	5 years	Delete/Destroy	Electronic/ LAN
Monthly Verifications (PM)	5 years	Delete/Destroy	Electronic and Hardcopy/ LAN and Data Manager
Bi-weekly QC Checks (Gas, PM)	5 years	Delete/Destroy	Electronic/ LAN

Weekly QC Checks (NCore Gas)	5 years	Delete/Destroy	Electronic/ LAN
Calibration Records (Gas, PM, Met)	5 years	Delete/Destroy	Electronic/ LAN
Control Charts	5 years	Delete/Destroy	Electronic/ LAN
Station Log Reports	5 years	Delete/Destroy	Hardcopy/ Data Manager
Quality Assurance Project Plan (QAPP)	Superseded by revision	Delete	Electronic/ LAN & Website
Standard Operating Procedures	Superseded by revision	Delete	Electronic/ LAN
Quality Management Plan (QMP)	Superseded by revision	Delete	Electronic/ LAN & Website
Corrective Action Requests	15 years	Delete/Destroy	Hardcopy/ Field Site
Equipment			
Instrument Logbooks	15 years	Dispose	Hardcopy/ Field Site
Record Type	**Retention Period**	**Disposition/ Notes**	**Type/ Location**
Maintenance and Calibration Records	15 years	Delete/Destroy	Electronic/ LAN
Work Orders and Repair Orders	15 years	Delete/Destroy	Electronic and Hardcopy/ Vendor and Field Site
Standard Traceability Certifications	15 years	Delete/Destroy	Electronic/ LAN
Requisitions and Purchase Orders	15 years	Delete/Destroy	Electronic/ LAN
Manuals	Life of equipment	Dispose	Hardcopy/ Field Site
Laboratory			
$PM_{2.5}$STN Custody and Field Sample Forms	Permanent	None	Hardcopy/ Data Manager
$PM_{2.5}$and PM_{10} FRM Field Sample Reports	Permanent	None	Hardcopy/ Data Manager
Laboratory Logbooks	Permanent	None	Hardcopy/ Laboratory
Annual Service/Calibration Records	15 years	Delete/Destroy	Electronic/ LAN
Quarterly Audits (Temp, RH)	15 years	Delete/Destroy	Electronic/ LAN

PM Weigh Logs	15 years	Delete/Destroy	Electronic/ LAN
Mass Standard Verifications	15 years	Delete/Destroy	Electronic/ LAN
Mass Standard Traceability Certifications	15 years	Delete/Destroy	Electronic/ LAN
47mm $PM_{2.5}$and PM_{10} Filters	5 years	Dispose	Refrigerated
BAM $PM_{2.5}$and PM_{10} Filter Tape	5 years	Dispose	Field Site
PM Filters Relating to Legal Action	Until Action is Complete	Dispose	Refrigerated
Other			
Training Certificates	Permanent	None	Hardcopy/Electronic LAN
Required Reading	Superseded by previous	Delete/Destroy	Hardcopy/Electronic LAN
Lease Agreements	Permanent	None	Hardcopy

Table 9-3 Standard Operating Procedures (SOP) Tracking Sheet

Appendix	SOP Title	Version	Revision Date	Approval Date
A	Anderson Samplers, Inc. High Volume Particulate Matter Sampler – 10 Micron (PM_{10})	1	12/30/10	02/12/13
B	Met One SASS – Chemical Speciation $PM_{2.5}$	1	12/30/10	02/12/13
BB	Met One SuperSASS – Chemical Speciation $PM_{2.5}$	1	11/05/19	
C	URG 3000N	1	12/30/10	02/12/13
CC	URG 3000N	1	11/05/19	
D	Beta Attenuation Monitors – $PM_{2.5}$and PM_{10}	1	12/21/12	02/12/13
D	Beta Attenuation Monitors – $PM_{2.5}$ and PM_{10}	2	03/31/15	08/30/16
D	Beta Attenuation Monitors – $PM_{2.5}$and PM_{10}	3	11/05/19	
E	BGI Particulate Matter Samplers PQ200 – $PM_{2.5}$and PM_{10}	1	12/30/10	02/12/13
E	BGI Particulate Matter Samplers PQ200 – $PM_{2.5}$and PM_{10}	2	08/04/15	
E	BGI Particulate Matter Samplers PQ200 – $PM_{2.5}$and PM_{10}	3	03/31/17	05/09/19
E	BGI Particulate Matter Samplers PQ200 – $PM_{2.5}$and PM_{10}	4	10/10/19	
F	Carbon Monoxide Analyzers	1	02/28/12	02/12/13
F	Carbon Monoxide Analyzers	2	11/01/19	
G	Ozone Analyzers	1	02/28/12	02/12/13
G	Ozone Analyzers	2	11/01/19	
H	Trace Carbon Monoxide Analyzers	1	12/05/12	02/12/13
H	Trace Carbon Monoxide Analyzers	2	11/01/19	
I	Trace Reactive Oxides of Nitrogen Analyzers	1	12/13/12	02/12/13
I	Trace NOx/NOy Analyzers	2	11/01/19	
J	Trace Sulfur Dioxide Analyzers	1	12/05/12	02/12/13
J	Trace Sulfur Dioxide Analyzers	2	11/01/19	
K	Zero Air Generator	1	12/12/12	02/12/13
K	Zero Air Generator	2	11/01/19	
L	Environics 6103 Ozone Transfer Standard/Multi-gas Calibrator	1	12/20/12	02/12/13
LL	Teledyne Calibrators (T700, T700U, T750U)	1	10/22/19	
M	Laboratory Procedures	1	12/12/12	
M	Laboratory Procedures	2	03/31/15	
M	Laboratory Procedures	3	06/30/17	
M	Laboratory Procedures	4	05/08/19	05/09/19
M	Laboratory Procedures	5	10/11/19	

Appendix	SOP Title	Version	Revision Date	Approval Date
N	Meteorology	1	12/20/12	
N	Meteorology	2	03/31/15	08/30/16
N	Meteorology	3	10/15/19	
O	RadNet	1	12/06/12	02/12/13
O	RadNet	2	11/05/19	
P	Data Retrieval	1	12/05/12	02/12/13
P	Data Retrieval	2	11/05/19	
Q	Data Validation for Data Management System (Continuous and Manual Monitoring Methods)	1	10/28/10	02/12/13
Q	Data Validation for Data Management System (Continuous and Manual Monitoring Methods)	2	03/31/15	
Q	Data Validation for Data Management System (Continuous and Manual Monitoring Methods)	3	12/29/16	
Q	Data Validation for Data Management System (Continuous and Manual Monitoring Methods)	4	03/31/19	05/09/19
Q	Data Validation for Data Management System (Continuous and Manual Monitoring Methods)	5	11/05/19	
R *Combined in App. Q	Data Validation for Manual Monitoring Methods	1	12/17/12	02/12/13
S	File Generation for Continuous Monitoring Methods	1	12/12/12	02/12/13
S	File Generation for Continuous and Manual Monitoring Methods	2	11/05/19	
T *Combined in App. S	File Generation for Manual Monitoring Methods	1	12/12/12	02/12/13
U	Uploading Ozone and $PM_{2.5}$ data to AirNow	1	12/10/12	02/12/13
U	Uploading Ozone and $PM_{2.5}$ data to AirNow	2	03/31/15	08/30/16
V	Environmental Systems Corporation (ESC) 8832 Data Loggers	1	12/20/12	02/12/13
V	Environmental Systems Corporation (ESC) 8832 Data Loggers	2	11/05/19	
W *Combined in App. F, G, H, I, J, & K	Quarterly Gaseous Audits at SLAMS and NCore Stations	1	06/28/12	02/12/13

Section 10: Sampling Process Design

The purpose of this section is to describe AQMD's network design in accordance with 40 CFR Part 58. Monitoring networks must be designed to meet three basic monitoring objectives:

- To provide air pollution data to the general public in a timely manner.
- Support compliance with ambient air quality standards and emissions strategy development.
- Support for air pollution research studies.

In order to support the air quality management work indicated in the three basic air monitoring objectives, a network must be designed with a variety of types of monitoring sites. Monitoring sites must be capable of informing managers about many things including the peak air pollution levels, typical levels in populated areas, air pollution transport, and air pollution levels near specific sources. The six general site types are described as sites located to:

- determine the highest concentrations expected to occur in the area covered by the network;
- measure typical concentrations in areas of high population density;
- determine the impact of significant sources or source categories on air quality;
- determine general background concentration levels;
- determine the extent of regional pollutant transport among populated areas; and
- measure air pollution impacts on visibility, vegetation damage, or other welfare-based impacts.

10.1 Network Design and Site Selection

A properly sited monitoring network is essential to achieving representativeness. Representativeness is defined in 40 CFR Part 58, Appendix D along with guidelines provided to reach this goal. Representativeness is described in terms of the physical dimensions of the air parcel nearest to a monitoring site where actual pollutant concentrations are reasonably similar. Each monitor operated by AQMD is assigned a scale of representativeness based on the definitions outlined in 40 CFR Part 58, Appendix D.

- **Microscale** - Defines the concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters.
- **Middle scale** - Defines the concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometer.
- **Neighborhood scale** - Defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range. The neighborhood and urban scales listed below have the potential to overlap in applications that concern secondarily formed or homogeneously distributed air pollutants.
- **Urban scale** - Defines concentrations within an area of city-like dimensions, on the order of 4 to 50 kilometers. Within a city, the geographic placement of sources may result in there being no single site that can be said to represent air quality on an urban scale.
- **Regional scale** - Defines usually a rural area of reasonably homogeneous geography without large sources, and extends from tens to hundreds of kilometers.

- **National and global scales** - These measurement scales represent concentrations characterizing the nation and the globe as a whole.

Classification of a monitor by its type and spatial scale of representativeness is necessary and will aid in interpretation of the monitoring data for a particular monitoring objective (e.g., public reporting, NAAQS compliance, or research support). Table 10–1 illustrates the relationship between the various site types that can be used to support the three basic monitoring objectives, and the scales of representativeness that are generally most appropriate for that type of site.

Table 10–1 Relationship between Site Types and Scales of Representativeness

Site Type	Appropriate Siting Scales
1. Highest concentration	Micro, middle, neighborhood (sometimes urban or regional for secondarily formed pollutants).
2. Population	Neighborhood, urban.
3. Source impact	Micro, middle, neighborhood.
4. General/background & regional transport	Urban, regional.
5. Welfare-related impacts	Urban, regional.

The selection of a monitoring site includes developing and understanding the monitoring objective and appropriate data quality objectives, as well as identifying the spatial scale most appropriate for the monitoring objective of the site. Once these criteria have been determined, potential locations for the monitoring site can be identified.

10.2 Monitor Placement

The placement of each monitor is determined by the defined monitoring objective. Monitors are placed according to potential exposure to pollution. Final placement of a particular monitor, based on the various site selection criteria, is based on physical obstructions and activities in the immediate area. Monitor inlets must be placed away from obstructions such as trees and fences to avoid their airflow effects. Additionally, airflow around monitor sampling probes must be representative of the general airflow in the area. The availability of utilities is also a factor in determining monitor placement.

10.3 Probe Siting Criteria

AQMD adheres to 40 CFR Part 58, Appendix E for probe siting criteria. Table 10-2 summarizes the general probe and monitoring path siting criteria for criteria pollutants and Table 10-3 and 10-4 summarizes minimum separation distances.

Table 10-2 Probe and Monitoring Path Siting Criteria

Pollutant[7]	Scale	Height from ground to probe inlet	Horizontal and vertical distance from supporting structures[4,5]	Distance from trees to probe inlet[3]	Distance from roadways to probe inlet
CO[6]	Micro, Middle 300m Neighborhood 1 km	3 1/2: 2–15m	>1m	>10m	2-10m (Micro) See Table 10-4 for all other scales
O_3	Middle 300m Neighborhood, Urban and Regional 1km	2-15m	>1m	>10m	See Table 10-3 for all scales
NO_2	Middle 300m Neighborhood, Urban and Regional 1km	2-15m	>1m	>10m	See Table 10-3 for all scales
SO_2	Middle 300m Neighborhood, Urban and Regional 1km	2-15m	>1m	>10m	Not Applicable
PM[1]	Micro: Middle, Neighborhood, Urban and Regional	2–7m (micro); 2–7m (middle $PM_{10-2.5}$); 2–15m (all other scales)	>2m (all scales, horizontal distance only)	>10m	2-10m (Micro) See Figure E-1 of 40 CFR 58 App E for all other scales

[1] Collocated monitors must be within 4m of each other and at least 2m apart for flow rates greater than 200 liters/min or at least 1m apart for samplers having flow rates less than 200 l/min to preclude airflow interference

[3] Should be >20m from dripline of trees and must be 10m from dripline when the trees are an obstruction)

[4] Distance from sampler or probe to a supporting structure, such as a building, must be at least twice the height the obstacle protrudes above the sampler or probe. Sites not meeting this criterion may be classified as middle scale.

[5] If probe is on a rooftop, separation distance refers to walls, parapets, or penthouses

[6] Microscale sites: probe must be >10m from an intersection and preferably at a midblock location.

[7] 270° unobstructed around probe or sampler or 180° unobstructed if probe is on the side of a building

Table 10-3 Minimum Separation Distance between Roadways and Probes for Neighborhood and Urban Scale Ozone and Nitrogen Oxides

Roadway average daily traffic, vehicles per day	Minimum distance (meters) – Interpolated based on traffic flow	Minimum distance (meters) – for ozone monitors not approved as of Dec. 18, 2006
≤1,000	10	10
10,000	10	20
15,000	20	30
20,000	30	40
40,000	50	60
70,000	100	100
≥110,000	250	250

Table 10-4 Minimum Separation Distance between Roadways and Probes for Neighborhood Scale Carbon Monoxide

Roadway average daily traffic, vehicles per day	Minimum distance (meters) – Interpolated based on traffic flow
≤10,000	10
15,000	25
20,000	45
30,000	80
40,000	115
50,000	135
≥60,000	150

10.4 Meteorological Sensor Siting Criteria

10.4.1 Towers

The towers shall be of an open grid-type construction and of sufficient strength (steel or other suitable material) to be climbed safely or cranked down in order to install, service, and audit the sensors. A tower must be rigid enough to maintain all mounted instruments in proper alignment and orientation in high winds. To accommodate wind speed/wind direction sensors, meteorological towers shall reach a height of 10 m.

When sensors are located on a cross arm projecting out from the tower, the cross arms shall be securely fastened to the tower and shall be strong enough so that the sensors do not sway or vibrate in high winds. The sensors shall be securely fastened to the cross arm at a distance of two tower diameters or widths, measured from the edge of the tower to the sensor, to avoid any influence of tower-induced turbulence on the sensors. The cross arm shall be installed so that it is horizontally level and the sensors shall be installed so that they are vertical. The cross arm shall be mounted and aligned so that the wind direction sensor is correctly aligned. The correct alignment varies on a sensor-by-sensor basis. Consult the appropriate section of manufacturer's operator's manual for the correct alignment.

10.4.2 Wind Velocity Sensors

Wind sensors shall be mounted on a boom so that the sensors are twice the maximum diameter or diagonal of the tower away from the tower. The boom shall project into the prevailing winds. Wind sensors shall be mounted on booms or cross arms so that a sensor's wake does not impact adjacent sensors. Usually, this means mounting the sensors a minimum of 2 meters apart. If the wind sensors are to be mounted on top of a tower, they shall be mounted at a height above the tower so that distance between the sensor and the tower is equal to twice the maximum diameter or diagonal of the tower.

If the wind sensors are to measure surface level winds, the sensors should be located on a 10-m tower in open terrain. Open terrain is defined as an area where the distance between the tower base and any obstruction is at least ten times the height of that obstruction above the instrument. This applies to manmade (buildings) and natural (trees, rocks, or hills) obstructions. Distances are to be measured from the edge of the obstruction nearest the tower. Trees and shrubs shall be measured from the outside edge of the crown or drip line, and not the trunk. If the sensors (and tower) are to be located in areas of uneven terrain or terrain containing obstacles, refer to Table 10-5 for the limits for terrain variation and obstacle height near the tower.

Table 10-5 Limits on Terrain and Obstacles near Towers

Distance from Tower (m)	Slope (No Greater Than)	Maximum Obstruction or Vegetation Height (m)*
0-15	+/- 2 %	0.3
15-30	+/- 3 %	0.5-1.0
30-100	+/- 7 %	3.0
100-300	+/- 11 %	10 x Height

* Most vegetation is < 0.3 meters

10.4.3 Temperature and Humidity Sensors

Temperature and humidity sensors shall be mounted over an open plot of short grass or natural earth (not concrete or asphalt) at least 9 meters in diameter. A height of 1.25 to 2 meters above the ground surface is the standard height for mounting temperature and humidity sensors. The sensors shall be no closer to obstructions than a distance of four times the height differential between the height of the sensor and the height of the obstruction. This applies to both manmade and natural obstructions. The distance shall be measured from the edge of the crown or drip line of the vegetation, not the trunk. The sensors shall be positioned at a minimum of 30 meters from large paved areas (streets, parking lots, etc.), steep slopes, ridges, hollows, or bodies of standing water. Temperature probes shall be located so that they are not influenced by heat leakage from the shelter containing the electronics and recorders for the meteorological equipment. Temperature sensors that are to be mounted on a boom shall be mounted on a boom with a length that is greater than the diameter of the tower at the height at which the boom is mounted. The temperature sensors shall always be mounted on the south side of a tower. Temperature sensors that are mechanically aspirated shall have a downward-facing shielding.

10.4.4 Barometric Pressure Sensors

Barometric pressure sensors are usually mounted inside the shelter housing meteorological instruments and recorders since barometric pressure is not affected by indoor installations. The installation of the barometric pressure sensors inside the stable shelter environment protects the instruments from exposure to extreme climatological events that may impact the sensors or recorders. However, when a sensor is mounted inside a shelter, it should be placed inside the building on an interior wall, and removed from drafts from the heating/ventilating/air conditioning system, doors, and windows. The instrument should be mounted to minimize vibration and be vented to eliminate shelter interior pressurization.

10.4.5 Solar Radiation Sensors

All solar or net (solar and terrestrial or long-wave) radiation sensors must be positioned so they are horizontal. These sensors must have an unobstructed view of the sun during the entire year, from sunrise to sunset. They should not be positioned within 50 meters of any light colored walls or sources of artificial light. Net radiation sensors shall be sited according to the siting criteria for temperature sensors unless a specific application is desired.

10.5 Sampling Frequency

The AQMD follows the sampling schedule established by the EPA in 40 CFR 58. For filter-based PM monitoring, every third and six day sampling follows the sampling schedule published annually by the EPA. Gaseous pollutants, meteorological data and some PM data are collected continuously throughout the entire year. At least 75% of the total possible observations per quarter must be present before summary statistics are calculated.

10.6 Rationale for Air Quality Network Design

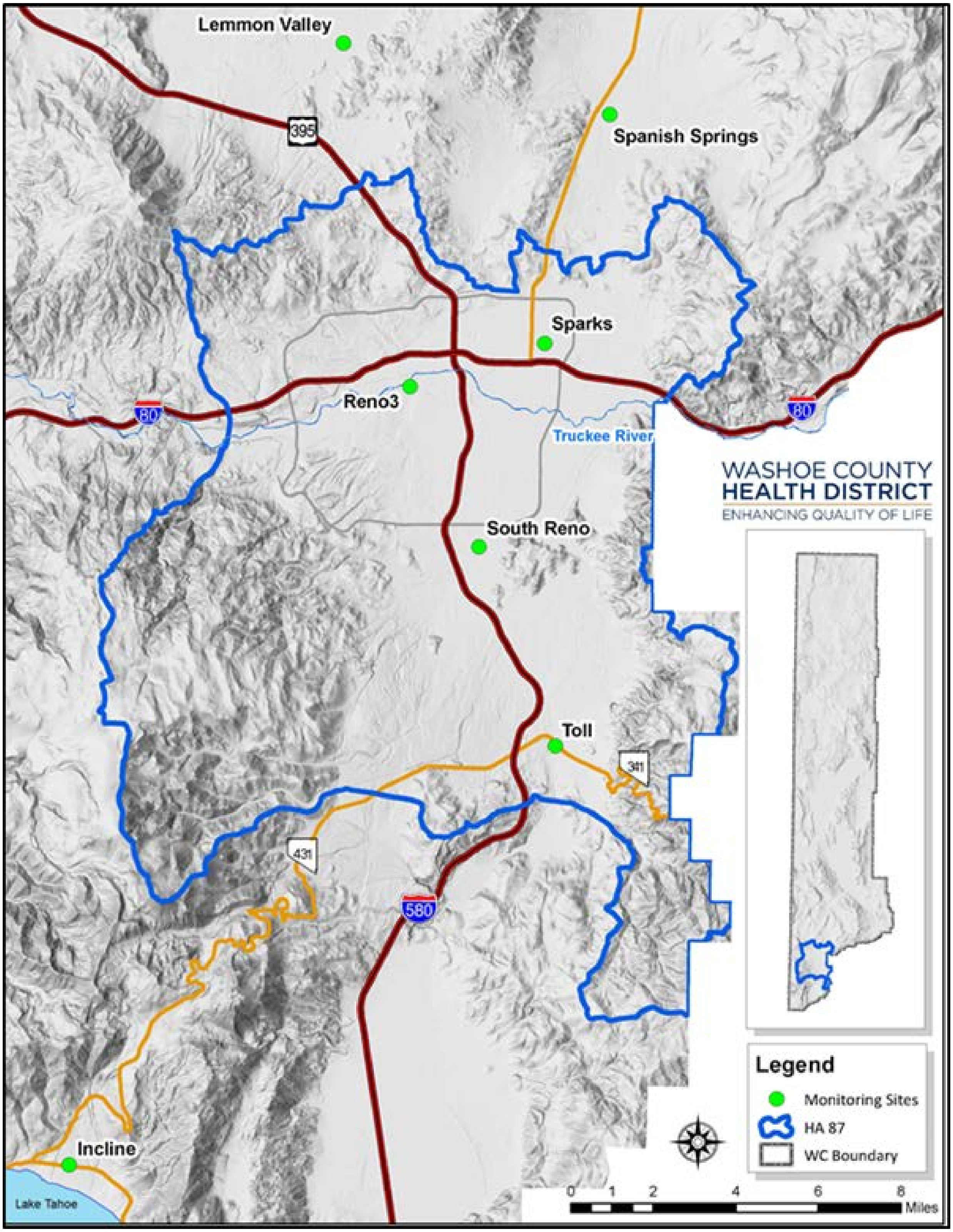
Washoe County's Ambient Air Quality Monitoring Network has 7 monitoring stations located throughout Washoe County. The locations of the monitoring stations are identified in Figure 10-1. The AQMD Monitoring Network operates under an approved Annual Network Plan with EPA Region 9. Table 10-6 lists the parameters monitored in 2019 sorted by network type and site. All Monitoring Network site details, including monitoring type, can be found in the Annual Network Plan on OurCleanAir.com.

Table 10-6 Ambient Air Monitoring Sites and Parameters Monitored

Network Type / Site	O_3	CO	Trace CO	NO	NO_2	NO_x	Trace NO	NOy-NO	NOy	Trace SO_2	PM_{10} (manual)	PM_{10} (continuous)	$PM_{2.5}$ (manual)	$PM_{2.5}$ (continuous)	PM_{coarse} (manual)	PM_{coarse} (continuous)	$PM_{2.5}$ Speciation	Meteorology
Incline	✓																	
Lemmon Valley	✓																	
South Reno	✓																	✓
Spanish Springs	✓											✓		✓		✓		
Sparks	✓	✓										✓		✓		✓		✓
Toll	✓											✓						✓
NCore																		
Reno3	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
STN																		
Reno3																	✓	
SPM																		

Notes: Meteorology for the NCore network includes ambient temperature, wind speed, wind direction, and relative humidity. The PM_{10} manual method monitor at NCore is for PM_{coarse} calculation only and is not submitted to AQS for data to be used in comparison to the NAAQS.

Figure 10-1 Washoe County's Ambient Air Quality Monitoring Network



Section 11: Sampling Method Requirements

The purpose of this section is to describe the sampling methods and procedures used for collecting the required air quality samples. This section will describe the equipment used for data collection, the necessary support facilities and sample preparation, preservation and decontamination procedures. This section will also address failures in the sampling system and the protocols for corrective action.

11.1 Monitoring Methodology and Interferences

11.1.1 Carbon Monoxide (Nondispersive Infrared Photometry)

The detection and measurement of CO utilizes this chemical's propensity to absorb infrared (IR) radiation at wavelengths near 4.7 microns. Broadband IR radiation is generated using a high energy heated element. The IR radiation is modulated using gas filter correlation technology. Gas filter correlation utilizes a rotating wheel containing two gas filled cells that selectively modulate the IR radiation. One cell contains nitrogen (the measure cell), while the other contains CO (the reference cell). This configuration modulates the IR radiation into reference and measured pulses. During the reference pulse, the CO in the gas filter wheel effectively strips the beam of all IR energy at wavelengths susceptible to CO absorption. This results in a beam that is unaffected by any CO in the sample cell being evaluated. During the measure pulse, the nitrogen in the filter wheel does not affect the IR radiation beam. The CO subsequently absorbs the IR radiation in the sample cell. The attenuation of the IR radiation is directly proportional to the quantity of CO present in the sample being evaluated. The IR beam enters the multi-pass sample cell after the gas filter wheel.

The sample cell uses folding optics to extend the absorption path through the sample, by making the reference and measurement beams pass multiple times through the sample in the cell. The length of the absorption path is directly related to the sensitivity of the instrument in measuring CO concentrations. Upon exiting the sample cell, the beam passes through a band-pass interference filter to limit the light to the wavelength of interest. Finally, the beam strikes a thermoelectrically cooled, solid-state photo-conductor. This solid-state device, coupled with its support circuitry, amplifies the signal generated by the modulated IR radiation beam, and outputs a modulated voltage. This voltage is de-modulated resulting in two voltage signals associated with the reference and measurement pulses. The ratio of the de-modulated voltage signals is indirectly proportional to the concentration of CO in the sample being evaluated.

It should be noted that the gas filter correlation method for detecting CO is subject to interference from a number of other gases that absorb IR in a similar fashion to CO. Most notable of these are water vapor, CO2, N2O (nitrous oxide) and CH4 (methane). The T300 has been successfully tested for its ability to reject interference from of these sources, however high concentrations of these gases can interfere with the instrument's ability to make low-level CO measurements.

1. INTERFERENCE AND SIGNAL TO NOISE REJECTION. If an interfering gas, such as H2O vapor is introduced into the sample chamber, the spectrum of the IR beam is changed in a way that is identical for both the reference and the measurement cells, but

without changing the ratio between the peak heights of CO MEAS and CO REF. In effect, the difference between the peak heights remains the same. Thus, the difference in the peak heights and the resulting M/R ratio is only due to CO and not to interfering gases. In this case, GFC rejects the effects of interfering gases and so that the analyzer responds only to the presence of CO. To improve the signal-to-noise performance of the IR photo-detector, the GFC Wheel also incorporates an optical mask that chops the IR beam into alternating pulses of light and dark at six times the frequency of the measure/reference signal. This limits the detection bandwidth helping to reject interfering signals from outside this bandwidth improving the signal to noise ratio.

2. SUMMARY INTERFERENCE REJECTION. The basic design of the T300 rejects most of this interference at a 300:1 ratio. The two primary methods used to accomplish this are:
   - The 4.7µm band pass filter just before the IR sensor which allows the instrument to only react to IR absorption in the wavelength affected by CO.
   - Comparison of the measure and reference signals and extraction of the ratio between them.
3. PNEUMATIC OPERATION. An internal pump evacuates the sample chamber creating a small vacuum that draws sample gas into the analyzer. Normally the analyzer is operated with its inlet near ambient pressure either because the sample is directly drawn at the inlet or a small vent is installed at the inlet. There are several advantages to this “pull through” configuration. By placing the pump down stream from the sample chamber several problems are avoided:
   - First the pumping process heats and compresses the sample air complicating the measurement process.
   - Additionally, certain physical parts of the pump itself are made of materials that might chemically react with the sample gas.
   - Finally, in certain applications where the concentration of the target gas might be high enough to be hazardous, maintaining a negative gas pressure relative to ambient means that should a minor leak occur, no sample gas will be pumped into the atmosphere surrounding analyzer.

11.1.2 Sulfur Dioxide (Fluorescence Analyzer)

The physical principle used in SO_2 molecule measurement relies on exciting an electron shell, which occurs in the presence of a specific wavelength (214 nanometers [nm]) of ultraviolet (UV) radiation, and the subsequent relaxation which produces a photon of light. A photomultiplier tube allows the light emissions to be measured as the SO_2 molecule returns to the ground state. The intensity of this light is proportional to the quantity of SO_2 present in the sample. A reference detector continuously monitors the intensity of the UV lamp, used to excite the SO_2, and allows use of a ratiometric measurement technique that compensates for lamp degradation. A hydrocarbon scrubbing system, containing no consumable material, removes interfering hydrocarbons prior to the ambient sample entering the measurement chamber.

It should be noted that the fluorescence method for detecting SO2 is subject to interference from a number of sources. The T100 has been successfully tested for its ability to reject interference from most of these sources.

1. DIRECT INTERFERENCE. The most common source of interference is from other gases that fluoresce in a similar fashion to SO2 when exposed to UV Light. The most significant of these is a class of hydrocarbons called poly-nuclear aromatics (PNA) of which xylene and naphthalene are two prominent examples. Nitrogen oxide fluoresces in a spectral range near to SO2. The T100 Analyzer has several methods for rejecting interference from these gases:
    - A special scrubber (kicker) mechanism removes any PNA chemicals present in the sample gas before it the reach the sample chamber.
    - The exact wavelength of light needed to excite a specific non-SO2 fluorescing gas is removed by the source UV optical filter.
    - The light given off by Nitrogen Oxide and many of the other fluorescing gases is outside of the bandwidth passed by the PMT optical filter.
2. UV ABSORPTION BY OZONE. Because ozone absorbs UV Light over a relatively broad spectrum it could cause a measurement offset by absorbing some of the UV given off by the decaying SO2* in the sample chamber. The T100 prevents this from occurring by having a very short light path between the area where the SO2* fluorescence occurs and the PMT detector. Because the light path is so short, the amount of O3 needed to cause a noticeable effect would be much higher than could be reasonably expected in any application for which this instrument is intended.
3. DILUTION. Certain gases with higher viscosities can lower the flow rate though the critical flow orifice that controls the movement of sample gas though the analyzer reducing the amount of sample gas in the sample chamber and thus the amount of SO2 available to react with the to the UV light. While this can be a significant problem for some analyzers, the design of the T100 is very tolerant of variations in sample gas flow rate and therefore does not suffer from this type of interference.
4. THIRD BODY QUENCHING. While the decay of SO2* to SO2 happens quickly, it is not instantaneous. Because it is not instantaneous it is possible for the extra energy possessed by the excited electron of the SO2* molecule to be given off as kinetic energy during a collision with another molecule. This in effect heats the other molecule slightly and allows the excited electron to move into a lower energy orbit without emitting a photon. The most significant interferents in this regard are nitrogen oxide (NO), carbon dioxide (CO2), water vapor (H2O) and molecular oxygen (O2). In ambient applications the quenching effect of these gases is negligible.
5. LIGHT POLLUTION. Because T100 measures light as a means of calculating the amount of SO2 present, obviously stray light can be a significant interfering factor. The T100 removes this interference source in several ways.
    - The sample chamber is designed to be completely light tight to light from sources other than the excitation UV source lamp.
    - All pneumatic tubing leading into the sample chamber is completely opaque in order to prevent light from being piped into the chamber by the tubing walls.
    - The optical filters remove UV with wavelengths extraneous to the excitation and decay of SO2/SO2*.

- Most importantly, during instrument calibration the difference between the value of the most recently recorded PMT offset and the PMT output while measuring zero gas (calibration gas devoid of SO2) is recorded as the test function OFFSET. This OFFSET value is used during the calculation of the SO2 concentration. Since this offset is assumed to be due to stray light present in the sample chamber is also multiplied by the SLOPE and recorded as the function STR. LGT. Both OFFSET & STR. LGT are viewable via the front panel.

11.1.3 Nitrogen Oxides and Reactive Oxides of Nitrogen (Chemiluminescence)

The 200EU/501Y is a low level NO/NOy analyzer (0-0.20 ppm range), which operates in virtually the same manner as the Model 200E, with the exception of the 501Y module. This 501Y module contains a molybdenum catalytic converter. The module is mounted outside the shelter on a 10-meter height tower so that catalytic reaction to convert NOy species to NO occurs very close to the point where ambient air is sampled. This configuration allows the immediate conversion of approximately 30 nitroxyl compounds (collectively known as NOy) to NO. The NOy compounds are too unstable to be measured when taken in through the entire length of the typical ambient air sampling inlet system. The analytical principle is based on the chemiluminescent reaction of NO with O_3. This reaction produces a characteristic near-infrared luminescence with an intensity that is linearly proportional to the concentration of NO present. Specifically,

$$NO + O_3 > \quad NO_2^* > \quad NO_2 + O_2 + h\nu$$

Where:
NO = Nitric Oxide
O_3 = Ozone
NO_2^* = Nitrogen Dioxide in an excited state
NO_2 = Nitrogen Dioxide
O_2 = diatomic oxygen
$h\nu$ = emitted photon energy

The reaction results in electronically excited NO_2 molecules which revert to their ground state, resulting in an emission of light or chemiluminescence. To determine the concentration of NO, the ambient air sample (that bypasses the probe-mounted molybdenum converter) is blended with excess O_3 in a reaction chamber. The chemiluminescent emission that results from the reaction is detected by an optically-filtered, high-sensitivity photomultiplier tube. The optical filter and photomultiplier respond to light in a narrow wavelength band unique to the NO and O_3 reaction.

To measure NOy, the ambient sample air is passed through the probe-mounted chemical reduction converter and the nitroxyl compounds present are reduced to NO. This sample is then blended with O_3, chemiluminescence occurs, and the detected light response is proportional to the concentration of NOy.

It should be noted that the chemiluminescence method is subject to interferences from a number of sources. The T200 has been successfully tested for its ability to reject interference from most of these sources.

1. DIRECT INTERFERENCE. Some gases can directly alter the amount of light detected by the PMT due to chemiluminescence in the reaction cell. This can either be a gas that undergoes chemiluminescence by reacting with O3 in the reaction cell or a gas that reacts with other compounds and produces excess NO upstream of the reaction cell.
2. THIRD BODY QUENCHING. Other molecules in the reaction cell can collide with the excited NO2*, causing the excited NO2* to return to its ground state without releasing a photon of light. This is known as third party quenching. Quenching is an unwanted phenomenon and the extent to which it occurs depends on the properties of the collision partner.
    - Larger, more polarized molecules such as H2O and CO2 are the most significant quenching interferents of NO chemiluminescence.
    - The influence of water vapor on the T200 measurement can be eliminated with an optional, internal sample gas dryer.
    - The interference of varying CO2 amounts at low concentrations (less than 0.5%) is negligible.
    - In cases with excessively high CO2 concentrations (larger than 0.5%), the effect can be calibrated out by using calibration gases with a CO2 content equal to the measured air.
    - Only very high and highly variable CO2 concentrations will then cause a measurable interference.
    - Smaller less polar and electronically "harder" molecules such as N2 and O2 can cause interference of this type as well, however, the concentrations of N2 and O2 are virtually constant in ambient air measurements, hence provide a constant amount of quenching that is accounted for in the calibration of the instrument.
3. LIGHT LEAKS. The T200 sensitivity curve includes a small portion of the visible light spectrum, therefore it is important to ensure that the reaction cell is completely sealed with respect to light. To ensure this:
    - All pneumatic tubing leading into the reaction cell is opaque in order to prevent light from entering the cell.
    - Light penetration is prevented by stainless steel filters and orifices.

11.1.4 Ozone (Ultraviolet Photometry)

The physical principle used to measure O_3 relies on the absorption of UV radiation by the O_3 molecule. The O_3 molecule has an affinity for specific wavelengths between 240 nm and 320 nm. The affinity peaks in the UV range at approximately 255 nm. Utilizing this phenomenon, and employing the Beer-Lambert relationship (see Equations 11-1 and 11-2), one can measure the quantity of O_3 present in a sample by determining the quantity of UV radiation absorbed along a specified path length. To employ these concepts, a UV photometer splits the sample stream. The first stream is directed into a measurement cell, while the second stream is passed through a catalytic converter to remove all traces of O_3. The measurement cell has a specified length, a UV source at one end, and a photometer at the other end. The analyzer allows a specified time to pass, determined by the cell volume and the sample flow rate, to ensure that a clean, uniform sample is present in the cell. A measurement is taken of this sample over the subsequent, equal time span. Next, the instrument cycles the catalyzed sample into the cell, utilizing the same time spans to insure a clean, O_3-free sample exists in the cell, prior to measuring the O_3-free UV attenuation level. The cycle is then repeated with a new O_3 containing sample.

Equation 11-1 Beer-Lambert relationship

$A = \varepsilon b c$
Where:
A = absorbance
ε = molar absorptivity
b = path length
c = concentration
P = transmitted power
P_0 = initial incident power

The absorbance is the logarithm of the ratio of initial incident power to transmitted power (i.e., $A = \log_{10} P_0/P$). The concentration of O_3 contained in the sample can be calculated based on this relationship. The result is Equation 11-2:

Equation 11-2 Concentration of O_3

$$C = \frac{\log_{10} (P_0/P)}{\varepsilon b}$$

The detection of O3 is subject to interference from a number of sources including, SO2, NO2, NO, H2O, aromatic hydrocarbons such as meta-xylene and mercury vapor. The Model T400's basic method or operation successfully rejects interference from most of these interferents. The O3 scrubber located on the reference path is specifically designed ONLY to remove O3 from the sample gas. Thus, the variation in intensities of the UV light detected during the instrument's measurement phase versus the reference phase is ONLY due to the presence or absence of O3. Thus, the effect of interferents on the detected UV light intensity is ignored by the instrument. Even if the concentration of interfering gases were to fluctuate so wildly as to be significantly different during consecutive reference and measurement phases, this would only cause the O3 concentration reported by the instrument to become noisy. The average of such noisy readings would still be a relatively accurate representation of the O3 concentration in the sample gas. Interference from SO2, NO2, NO and H2O are very effectively rejected by the Model T400. The two types of interferents that may cause problems for the Model T400 are aromatic hydrocarbons and mercury vapor.

1. AROMATIC HYDROCARBONS. While the instrument effectively rejects interference from meta-xylene, it should be noted that there are a very large number of volatile aromatic hydrocarbons that could potentially interfere with ozone detection. This is particularly true of hydrocarbons with higher molecular weights. If the Model T400 is installed in an environment where high aromatic hydrocarbon concentrations are

suspected, specific tests should be conducted to reveal the amount of interference these compounds may be causing.

2. MERCURY VAPOR Mercury vapor absorbs radiation in the 254nm wavelength so efficiently that its presence, even in small amounts, will reduce the intensity of UV light to almost zero during both the Measurement and Reference Phases rendering the analyzer useless for detecting O3. If the Model T400 is installed in an environment where the presence of mercury vapor is suspected, specific steps MUST be taken to remove the mercury vapor from the sample gas before it enters the analyzer.

11.1.5 Particulate Matter (Intermittent operation)

This methodology utilizes precisely weighed filters that are placed in a carefully controlled volumetric flow for a specified period of time. The combination of flow and duration identify a controlled volume that has passed through the clean filter. The mass added to the filter has been applied during the period when the flow was present. Determining the amount of mass added, and dividing by the volume of air filtered, yields a particulate concentration that is an average of the time the flow occurred. These intermittent operating filter monitors require that the filters be changed between each 24-hour sampling period, which usually occurs once every three or six days. The filters are precisely weighed in a lab prior to field installation. They are once again precisely weighed, at the same humidity level as at the initial weighing, after the filtering operation. The resulting difference yields the mass trapped during filtering. Specific information regarding the operation of PM_{10} versus $PM_{2.5}$ particulate monitors is available in BGI Samplers SOP.

Interferences to the FRM PM filter-based sampler include contamination through a build-up of dust and debris. Cleaning of the inlet, VSCC, and downtube should be performed in the field at least once per month. Parts to be cleaned should be removed from the PQ200 sampler prior to cleaning to prevent the introduction of foreign materials or cleaning compounds into the sampler filter assembly and pump. Parts should be clean and dry before they are reinstalled.

11.1.6 Particulate Matter (Continuous)

The BAM-1020 Particulate Monitor automatically measures and records dust concentration by using the principle of beta ray attenuation to provide a simple determination of mass concentration. A small amount of 14C emits a constant source of beta particles that are efficiently detected by an ultra-sensitive scintillation counter. An external pump pulls a measured amount of air through filter tape. The filter tape impregnated with ambient dust is placed between the source and the detector causing the attenuation of the measured beta-particle signal. The degree of attenuation of the beta-particle signal is used to determine the mass concentration of particulate matter on the filter tape and the volumetric concentration of particulate matter in the ambient air. The BAM-1020 is certified as an Equivalent Method for PM_{10} and $PM_{2.5}$ by the US EPA when equipped with the PM_{10} sampling inlet and/or the $PM_{2.5}$ Very Sharp Cut Cyclone (VSCC) and when operated under specific conditions.

Interferences to the BAM measurement cycle are possible. The BAM 1020 monitor is not weatherproof. It is designed to be mounted in a weatherproof, level, low vibration, dust free, and temperature-stable environment where the operating temperature is between 0^{o} C and +50^{o} C, and where the relative humidity is non-condensing and does not exceed 90%. There are two standard configurations described below for providing a weatherproof location in which to install the BAM 1020.

1. A walk-in shelter or building: These are usually semi-portable pre-fabricated shelters or portable trailers with a flat roof, or a room in a permanent building or structure. The BAM 1020 may be placed on a workbench or mounted in an equipment rack. The inlet tube of the BAM must extend up through a hole in the roof of the structure with appropriate sealing hardware. AC power must be available. Instructions for this type of installation are included in this section of this manual.
2. Mini weatherproof enclosures: these small pre-fabricated enclosure are just big enough for the BAM and related accessories, and are installed on the ground or on the roof of a larger building. They are available with a heater, or with a heater and air conditioner. A dual-unit air conditioned mini shelter is also available.

11.1.7 Chemical Speciation Network (Intermittent operation)

The Super SASS accommodates up to eight sampling canisters with active flow controllers on each canister. The Super SASS operates in groups for each flow controller. Each canister has its own $PM_{2.5}$ sharp cutoff cyclone inlet for excluding particles above 2.5 µm, a denuder ring for removing interfering gases and a 47 mm filter holder for collecting ambient fine particles. The canisters are mounted in a wind aspirated radiation shield that maintains sampler temperature close to ambient. The sample flow rate is controlled at a flow rate of 6.7 L/min per canister depending on filter media and denuder material pressures. The $PM_{2.5}$ separation is produced by a sharp cut cyclone (SCC) that removes both solid and liquid coarse particles. The denuders are 25 mm in length and are housed in a 47-mm aluminum sleeve. The filter size (media) used in the sample canister is 47 mm. Each canister can hold either one or two 47-mm filters in tandem. The Super SASS uses four active volumetric flow controllers to provide precise flow control. Volumetric flow rate measurement is made independently for each of the active flow channels using electronic mass flow sensors. The mass flow sensors in conjunction with ambient temperature, and the barometric pressure readings, are used by the control unit microprocessor to calculate the actual volumetric flow. This provides site-specific flow measurements so no correction is needed in the field or for data reporting at true volumetric readings.

The URG accommodates up to four sequential sampling filters located within the sampling module portion of the instrument. Ambient air enters through a screened inlet on the top of the stack. The screened inlet removes bugs, rain and particles larger than approximately 15 µm. The air stream then passes through a cyclone that removes particles larger than 2.5 µm. The cyclone is 50% efficient at removing particles with aerodynamic diameters larger than 2.5 µm at the nominal flow rate of 22.0 liters per minute (L/min). It is volumetric flow controlled using a mass flow controller and corrections are made for temperature and barometric pressure variations. A temperature probe is located in the inlet tee of the Module C. The temperature probe is situated in the air stream just prior to the cyclone. The controller portion of the instrument contains the timer, keypad and memory card slot. This portion of the instrument also houses the barometric pressure sensor. The lower portion of the instrument contains the vacuum pump as well as the mass flow controller, which maintains a constant flow rate during the sampling period.

11.1.8 Meteorology

11.1.8.1 Wind Speed and Wind Direction

The speed of sound in still air can be measured accurately between two points a few centimeters apart by two ultrasonic transducers set at that distance. The resulting speed of sound is a known function of the air temperature and composition. The transit time of a sound signal traveling from one end of a sound path to the other separated by a distance is used to compute the velocity of the air in the path between two opposing transducers.

11.1.8.2 Relative Humidity

The 083E relative humidity sensor measures variance in the capacitance change of a one micron thick dielectric polymer layer. This film absorbs water molecules through a metal electrode, and causes capacitance change proportional to relative humidity. The thin polymer layer reacts very quickly, providing up to 90% of the final value of relative humidity in fewer than five seconds. The sensor's response is essentially linear, with small hysteresis, and negligible temperature dependence.

11.1.8.3 Ambient Temperature

Thermistors have an exponential non-linear resistance curve. Over small ranges of temperature, linearization is achieved with a single resistor. YSI thermilinear components use multiple thermistors and fixed resistors to provide a linear output over wider temperature ranges.

11.2 Sample Collection Methodology

11.2.1 Physical Collection

The physical collection of particulate filter samples, sample transport, and sample preservation techniques adhere to the requirements of 40 CFR Part 50, Appendix J, and the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume II and are described in detail in Appendix A and Appendix E.

11.2.2 Electronic Data Collection

Electronic data collection is possible through the network's data loggers and network connections. This equipment is located in the shelters where the data loggers record the data history. The data loggers are directly connected to AQMD's data management server, and provide a path to download the data for analysis. The data loggers are polled automatically every hour to retrieve data for analysis. Monitoring personnel can also poll the stations manually to retrieve data, determine the status of the systems, or identify problems within the polling schedule.

11.3 Support Facilities

11.3.1 Shelter Design and Criteria

The monitoring station must be designed to meet the operational needs of the equipment, provide an environment that supports sample integrity and allows the operator the ability to safely and easily service and maintain the equipment. Gaseous analyzers must be housed in a shelter capable of meeting the following requirements:

- Shelter temperature maintained between 20 and 30°C.
- Power supply must not vary more than +/-10% from 117 Alternating Current Voltage (ACV).
- Shelter must protect instrumentation from precipitation and excessive dust and dirt and must be cleaned regularly to prevent dust buildup.
- Shelter must provide third wire grounding and meet federal Occupational Safety and Health Administration regulations.

A sample manifold is used to provide air from outside the shelter. The analyzers each have individual pumps that draw ambient air from the manifold. Criteria pollutant analyzers require that the material used for manifolds must be stainless steel, borosilicate glass, or an acceptable inert plastic. EPA has determined borosilicate glass, FEP Teflon® or their equivalent are the only acceptable probe materials for delivering test atmospheres in the determination of reference or equivalent methods, therefore these materials must be the only material in the sampling train (from inlet probe to the back of the analyzer) that can be in contact with the ambient air sample. The manifold must also prevent rainwater from entering the analyzers. AQMD's manifold design uses FEP Teflon® tubing. Figure 11-1 depicts the manifold design found throughout the network. Gas calibrations and QC checks are performed through-the-probe, meaning that the calibration gas travels through all portions of the sample manifold, including the inlet, sample lines, fittings, and inline filters. Routine maintenance of the manifold consists of replacement of the FEP Teflon® once annually to prevent contamination.

Airflow through the manifold must be sufficient to keep the residence time of gases in the manifold below 20 seconds. The airflow through the manifold must also not be so great as to cause the pressure inside the manifold to be more than 1 inch of water below ambient. The residence time of the manifold is determined by using the following equations:
Total Volume = Cv + Mv + Lv

Where:
Cv = Volume of the sample manifold extensions, cm^3
Mv = Volume of the sample manifold, cm^3
Lv = Volume of the instrument lines, cm^3

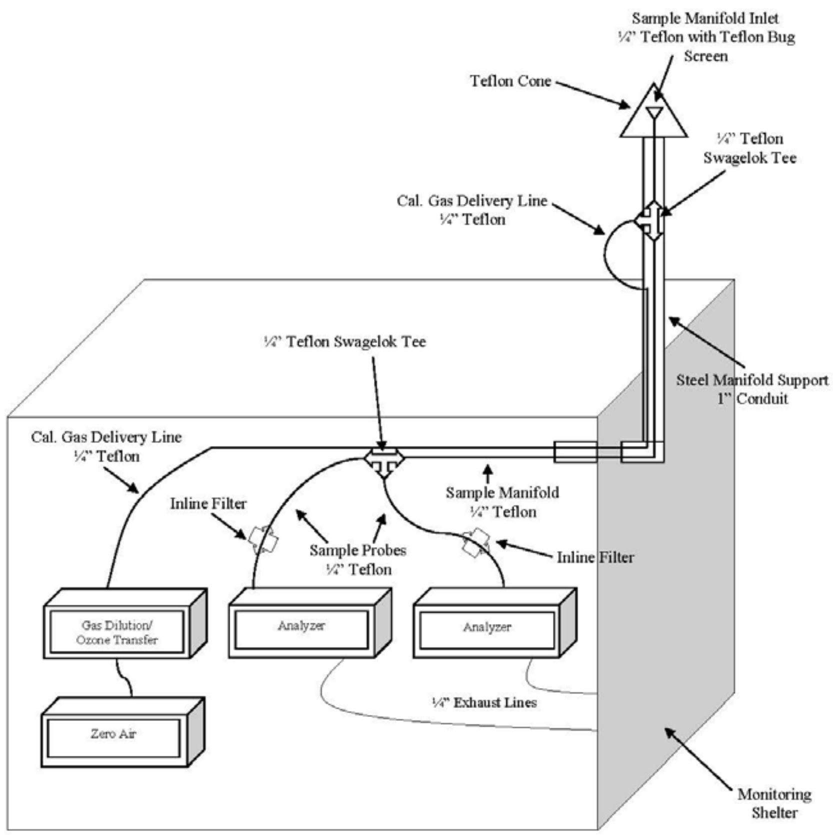
Each of the components of the sampling system must be measured individually. To measure the volume of the components, the following equation will be used:

$$V = \pi * (d/2)^2 * L$$

Where:
V = Volume of the component, cm^3
$\pi = 3.14159$
L = Length of the component, cm
d = inside diameter, cm

When the total volume is determined it is divided by the summed flow rate of all instruments to determine the residence time.

Figure 11-1 AQMD Manifold Design



11.4 AQMD Monitoring Network Samplers

All instruments used in AQMD's Ambient Air Quality Monitoring Network are listed in Table 11-1. For specific details on how each monitor is run, refer to each monitor's specific SOP.

Table 11-1 AQMD Network Criteria Pollutant and NCore Monitors

Criteria Pollutant	Model Designation	EPA Reference / Equivalent	SOP
Carbon Monoxide (CO)	TAPI Model 300EU	RCFA-1093-093	Appendix F
Trace CO	TAPI Model 300EU	RCFA-1093-093	Appendix H
Ozone (O_3)	TAPI Model 400E and T400	EQOA-0992-087	Appendix G
Nitrogen Dioxide (NO_2)	TAPI Model 200EU	RFNA-1194-099	Appendix I
Reactive Oxides of Nitrogen (NO_y)	TAPI Model 200EU with 501	Not Applicable	Appendix I
Trace Sulfur Dioxide (SO_2)	TAPI Model 100EU	EQSA-0495-100	Appendix J
PM_{10} Filter-based	BGI PQ200	RFPS-1298-125	Appendix E
PM_{10} Continuous	Met One BAM 1020	EQPM-0798-122	Appendix D
$PM_{2.5}$ Filter-based	BGI PQ200	EQPM-0202-142	Appendix E
$PM_{2.5}$ Continuous	Met One BAM 1020	EQPM-0308-170	Appendix D
$PM_{10-2.5}$ Filter-based	BGI PQ200 Coarse Pair	RFPS-1208-173	Appendix E
$PM_{10-2.5}$ Continuous	Met One BAM 1020 Coarse Pair	EQPM-0709-185	Appendix D
$PM_{2.5}$ Speciation	Met One SuperSASS URG 3000N	Not Applicable Not Applicable	Appendix BB Appendix CC

11.5 Sample Collection

All samples for criteria pollutants will be collected using FRMs or FEMs. For NCore pollutants, which lack FRMs or FEMs, other methods specified by the EPA will be used. Each monitor will be installed in adherence to procedures, guidance, and requirements detailed in 40 CFR Parts 50, 53 and 58, the sampler's manufacturer's operation manual, the SOP, and other sections of this QAPP. Staff are not allowed to change a sample method or sample probe material without prior approval from the Senior Air Quality Specialist and Monitoring Supervisor. However, staff may "swap out" an instrument with another instrument of the same method without prior approval.

11.6 Sampling/Measuring System Corrective Action

Corrective action measures in the ambient air quality monitoring network will be taken to ensure the DQOs are attained. There is the potential for many types of sampling and measurement system corrective actions. Each approved SOP details some expected problems and corrective actions needed for a well-run monitoring network.

11.7 Analyzer Audits

Audits are performed according to the methodology required by EPA. For each specific method and sampler type, the method followed is according to the procedures outlined in the *Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II. Ambient Air Specific Methods* (EPA-454/B-17-001, January 2017). For each parameter and sampler type, audit procedures are performed following the procedures defined by the approved SOPs.

Section 12: Sample Handling and Custody

The AQMD inspects, equilibrates, weighs, QC's and analyzes all $PM_{2.5}$ and PM_{10} filters sampled in the field. This section describes the sample handling requirements for manual method samples collected in the field. This section will also describe the procedures for sample handling and custody of speciation filters. Detailed laboratory procedures are in the laboratory SOP in Appendix M.

12.1 $PM_{2.5}$ and PM_{10} Sample Handling and Custody Procedures

Sample handling and custody is one of the most important aspects of a quality system. Sample handling procedures must be consistently followed to provide data meeting the DQOs. A sample is considered to be in custody if it is in one's actual physical possession, is stored in a secured area restricted to authorized personnel such as AQMD's repair/filter archival room, or when it is in view after being in one's possession such as when a sample is being analyzed in AQMD's weigh laboratory. To protect a sample from tampering, and to ensure that a sample's history and integrity is known, a chain-of-custody (COC) accompanies each sample.

The COC is a documented trail of who had possession of a sample or group of samples at any specific point from collection through receipt at the laboratory. Custody records must include details of transfers of possession between individuals, between individuals and shippers (when applicable), and to storage at the laboratory and any pertinent details such as storage location and conditions. AQMD uses multiple types of COC forms. Examples of AQMD's COC forms are shown in Figures 12-1, 12-2, 12-3, and 12-4.

12.1.1 Pre-Sample Handling and Custody Procedures

Upon receipt of the Teflon PM filters from EPA, the Senior Air Quality Specialist unpacks and stamps the EPA-provided memo/packing list with the "Received" date (see Figure 12-1). The Senior Air Quality Specialist then gives the filters to the Laboratory Manager. The Laboratory Manager is designated as the Sample and COC custodian. The Lab Manager labels each box of filters with the year of use and a letter, so that the filters are used in a first-in, first-out basis. The filters are inspected by the Lab Manager, placed in a petri slide, labeled with the filter number, logged on the Teflon Filter Inspection/Conditioning Log (see Figure 12-2), arranged in a filter equilibration tray with lid, and allowed to equilibrate in the required laboratory conditions for three months. The equilibration tray is kept in a glass-doored cabinet in the laboratory. The petri slides, equilibration trays with lids, and glass-doored cabinet are used to ensure that samples are not tampered with. After the initial equilibration, pre-sample filters are pre-weighed by the Lab Manager and recorded on a PM Filter Weigh Log (see Figure 12-3 for an example). 10 percent of the filters are then re-weighed by an Air Quality Specialist other than the Lab Manager. The filters are then ready for use in the field and are stored in the laboratory. Filters ready for field use must be used within 30 days of the pre-weight.

12.1.2 Handling/Transporting Samples to the Field

The Lab Manager prepares filters for a sample run, which includes marking the filter petri slide with the sample run date, day, and instrument name, loading the filters into cassettes with the corresponding instrument name, and placing filter cassettes in a filter transport case. A hardcopy Field Sample Report (see Figure 12-4) is created by the Lab Manager for each sample filter. The Lab Manager transports the filters to the monitoring station, installs the filters for the sample run, and logs the sample installation date and time on the Field Sample Report (Figure 12-4).

12.1.3 Handling/Transporting Samples from the Field

After a run, the Lab Manager collects the samples within 48-hours, places the corresponding caps back on the filter cassette, and records the removal date, time, and instrument parameter values on the Field Sample Report (Figure 12-4). The filter cassettes are placed back in the filter transport case, and are transported directly back to the laboratory inside of a temperature-monitored cooler with blue ice packs. When samples arrive back to the laboratory, the maximum transport temperature is recorded on the Field Sample Report, and are stored in a refrigerator at 4°C until post-weigh activities occur. The start date and time of the refrigeration is recorded on the Field Sample Report. Post filters must be weighed within 30 days of refrigerated storage.

12.1.4 Post-Sample Handling and Custody Procedures

Post samples are removed from refrigerated storage by the Lab Manager and equilibrated in the laboratory under the required temperature and relative humidity requirements for a minimum of 24-hours and less than 10 days. The post-sample conditioning start date and time is logged on the Field Sample Report. After a minimum of 24-hours, post-sample conditioning end date and time is recorded on the Field Sample Report, and a set of filters are then weighed by the Lab Manager. The weigh session is recorded on a PM Filter Weigh Log (see Figure 12-3 for an example) and concentration loading of the samples is calculated. Again, 10 percent of the filters are re-weighed by an Air Quality Specialist other than the Lab Manager, and all concentration calculations are re-checked by the same Air Quality Specialist. After weighing, post-samples are then placed in storage for five years with the first year refrigerated. The hardcopy Field Sample Reports are retained by the Data Manager. See Appendix E for detailed procedures on $PM_{2.5}$ and PM_{10} sampling.

Figure 12-1 EPA Teflon Filter Memorandum

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Assessment Division
Ambient Air Monitoring Group
109 T.W. Alexander Dr., Research Triangle Park, NC 27711

RECEIVED
04/10/19
GAP.

MEMORANDUM

SUBJECT: PTFE Filters for Use in Calendar Year (CY) 2019

FROM: Solomon Ricks 3/21/2019
Ambient Air Monitoring Group (C304-06)

TO: Calendar Year 2019 PTFE Filter Users

This memorandum summarizes characteristics of the polytetrafluorethylene (PTFE) filters which will be used for CY 2019. Calendar year 2019 PTFE filters are supplied by Measurements Technology Laboratory.

You have already received at least thirty percent of your CY 2019 filters from our CY 2018 surplus. This shipment contains your full order of CY2019 filters. As a result, if your filter needs remain the same, you will now have enough filters to last through March 2020.

Test results show that some filters exceeded the 30 cm H_2O allowable pressure drop at 16.67 liters/minute. After discussions with the manufacturer, a review of the performance characteristics of sampling equipment, and additional testing, EPA decided to accept the filters.

If you have any problems or other comments concerning the use or quality of the filters, please contact me at the above address, via email ricks.solomon@epa.gov, or 919-541-5242. State and local agencies should also report the same information to their Regional Office Quality Assurance Coordinator.

Any agency that distributes filters to other local agencies in their Region or State should transmit a copy of this memorandum to them. This memorandum is mailed only to those agencies that have received filters directly from us.

Attachments:
Table 1. Summary of CY 2019 PTFE Filter Acceptance Testing Results for Use in CY 2019
Table 2. Summary of CY 2018 PTFE Filter Acceptance Testing Results for Use in CY 2019 (updated)
Table 3. Trace Element Acceptance Criteria for PTFE Filters for Use in CY2019

cc: Regional Office Air Monitoring Coordinators
Regional Office Quality Assurance Coordinators
Solomon Ricks (EPA)
David Elam (TRC)

Number of boxes of PTFE filters ordered for CY 19	3
Number of boxes of PTFE filters previously shipped for CY 19	3
Number of boxes of PTFE filters shipped for CY 19	6
Number of Cartons in Shipment	1

Internet Address (URL) • http://www.epa.gov
Recycled/Recyclable • Printed on Recycled Paper (Minimum 50% Postconsumer content)

Figure 12-2 Teflon Filter Inspection/Conditioning Log

Washoe County District Health Department
Air Quality Management Division
Teflon Filter Inspection/Conditioning Log

Conditioning Tray Number	Lot Number	Filter ID Number Ranges From	To	Conditioning Start Date	Inspector Initials	Reject Filters/Comments

File Name: Filter Inspection Conditioning Log.xls
Reviewed: 03/19/2015

Figure 12-3 Example PM Filter Weigh Log

Washoe County Health District - Air Quality Management Division
PM Filter Weigh Log

Balance:	Sartorius MSE6.6S	**Date:**	11/14/19
S/N:	27602434	**Time (PST):**	0840
Cert. Date:	04/16/19	**Analyst:**	MKC

Weigh Room Conditions

RH 24-hr Avg (%):	35.9	SD:	1.3	Criteria Passed? [1]	Y
Temp 24-hr Avg (°C):	21.6	SD:	0.5	Criteria Passed? [2]	Y

Batch Type

Pre Sample:	X	Post Sample:	

Post Sample Batch Only

Through Filter ID:	N/A	Through Filter ID:	N/A
Pre Sample RH 24-hr Avg (%):		Pre Sample RH 24-hr Avg (%):	
Post Sample RH 24-hr Avg (%):		Post Sample RH 24-hr Avg (%):	
Difference:	0.0	Difference:	0.0
Criteria Passed? [3]	Y	Criteria Passed? [3]	Y

Sample	Filter ID	Weight (mg)	Verified Weight (mg)	Difference	Criteria Passed? [4]	Comments
400 mg	ws83551	400.002	400.002	0.000	Y	
300 mg	ws65511	299.999	300.000	-0.001	Y	
Lab Blank	T8553647	373.880				
Filter	T8553649	371.250				
Filter	T8553650	366.497				
Filter	T8553701	361.550				
Filter	T8553702	357.595				REWEIGH
Filter	T8553703	358.909				
Filter	T8553704	360.581				
Filter	T8553705	369.171				
Filter	T8553706	368.951				
Filter	T8553707	370.036				
Filter	T8553708	365.489				

Sample	Filter ID	Reweigh (mg)	Verified Weight (mg)	Difference	Criteria Passed? [4,5]	Comments
400 mg	ws83551	400.001	400.002	-0.001	Y	
300 mg	ws65511	299.999	300.000	-0.001	Y	
Reweigh	T8553702	357.595	357.595	0.000	Y	

Sample	Filter ID	QC Weight (mg)	Verified Weight (mg)	Difference	Criteria Passed? [4,5]	Date	Initials
300 mg QC	ws65511	299.999	300.000	-0.001	Y	11/14/19	DRT
Filter QC	T8553708	365.491	365.489	0.002	Y	11/14/19	DRT

Acceptance Criteria

1. RH 24-hr average must be between 30 and 40% with SD ≤ 5 to meet acceptance criteria.
2. Temp 24-hr average must be between 20 and 23°C with SD ≤ 3 to meet acceptance criteria.
3. Pre sample RH and post sample RH must be +/- 5% to meet acceptance criteria.
4. Working standards must be within +/- 3 µg of the verified weight (true mass) to pass.
5. Reweigh and QC weights must be within +/- 15 µg of the batch weight to pass.

File Name: 20191114_PRE_A
Reviewed: 11/02/16

Figure 12-4 Field Sample Report

Washoe County Health District - Air Quality Management Division
Field Sample Report

Site: *Reno 3*
Sampler: *BGI, Inc.* Model: *PQ 200*

S/N: ID:	*790* *$PM_{2.5}$*	*794* *PM_{10}*	*FB*

Filter Number: ______

Sample Date: ______ Su M T W Th F Sa

Weigh by: ______

Pre Weighed on: ______

Post Weighed on: ______

Chain of Custody

Action	Date	Time (PST)	Cap ID	Operator
Sample Installed				
Sample Removed				
Sample Refrigerated				

Conditioning

Pre Conditioning Start			---	
Pre Conditioning End			---	
Post Conditioning Start			---	
Post Conditioning End			---	

Sample Summary

	Date	Time (PST)
Sample Start:		
Sample Stop:		
Elapsed Time:		

	Avg.	Max.	Min.	
T_A:				°C
Press:				mmHg
Flow:		---	---	lpm

Total Volume: ______ m^3

Flow Rate CV: ______ %

Flags: ______

Max Transport Temp: ______ °C

Operator Comments:

______

Filter Loading and Concentration

	Mass	Reweigh	Date	Analyst
Post-Sample:	. mg	. mg		
Pre-Sample:	. mg	. mg		
Loading:	µg			

Concentration: . µg/m^3

PM_{10}		$PM_{2.5}$ Designated		PM_{COARSE}
. µg/m^3	-	. µg/m^3	=	. µg/m^3

Laboratory Comments:

______

File Name: FIELD SAMPLE REPORT 3
Reviewed: 10/02/19

12.1.5 Use of Make-up PM Samples

Scheduled PM samples may be missed due to a variety of situations including: (1) sampler malfunction, (2) power outage, and (3) filter problems. Make-up samples are optional and should be encouraged whenever the achievement of minimum data capture goals are not likely. Although the use of make-up sampling will enhance overall data capture, they are not required. The EPA recognizes that make-up sampling causes additional work for the site operator and may or may not be possible depending on the time when the missing or invalidated sample is discovered. The number of make-up samples permitted in any calendar quarter should be limited to no more than 5 samples. Normally, AQMD should only rarely have make-up samples.

There are options for the selection of a make-up sampling day. The approach utilized should be chosen in accordance with the following priorities. In all cases, a make-up sampling day must be no later than 1 week from the missed sampling day.

- For monitoring sites sampling every third day, the earliest possible day before the next scheduled sample at the monitoring site is suggested. Although there are only two possible make-up days with 1 in 3 day sampling, selection of a replacement day as close as possible to the missing day increases the chances of a replacement day with similar meteorological conditions.
- Alternative approach: Sample one week later, on the same calendar day. This provides a replacement day on the same day of the week, thereby helping with temporal balance for the quarterly data set to reduce any potential day of the week effect of emissions.

A “make-up” day becomes a replacement for a scheduled day. Like scheduled days, these 24-hour periods (midnight to midnight) are selected without prior knowledge of pollution potential and may be used without prejudice in making comparisons to the National Ambient Air Quality Standards. Until notified otherwise, all make-up days should be treated the same as scheduled samples and reported under the same pollutant occurrence code (POC) as scheduled samples.

12.2 $PM_{2.5}$ Speciation Sample Handling Procedures

$PM_{2.5}$ Speciation samples include SASS filter canisters and URG Carbon sample filters received from Wood Group, the EPA-contracted laboratory. Wood Group also provides the shipping and sampling schedule. Sample filters are received in a large insulated box with corresponding Chain of Custody forms and Null Data forms. Upon receiving the sample filters, AQMD staff unpacks the sample filters, places the ice packs in the freezer and signs the Sample In on the Chain of Custody (COC) forms. The sample filters are then given to the site operator for installment in the field. After a run, samples are pulled as soon as possible by the site operator. All sample run information is recorded on the COC forms and any flags are marked on the Null Data forms and the form is signed by the operator. The samples are then taken back to the laboratory for refrigeration until the scheduled shipping day. On the shipping day, the samples are removed from refrigeration, placed in the same insulated box used for shipping to AQMD, and the frozen ice packs are placed around the samples. The COC forms are signed by the shipper on the Sample Out line and the white copies are included in the box to be shipped back to Wood Group by UPS. The yellow copies are retained in a binder in the shipping area. See Appendices BB and CC for detailed procedures on SASS and URG sampling.

12.3 Lead (Pb) Sample Handling Procedures

AQMD does not currently monitor for lead.

12.4 Air Toxics Sample Handling Procedures

AQMD does not currently monitor for air toxics.

Section 13: Analytical Methods

This section will identify the equipment and analytical methods required to complete the analyses of the samples obtained from the monitoring network. Where appropriate, the analytical methods will be identified by the regulatory citation, number, and date.

13.1 Purpose/Background

The analytical method employed for a specific criteria pollutant evaluation is dependent upon the monitoring technology utilized. For the gaseous criteria pollutants, SO_2, CO, NOx, and O_3, the analyzers are designed as completely contained monitoring units that do not require additional analytical methods to establish the pollutants' environmental concentrations. The particulate matter criteria pollutants, PM_{10}, and $PM_{2.5}$, do require analytical methods to evaluate the captured sample in order to establish the pollutant concentrations present in the environment.

The FRM used by the AQMD for particulate matter monitoring utilizes gravimetric analyses. The AQMD laboratory conducts the analyses of all filters collected in the field. A filter's net weight gain identifies the sample characteristic of interest, captured particulate mass. This net weight gain is obtained by subtracting the initial filter weight from the final weight of the exposed filter. Once calculated, the net weight gain can be used with the total filter volume 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 (e.g., subsequent chemical analyses), the filters will be archived for a minimum of five years after final gravimetric analyses has occurred.

13.2 Preparation of Samples

The AQMD BGI PQ200 $PM_{2.5}$ and PM_{10} Particulate Matter Samplers SOP (Appendix E) outlining activities associated with preparing pre-sample batches will be followed. In addition to the primary and collocated sample filters, field blanks, lab blanks, and flow check filters will also be prepared in the laboratory. Upon delivery of EPA approved 46.2 mm Teflon filters, their receipt will be documented, and the filters stored in the conditioning/weighing room. Each box of filters will be labeled with the date of receipt, opened one at a time, and used completely before another is opened. Filters are utilized on a first-in, first-out basis. All filters in a lot will be used before a case containing another lot is opened. Filters will be visually inspected according to the FRM inspection criteria. Filters will then be stored in a filter conditioning room in Petri slides. The minimum initial conditioning period is three months prior to weighing.

13.3 Analysis Method

13.3.1 Analytical Equipment and Methods

The analytical instruments employed for sample analysis of the gaseous criteria pollutants have been identified and their specific technological methods detailed in Section 11, including possible interferences to each analysis method. The analytical instrument (microbalance) that will be used for gravimetric analysis of the BGI PQ200 FRM $PM_{2.5}$ and PM_{10} sampler methods will have a readability of 1µg and a repeatability of 1µg. The microbalance will be serviced and calibrated annually by a third-party vendor to satisfy the initial calibration verification (ICV) and the continuing calibration verification (CCV). The service and calibration records are stored digitally on AQMD servers and the hard copies are stored in the lab.

13.3.2 Conditioning and Weighing Room

The primary support facility for the $PM_{2.5}$ and PM_{10} network is the filter conditioning and weighing room located in the office of the AQMD. This laboratory is used to conduct pre-exposure weighing and post-exposure weighing of each $PM_{2.5}$ and PM_{10} filter. The laboratory is an environmentally controlled room with temperature and humidity controls. The temperature is controlled between 20 and 23 °C with a 24-hour variability of < +/- 2°C. The relative humidity is controlled between 30 and 40% with a 24-hour variability of < +/- 5% RH. The temperature and relative humidity are measured and recorded continuously during equilibration. The balances are located on marble slabs to limit interferences from vibration. They are protected from or located out of the path of any sources of drafts in a laminar flow hood. The filters are conditioned before both the pre-exposure and post-exposure weighing activities. Pre-exposure filters are conditioned for a minimum three-month period, while post-exposure filters are conditioned for 24 hours before weigh session. The AQMD follows the specific requirements for environmental control of the conditioning/weighing room which are detailed in 40 CFR Part 50, Appendix L.

13.4 Internal Quality Control and Corrective Actions for Measurement Systems

A QC notebook or database (with backups) will be maintained and will contain QC data, including the microbalance certification and maintenance information, routine internal QC checks of mass reference standards, QC checks of filter batches, laboratory and field filter blanks, and external QA audits. This data will duplicate data recorded on laboratory data forms but will consolidate them so long-term trends can be identified. At the beginning of each weighing session the analyst will zero the microbalance and weigh the working standards before the filters. One lab blank and one field blank will be weighed for every 10 samples for the $PM_{2.5}$ filters. The balance will be re-zeroed between each weighing and after every tenth filter weighing and the working standards will be reweighed. The analyst will record the working standard and lab blank measurements on the PM Filter Weigh Log. If the working standard measurements differ from the certified values or the pre-exposure values by more than 3 µg, the analyst will repeat the working standard measurements. If the $PM_{2.5}$ lab blank measurements differ from the pre-exposure values by more than 15 µg, the analyst will repeat the blank measurements. If the two measurements still disagree, the analyst will contact the laboratory manager, who may direct the analyst to:

- reweigh some or all of the previously weighed filters;
- recertify the working standard against the laboratory primary standard;
- conduct diagnostic troubleshooting; and/or
- arrange to have the original vendor or an independent, authorized service technician troubleshoot or repair the microbalance.

Corrective action measures in the filter program will be taken to ensure good quality data. Filter preparation and analysis checks along with corrective actions are detailed in the BGI SOP located in Appendix E. Filter weighing will be delayed until corrective actions are satisfactorily implemented.

13.5 Filter Sample Contamination Prevention

The QA component of the PM network has rigid requirements for preventing sample contamination. Filters are equilibrated/conditioned and stored in the same room where they are weighed. The weigh laboratory is equipped with a "sticky mat" just outside the door in an air lock to limit dust contamination and air mixing. All horizontal laboratory surfaces are dusted and the floor is cleaned with disposable wet mop weekly. Extreme care is taken while handling all filters and only handled with smooth, non-serrated forceps. All filters are run through Staticmasters prior to weighing to limit interference due to static electricity. Upon determination of its pre-exposure weight, the filter is placed in a protective Petri slide for filters. The Petri slides are labeled with a unique ID, originating from the filter number. Once the filters are taken outside of the weigh room, they will remain enclosed to minimize damage.

Section 14: 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 QA activities, such as establishing policies and procedures, developing DQOs, 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.

Quality control is the overall system of technical activities that measure the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the end user. In the case of the Ambient Air Quality Monitoring Network, QC activities are used to ensure that measurement uncertainty is maintained within acceptance criteria for the attainment of the DQOs. Lists of pertinent QC checks are provided in the SOPs and instrument manuals.

14.1 Quality Control Procedures

Quality control is achieved through periodic maintenance, flow rate audits, acceptance test procedures, precision and accuracy checks, collocated instruments, control charts, and other verification techniques. The AQMD utilizes the MQOs and Validation Templates in the EPA *Quality Assurance Handbook for Air Pollution Measurement Systems Volume II, Appendix D.* and the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: meteorological Measurements Version 2.0. These MQOs and Validation Templates compile all the necessary QC for each pollutant. Refer to the individual SOP for each instrument type to identify QC procedures in more detail, located in the appendices of this document.

14.1.1 Calibration Scale

Calibration scale is used to indicate the concentration range that the instrument is calibrated over. EPA regulations provide some flexibility on how monitoring organizations chose the QC concentration ranges. AQMD's calibration scales are summarized in Table 14-1 below, and are selected based on the maximum 1 hour concentrations for each pollutant multiplied by 2, then rounded up to the nearest hundred.

Table 14-1 AQMD Calibration Scale

Pollutant	FRM/FEM Approved Scale	AQMD Calibration Scale
CO	Any range between 0-10 and 0-50 ppm	0-10 ppm NCore 0-50 ppm SLAMS
NO2	Any range between 0-50 and 0-1000 ppb	0-500 ppb
O3	Any range between 0-100 and 0-1000 ppb	0-200 ppb
SO2	Any range between 0-50 and 0-100 ppb	0-100 ppb

14.1.2 Gaseous Analyzer Span/Zero Checks

Nightly CO, O_3, and SO_2 span/zero checks are performed at the NCore monitoring station using automatic calibrations programmed into the data logger. Automatic NOx and NOy span/zero checks are performed at the NCore monitoring station every third night. Span levels are set at 90% of full-scale of the instrument being tested. Difference from zero (see Equation 1) and percent deviation (see Equation 2) for automatic calibrations are calculated by the data logger and data management software.

Equation 14-1 Difference

$$difference = site - standard$$

Equation 14-2 Percent Deviation

$$percent\ deviation = \frac{site - standard}{standard} \times 100$$

If any span or zero point is outside the specifications in the MQOs and Validation Templates, a calibration must be performed. Refer to the individual SOP for each instrument type for more detailed information regarding span/zero checks.

14.1.3 Gaseous Analyzer Zero/Precision/Span Checks

Weekly CO, O_3, and SO_2 zero/precision/span (z/p/s) checks are manually performed at the NCore station by the station operator. Bi-weekly CO and O_3 z/p/s checks are manually performed at the SLAMS stations by the station operator. Precision checks are also referred to as 1-point QC checks. As described in the May 5, 2016 EPA Technical Note titled, *Guidance on Statistics for Use of 1-Point QC Checks at Lower Concentrations as described in 40 CFR Part 58 Appendix A Section 3.1.1*, 1-point QC check levels are between the prescribed range of 5 and 80 ppb for O_3, SO_2, and NO_2 and between 0.5 and 5 ppm for CO. Difference from zero (see Equation 14-1) and percent deviation (see Equation 14-2) for manual checks are calculated by Excel worksheets. If any zero, precision, or span point is outside the specifications in the MQOs and Validation Templates, a calibration must be performed. Refer to the individual SOP for each instrument type for more detailed information regarding z/p/s checks.

14.1.4 Gaseous Analyzer Calibrations

A zero and/or span adjustment is performed when the zero or span point is outside the specifications in the MQOs and Validation Templates. Adjustments are only made after completing a weekly or biweekly z/p/s check. Refer to the individual SOP for each instrument type for more detailed information regarding calibrations.

14.1.5 Gaseous Analyzer Multipoint Verifications

A multipoint verification is performed annually on analyzers that have nightly span/zero checks, semi-annually on analyzers without nightly span/zero checks, weekly on NOx and NOy analyzers at the NCore station, and any time a span adjustment is made to an analyzer. A multipoint verification must be completed before any other adjustments are made to the analyzer. Multipoint verifications consist of a zero and 4 upscale points, encompassing the full calibration scale of the instrument. Refer to the individual SOP for each instrument type for more detailed information regarding multipoint verifications.

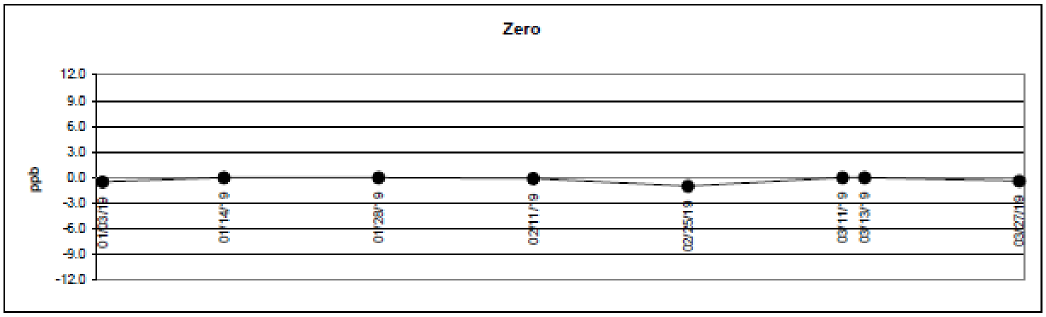
14.1.6 Control Charts

Control charts are used to provide a graphical means of determining whether various phases of the measurement process are in statistical control. The control charts will be utilized as an “early warning system” to evaluate trends in precision and bias. AQMD plots zero, precision, and span points on the control charts to watch for drift over time. An example of a control chart is shown in Figure 14-1.

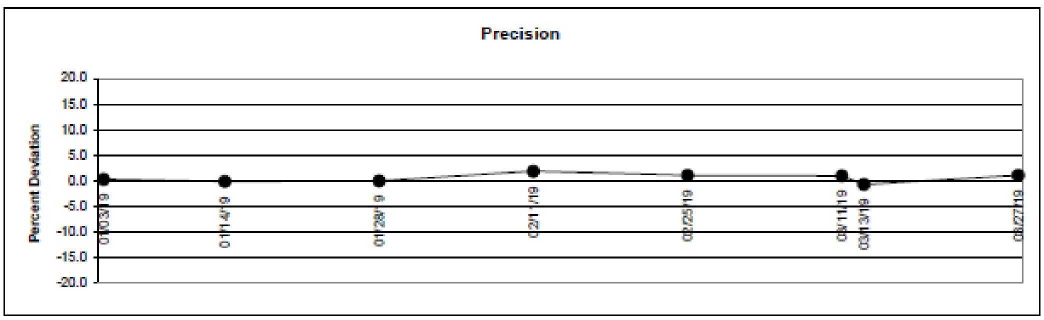
Figure 14-1 Carbon Monoxide Control Chart

Ozone Control Chart

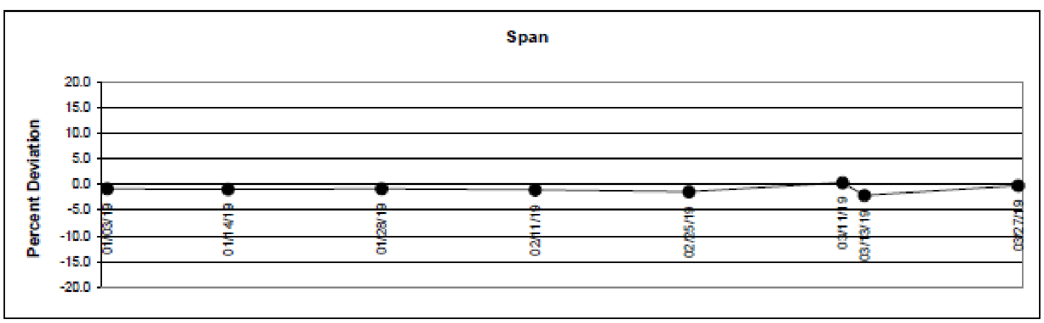
Site:	Spanish Springs	**Instrument:**	TAPI
Year:	2019	**Model:**	T400
Quarter:	1st	**Serial #:**	2789



Zero Drift Limits: 0 - 3 ppb, no adjustment necessary
4 - 10 ppb, adjust analyzer
>10 ppb, invalidate data and recalibrate



EPA Acceptance Criteria: <7% dev.



Span Drift Limits: 0 - 3.4% dev., no adjustment necessary
3.5 - 7% dev., adjust analyzer and run multipoint
>7% dev., invalidate data and recalibrate

Notes: 01/14/19 Multipoint
03/13/19 Qtrly audit

14.1.7 PM Monitor Verifications

Bi-weekly time, temperature, pressure, leak, and flow verifications are completed on all continuous PM monitors. Monthly time, temperature, pressure, leak, and flow verifications are completed on all filter-based PM samplers. The percent deviation (see Equation 14-1) between the monitor's indicated flow and the actual flow measured by the flow standard is calculated by an Excel worksheet. The difference between the monitor's indicated temperature/pressure and the actual temperature/pressure measured by the temperature and pressure standard is also calculated by an Excel worksheet. If any time, temperature, pressure, leak, or flow verifications are outside the specifications in the MQOs and Validation Templates, a calibration must be performed. Refer to the individual SOP for each instrument type for more detailed information regarding PM monitor verifications.

14.1.8 Collocated Sampling

Title 40 CFR 58, Appendix A, Section 3.2.5 requires 15 percent (at least 1) of the continuous FEM $PM_{2.5}$monitors be collocated. The first collocated monitor must be a designated FRM monitor. AQMD meets this requirement by having the primary $PM_{2.5}$FEM monitor at the NCore station collocated by with a $PM_{2.5}$FRM sampler. The sampling frequency for the collocated FRM is 1 in 3 days.

Title 40 CFR 58, Appendix A, Section 3.3.1 requires 15 percent (at least 1) of the manual method samplers be collocated. Being that AQMD only runs one manual method sampler for the calculation of $PM_{10-2.5}$ at the NCore station, and all of the primary PM_{10} monitors are continuous methods, there is no collocation requirement.

14.1.9 Field Blanks

As required by 40 CFR 50, Appendix L, AQMD installs one filters pre-weighed with the routine samples into the $PM_{2.5}$FRM sampler every other week as a field blank. No flow is passed through the filter. The field blank is re-weighed with the routine samples, and then the initial/final weights are compared. The validation acceptance criteria for field blank is +-/ 30 µg between weighings.

14.1.10 Invalid QC Checks

There are instances when some QC checks may be considered invalid. These are not regarding an exceedance of a percent deviation or difference in the acceptance criterion, but rather, when something goes wrong with the QC check itself. Examples of this include failures and/or malfunctions of dilution calibrators, zero air generators, flow standards, temperature standards, and pressure standards. If a failed QC check is suspected to be caused by failed and/or malfunctioning standards, the QC check will be run again with a different set of NIST traceable standards.

14.2 Performance Evaluations

Performance evaluations (PEs) are 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. EPA also uses it to evaluate instrument performance.

14.2.1 Internal Audits

AQMD performs internal audits on all gaseous, PM, and meteorological monitoring instrumentation in accordance with EPA regulations. An air quality specialist independent of the specialist that routinely runs the instrumentation uses an independent set of "audit" standards to complete the evaluation. The evaluation is made by challenging the monitor with audit gas standards of known concentration from at least three audit levels from Table 14-2 below. EPA regulations state that one point must be within two to three times the method detection limit of the instruments within the PQAOs network, the second point will be less than or equal to the 99th percentile of the data at the site or the network of sites in the PQAO or the next highest audit concentration level. The third point can be around the primary NAAQS or the highest 3-year concentration at the site or the network of sites in the PQAO. An additional 4th level is encouraged for those agencies that would like to confirm the monitors' linearity at the higher end of the operational range.

Table 14-2 Expanded Audit Levels

Audit level	Concentration Range, ppm			
	O_3	SO_2	NO_2	CO
1	0.004–0.0059	0.0003–0.0029	0.0003–0.0029	0.020–0.059
2	0.006–0.019	0.0030–0.0049	0.0030–0.0049	0.060–0.199
3	0.020–0.039	0.0050–0.0079	0.0050–0.0079	0.200–0.899
4	0.040–0.069	0.0080–0.0199	0.0080–0.0199	0.900–2.999
5	0.070–0.089	0.0200–0.0499	0.0200–0.0499	3.000–7.999
6	0.090–0.119	0.0500–0.0999	0.0500–0.0999	8.000–15.999
7	0.120–0.139	0.1000–0.1499	0.1000–0.2999	16.000–30.999
8	0.140–0.169	0.1500–0.2599	0.3000–0.4999	31.000–39.999
9	0.170–0.189	0.2600–0.7999	0.5000–0.7999	40.000–49.999
10	0.190–0.259	0.8000–1.000	0.8000–1.000	50.000–60.000

Although AQMD does not currently run audit points down to two to three times the method detection limit, beginning in 2020, it plans on researching what is necessary to complete the evaluations at these low levels. AQMD will start with three times the Federal MDL levels, and run audit points in the ranges shown in Table 14-3 below. After some testing, AQMD may move to an "alternative MDL", which is created after determining MDLs on their monitors following EPA's procedure for the estimation of detection limit. The alternative MDL will be reported to AQS if it is used.

Table 14-3 AQMDs Annual Performance Evaluation Levels

Audit Level Description	Concentration Range, ppm				
	O_3	Trace SO_2	NO_2	Trace CO	CO
3 times MDL	0.006-0.019	0.0003-0.0029	0.0080-0.0199	0.060-0.199	0.900-2.999
$\leq 99^{th}$ Percentile	0.040-0.069	0.0030-0.0049	0.0200-0.0499	0.900-2.999	3.000-7.999
~NAAQS	0.070-0.089	0.0500-0.0999	0.0500-0.0999	8.000-15.999	8.000-15.999
Span (Linearity)	0.170-0.189	0.0500-0.0999	0.3000-0.4999	8.000-15.999	40.00-49.999

If any audit result falls outside of the specifications set in the MQOs and Validation Templates, a Corrective Action Request (Figure 14-2) is completed and issued to the routine instrument operator.

14.2.2 External Audits

14.2.2.1 National Performance Audit Program (NPAP)

Monitoring organizations operating SLAMS are required to participate in the NPAP by providing adequate and independent audits for its monitors as per Section 2.4 of 40 CFR Part 58, Appendix A. Organizations participating in the NPAP can choose to partake either through self-implementation or through federal implementation. AQMD uses EPA contractors to complete the NPAP audits.

14.2.2.2 $PM_{2.5}$Performance Evaluation Program (PEP)

The PEP is a quality assurance activity which will be used to evaluate measurement system bias of the $PM_{2.5}$monitoring network. The strategy is to collocate a portable PEP instrument with an established routine air sampler/monitor, operate both monitors in exactly the same manner, and then compare results. EPA has made arrangements to implement this audit for AQMD using independent contractors.

14.2.2.3 Technical Systems Audits (TSAs)

A TSA is an on-site review and inspection of a monitoring organization's ambient air monitoring program to assess its compliance with established regulations governing the collection, analysis, validation, and reporting of ambient air quality data. TSAs of AQMD is conducted every 3 years by EPA Region 9.

Figure 14-2 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ____________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ____________________________

Problem Identification:

Site: ____________________________
System: ____________________________
Date: ____________________________
Time: ____________________________
Nature of Problem: ____________________________

Recommended Action: ____________________________

Signature: ____________________________ Date: ______________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________________
Time corrective action taken: ____________________________
Corrective Action Summary: ____________________________

Signature: ____________________________ Date: ______________

QA Manager Signature: ____________________________ Date: ______________

Supervisor Signature: ____________________________ Date: ______________

Director Signature: ____________________________ Date: ______________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

14.3 Laboratory QC Checks

14.3.1 Balance Checks

Balance checks are frequent checks of the balance working standards (300 and 400 mg standards) against the laboratory balance to ensure that it is within acceptance criteria throughout weighing sessions. The AQMD 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 each weighing session. Additionally, one will be selected for a measure after every 10 filters during a QC check.

14.3.1 Lab Blanks

Weighing lab blanks is required under 40 CFR Part 50, Appendix L, Section 8.3.7.2. A lab blank is a filter that is inspected, equilibrated, pre-weighed with a specific batch of filters, post-weighed with the same batch or subset of that batch of filters, and two weights compared. AQMD replaces the lab blank filter annually, and re-weighs it with every batch of filters to provide an estimate of contamination that may be occurring during laboratory activities. The validation acceptance criteria is +/- 15 µg between weighings.

Section 15: Instrument/Equipment Testing, Inspection and Maintenance Requirements

15.1 Purpose/Background

The purpose of this section 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 must be documented and filed. See Section 9 for document and record details.

15.2 Acceptance Testing

All gaseous criteria and particulate matter pollutant monitors used in the AQMD Ambient Air Quality Monitoring Network shall be certified to adhere to EPA equivalent or reference methods. Therefore, they are assumed to be of sufficient quality for the data collection operation. Prior to field installation, AQMD staff will assemble and run the particulate samplers at the repair facility. The 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, AQMD will contact the vendor for initial corrective action. Once installed at the site, the field operators will again run the tests listed above. If the sampling instrument meets the acceptance criteria, it will be assumed to be operating properly. Prior to field installation of the gaseous criteria pollutant monitors, the analyzers shall successfully undergo zero/span and multi-point calibrations. Following site installation, field operators will initiate, observe, and document the successful completion of a zero/span cycle. If the analyzers meet the acceptance criteria, they will be assumed to be operating properly. Method detection limit (MDL) are provided by the instrument manufacturer. These tests will be properly documented and filed as indicated in Section 9. If acceptance testing fails, instruments are troubleshot and/or sent back to manufacturer under warranty. All acceptance testing results are documented in the instrument logbook.

15.3 Inspection

A discussion of the necessary inspections of various equipment and components is provided here. Inspections are subdivided into two sections: one pertaining to conditioning/weighing room issues and one associated with field activities.

15.3.1 Inspections in Conditioning/Weighing Room

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

Table 15-1 Inspections in Conditioning/Weighing Room

Item	Frequency	Parameter	Corrective Action	Documentation
Temperature	Daily	20-23°C, < +/- 2°C variability over 24-hours	If outside parameters, check temperature control system and call maintenance	Record in lab logbook and notify lab manager
Relative Humidity	Daily	30-40%, < +/- % RH variability over 24-hours	If outside parameters, check humidity control system and call maintenance	Record in lab logbook and notify lab manager
Dickson Chart	Weekly	Replace/ Download	Ensure correct time and date	Record in lab logbook
Debris Mat in Airlock	Weekly	Replace	Ensure new mat is free of dirt/debris	Record in lab logbook
Surfaces and Floor	Weekly	Inspect	Dust surfaces and mop floor	Record in lab logbook

15.3.2 Inspections of Field Items

There are several items that require periodic field inspection. Lists of pertinent field inspections are listed in Table 15-2. These items are further identified and procedures are presented in the applicable equipment SOPs and operations manuals.

Table 15-2 Field Inspections

Item	Frequency	Inspection Parameter	Corrective Action	Documentation
Shelter				
Temperature	Daily	20-30°C	Repair or replace air conditioner or heater	Record in site logbook
Damage	Upon Site Visit	Exterior and interior	Repair damage or call Facilities Management	Record in site logbook
Cleanliness	Upon Site Visit	Exterior and interior	Clean surfaces, floors, replace trash bags as needed	Record in site logbook
Instruments				
Analyzer Warnings	Upon Site Visit	Front panel instrument warnings	Repair instrument based on warning	Record in instrument logbook and site logbook
Data Logger	Upon Site Visit	Time, date and data collection	Adjust time if necessary and ensure proper data collection	Record in site logbook
Particulate Samplers	Upon Filter Change	Time, date, sample run, flags	Perform verification and/or calibration if any parameters are out of spec	Record in instrument logbook and site logbook
Continuous Particulate Monitors	Twice per Week	Filter tape, time, date, flow, errors	Replace filter tape when necessary, adjust time and date if necessary and perform calibrations if additional errors are discovered	Record in instrument logbook and site logbook

15.4 Maintenance, Warranties, and Service Contracts

15.4.1 Weigh Room Maintenance Items

Preventive maintenance for the microbalance will be performed by a certified service technician at initial setup and once per year thereafter. The AQMD laboratory technicians will perform other routine maintenance activities (air filter replacements, room cleaning, etc.).

15.4.2 Field Maintenance Items

Field equipment will be maintained according to manufacturers' specifications, manuals, and the applicable SOPs located in the appendices of this QAPP. All maintenance, testing, and repair activities are documented and tracked in instrument log books, see Figure 15-1 for routine monitoring responsibilities. AQMD maintains an inventory of critical spare parts for all gas analyzers and particulate monitors. AQMD maintains spare instruments located at the AQMD office storage room. AQMD tests all spare instruments prior to deploying in the field and documents the tests in the instrument log book.

15.4.3 Warranties and Service Contracts

All monitoring equipment comes with a manufacturer warranty that is typically 1-2 years depending on the specific vendor. AQMD uses these warranties to make sure that parts and repairs are covered at no charge. AQMD does not maintain service contracts with specific vendors, but does utilize the service and technical support of each supplier.

Figure 15-1 Routine Monitoring Responsibilities

Routine Monitoring Responsibilities

More than Weekly
AirVision Data Review (Every morning)
NCore CO, O3, SO2 auto zero/span (Daily)
Lab temp/RH check (Daily)
Radnet (Tues/Fri)
Site Checks (3x/week)
BAM Checks (3x/week)
NCore NOx and NOy auto zero/span (1/3 days)
BGI PM2.5 (1/3 days)
BGI PM10 (1/3 days)
Speciation SASS (1/3 days)
Speciation URG (1/3 days)
Ship/Receive SASS/URG filters

Weekly
Gas analyzer diagnostic check (Monday)
Lab Dickson data download (Wed.)
Dust lab and swiffer lab floor (Wed.)
Replace lab sticky mat (Wed.)
NCore CO, O3, SO2 precision
NCore NOx and NOy multipoint w/ GPT
Weigh pre & post BGI filters
Calculate BGI filter concentrations
Complete paperwork/data exception logs (by Friday)

Bi-Weekly
SLAMS CO z/p/s
SLAMS O3 z/p/s
BAM flow/leak checks
BGI PM2.5 field blank

Monthly
Particulate filters (replace all)
Cal Cylinder pressure checks
BGI PM2.5 verifications
BGI PM10 verifications
Speciation SASS verifications
Speciation URG verifications
BAM PM10 inlet maintenance (lower)
BAM PM2.5 VSCC maintenance
BAM nozzle and vane maintenance
BAM capstan shaft and pinch roller maintenance
BGI PM10 inlet maintenance (lower)
BGI PM2.5 VSCC maintenance
QC raw data
Inspect/condition BGI filters
Sweep shelters
Take out shelter trash (as needed)

Bi-Monthly
Replace BAM filter tape

Quarterly
BAM PM10 inlet maintenance (upper and lower)
BGI PM10 inlet maintenance (upper and lower)
Audits (all)
Speciation URG down tube maintenance
Speciation URG audit filter rotation
Lab working mass standard verifications (Qtrly.)
Print/file control charts

Semi-Annually
Calibrator photometer recertifications
Calibrator O3 generator calibrations
BAM Smart Heater, RH, and Filter Temperature Test
Replace lab static masters

Annually
Primary O3 standard recertification (CARB)
Audit calibrator photometer/MFC recertification (CARB)
Calibrator photometer recertifications
Calibrator O3 generator calibrations
Calibrator MFC recertifications
WSP/WDR sensor recertifications
Replace sample manifolds
Standard Traceability (flow, temp, RH)
Monitoring Network Annual Plan
Data Certification
Replace NOx/NOy O3 scrubbers
Lab primary mass standard recertifications
Lab microbalance recertification (Quality Control Services)
BAM zero tests
BAM Span Membrane Foil Check and Beta Detector/Dark Count
BAM Vertical Inlet Tube and Internal Debris Filter Cleaning
BAM pump maintenance

Other
5-year Monitoring Network Assessment
Cal Cylinder recertification/refilling
Cal Cylinder hydrostatic testing

Last Reviewed: 04/22/16

Section 16: Instrument Calibration and Frequency

AQMD is responsible for procuring and maintaining dedicated traceable standards and gases for the verification of the ambient air quality monitoring instrumentation. These standards provide a direct link to established national standards (ex, NIST) and are the foundation for the collection of the highest quality ambient pollution data possible in accordance with current procedures and existing federal regulations and guidelines.

16.1 Calibration of Local Primary Standards

16.1.1 ASTM Class 1 Primary Mass Standards

On a quarterly basis, AQMD's ASTM class 1 primary mass standards will be used to verify that the working mass standards are still within the acceptance criteria of their certified weight. Annually, the primary mass standards will be set back to the manufacturer for certification.

AQMD's laboratory microbalance will be certified annually during an annual visit by a certified service technician. The microbalance will be checked against the service technician's standards to ensure acceptability. These actions will be documented in the service technician's report, a copy of which will be provided to the laboratory manager, which after review, will be filed in the AQMD traceability log book.

16.1.2 Primary Ozone Standard

On a yearly basis, AQMD's Level 2 primary ozone standard is compared to EPA's Level 1 standard reference photometer (SRP) located at California Air Resource Board's (CARB) Standards Lab in Sacramento, CA. The EPA maintains Level 1 SRPs to set the standard for all ambient air ozone measurements made nationwide. AQMD's primary ozone standard serves as the reference standard for all ambient air O_3 measurements made by AQMD.

16.1.3 Mass Flow Controller Standards

AQMD's mass flow standards have their own certification and will be recertified annually by the manufacturer.

16.1.4 Calibration Gases

All ultra-pure zero and calibration gas cylinders will be NIST traceable and include the cylinder serial number, recertification status, gas type, PSI, impurity, and expiration date on the manufacturer provided certification.

16.2 Calibration of Transfer Standards

16.2 1 ASTM Class 1 Working Mass Standards

AQMD's working mass standards will be used to verify the microbalance accuracy during PM filter weigh sessions. These working mass standards will be checked quarterly against AQMD's primary mass standards.

16.2.2 Flow Transfer Standards

The field flow transfer standards used by AQMD to verify and calibrate flow rates will have their own certification and will be recertified annually by the manufacturer. The manufacturer establishes a calibration relationship for the flow rate standard as accurate to within 1% over the expected range of use. The calibration changes and recertification documents will be filed in the AQMD traceability log book.

16.2.3 Temperature Transfer Standards

The field temperature transfer standards used by AQMD to verify and calibrate temperature sensors will have their own certification and will be recertified annually by the manufacturer. The manufacturer will certify the standard to within 0.2°C over the expected range of use.

16.2.4 Pressure Transfer Standards

The field pressure transfer standards used by AQMD to verify and calibrate pressure sensors will have their own certification and will be recertified annually by the manufacturer. The manufacturer will certify the standard to within 1 mmHg over the expected range of use.

16.2.5 Site Ozone Transfer Standards

Before being put into operation at the air monitoring sites, each of AQMD's Level 3 ozone transfer standards are verified against the Level 2 primary ozone standard. During this "initial verification", the concentration produced by the Level 3 ozone transfer standard is adjusted to duplicate the concentration of ozone read by the Level 2 primary ozone standard. This calibration procedure establishes a direct link to the primary ozone standard and SRP. The verification is completed using EPA's procedure of averaging 6 comparisons covering the full range of ozone concentrations over 6 different days (6x6 verification).

Every six months, each of AQMD's Level 3 ozone transfer standards are brought back to AQMD's repair room, and reverified against the Level 2 primary ozone standard using EPA's 6x6 verification procedure. For specific details on AQMD's ozone transfer standard verification process, see Appendix LL.

16.2.6 Mass Flow Controllers/Gas Dilution Calibrators

AQMD uses gas dilution calibrators as field calibration devices and audit devices for CO, O3, NOx, NOy, and SO_2 continuous monitoring. The calibrator's photometers are certified internally every 6 months as outlined in Section 16.2. The calibrator's mass flow controllers (MFCs) are certified internally every year using mass flow calibration standards. The mass flow calibration standards are sent to the manufacturer annually for certification. For specific details on AQMD's use of gas dilution calibrators, see Appendix LL.

16.2.7 Calibration Gases

The calibration gas standards will have their own certifications provided by the manufacturer of the calibration gas using EPA Traceability Protocol. The calibration gas standards will be recertified after 96 months for NO in oxygen-free nitrogen and 48 months for CO/SO_2 blend in nitrogen.

Section 17: Inspection/Acceptance Requirements of Supplies and Consumables

This section describes the procedures by which supplies and consumables are inspected and accepted for use in the AQMD network.

17.1 Laboratory Supplies and Consumables

PM_{10} and $PM_{2.5}$ filters are supplied to the AQMD through annual orders placed by the Senior Air Quality Specialist with the Region 9 EPA representative. All filters are received directly from the EPA, inventoried, numbered and stored in the AQMD laboratory. Filters are inspected before equilibration. Any not meeting the acceptance criteria will be noted on the inspection forms and disposed of. Replacement air filters for the laminar flow hood in the laboratory are ordered from the equipment manufacturer or obtained locally following the manufacturer's specifications.

17.2 Instrument Supplies and Consumables

Instrument consumables are ordered from the manufacturer of each instrument. Upon receipt of an order, the parts are examined for shipping damage and stored in the repair facility. A copy of each order is identified as a complete order and filed in the appropriate vendor file as well as with the Administration staff. An inventory list of supplies and consumables are maintained and kept in the AQMD repair facility.

17.3 Calibration Gas

Calibration gas used for routine instrument checks, calibrations, and audits are ordered from an EPA approved vendor. All calibration gases are ordered per EPA protocol. Upon receipt of a cylinder, information regarding cylinder concentration, recertification, hydrostatic testing, and refilling are verified by the Senior Air Quality Specialist. Expiration dates of cylinders are verified monthly by the manufacturer certification tag on a cylinder tracking sheet at each station by the operator.

17.4 Teflon Sample Lines and Fittings

The Senior Air Quality Specialist orders annually FEP Teflon tubing from a manufacturer following EPA regulation. A maintenance schedule is used to track the annual replacement dates. Sample line fittings are inspected, cleaned, and/or replaced annually with sample lines.

17.5 Additional Supplies/Consumables

Additional supplies/consumables are listed on the inventory tracking sheet and are ordered as needed. When a supply or part is used from the inventory it is noted on the tracking sheet by staff. When the inventory is exhausted an order is placed by staff through pro card purchases. All orders placed are inspected upon receipt. If any shipping damage is evident, the vendor is notified, and the item sent back for repair or replacement. An accepted order is identified as a complete order and filed in the appropriate vendor file as well as with the Administrative staff.

Section 18: Non-Direct Measurements

This section addresses data not obtained by direct measurement from the Ambient Air Quality Monitoring Program. This includes data from outside sources and historical monitoring data. At this time, AQMD has not formally determined the types of additional data that may be needed in support of these monitoring programs. Possible databases and type of data and information might include:

- Chemical and physical properties data
- Sampler manufacturers' operational literature
- Geographic location data
- Historical monitoring data
- External monitoring databases
- Speciated particulate data
- National Weather Service data
- Exceptional Events data
- Traffic count data
- Population data

Any use of outside data will be quality controlled to the extent possible following QA procedures outlined in this document and in applicable EPA guidance documents. Non-direct measurements such as those listed above could be preliminary and may not be used to support legal determinations. These measurements may also be limited to informational only as to confirm AQMD data that has followed proper QA procedures. Data used for legal purposes must be certified by an agency like the MPO and State Demographer and match what AQMD uses for siting and monitoring requirements in 40 CFR 58.

18.1 Exceptional Events

The AQMD utilizes the National Weather Service Data and local media literature during exceptional events. This information is used for demonstrational purposes to help identify settling of particulate matter in the basin. Other statistical data needed to determine if an event is exceptional like the median, diurnal patterns, seasonal averages, maximums, and minimums are calculated by Planning staff using AQMD monitoring data and external monitoring databases for surrounding jurisdictions.

18.2 Chemical Speciation Network Data

Chemical Speciation Network (CSN) data is available to the AQMD as batches are released from the EPA via the Data Analysis and Processing Tool (DART) in AirNow Tech. The AQMD Data Manager reviews and approves the CSN in DART on a monthly basis. The AQMD uses this data as a comparison against the $PM_{2.5}$ FRM data collected in the network for exceptional event demonstrations and research.

18.3 Minimum Monitoring and Siting Data

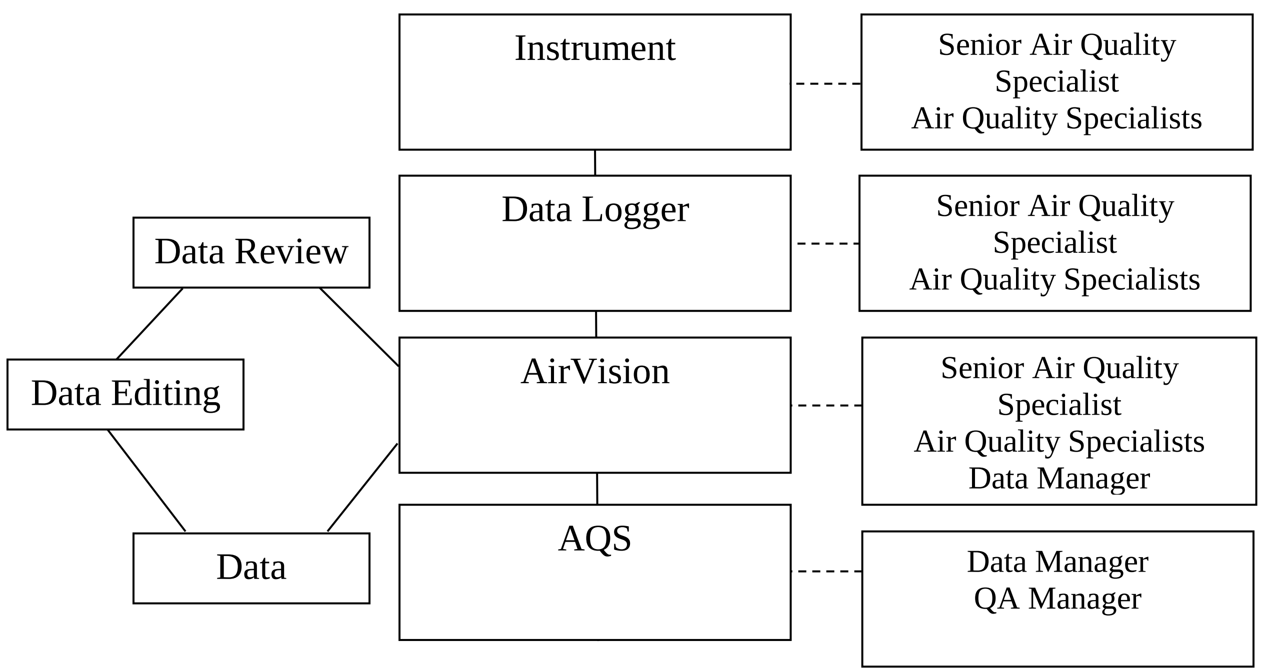
Detailed in the Annual Network Plan (ANP) are the minimum monitoring requirements for all criteria pollutant pursuant to 40 CFR 58, Appendices A, B, C, D, and E where applicable. The Nevada State Demographer's Office population data for the Reno-Sparks Metropolitan Statistical Area (MSA) and the Reno, NV Core-Based Statistical Area (CBSA) are used for years between the decennial censuses. National Emission Inventory data are used to determine the need for source-oriented monitoring for SO_2 and Pb. Annual average daily trip (AADT) counts are gathered from the Nevada Department of Transportation and the Regional Transportation Commission (RTC) of Washoe County on an annual basis and are detailed in the ANP. In addition to population, emissions, and traffic data, distances to roadways, trees, obstructions, and other air pollution sources are measured at each site as needed and are detailed in the ANP.

Section 19: Data Management

19.1 Purpose/Background

The following section will identify the processes and procedures that are to be followed to acquire, transmit, transform, reduce, analyze, store, and retrieve data. These processes and procedures will maintain the data integrity and validity through application of the identified data custody protocols. See detailed procedures for the data handling, processing and validation in Appendix P, Q and S. For a complete data flow for the laboratory, see Figure 19-1.

Figure 19-1 Data Flow and Responsibilities



19.2 Data Collection, Recording, and Storage

All monitoring data collected in the AQMD network is recorded electronically in Agilaire's Data Management System (DMS) called AirVision. To accomplish this, each monitoring site is equipped with a data logger and direct polling beta attenuation monitors (BAMs) that are polled every hour via a wireless broadband connection. A data logger or direct polling BAM is set up to record each monitor's output in preparation for downloading to AirVision. Data that require manual entry, such as those obtained from manual method particulate samplers, are recorded onto the appropriate field data sheets. Field data sheets for each manual method pollutant are found in Appendix E. The Laboratory Manager inputs the sampling filter weights obtained from the field data sheets after post-sampling analysis into spreadsheets (Appendix M). Final filter concentrations and sample run information are then inputted into AirVision's Sample Data Editor to complete the manual data recording effort.

Sub-hourly data is collected for gaseous pollutants at all monitoring sites. One minute and 5-minute data are both collected and stored in the DMS for permanent record. The data loggers at each site internally retains sub-hourly data for 7 days.

Data is stored on a dedicated server within Washoe County Information Technology Department. Data files generated for submittal is stored on a different Washoe County owned and operated server. All these servers are backed up every evening. Data is also located within the data loggers and BAMs to download and is stored for approximately 30 and 180 days, respectively. All data including manual data forms are stored, deleted, or destroyed in accordance with the Document and Record Retentions (Table 9-2).

19.3 Data Validation

Each of the network's analytical instruments employed to measure meteorological conditions and the ambient concentrations of the criteria pollutants undergoes periodic audits and calibrations. These procedures are outlined in the appropriate SOPs found in the appendices to this QAPP. Performance audits and calibrations ascertain the accuracy, precision, and repeatability of each instrument in performing its required function.

The data generated by the instruments are stored on site in the data logger. When the data are accessed through wireless broadband, they are downloaded to a database where they will undergo verification, reduction, and analysis. Data verification is performed electronically by searching the data for status flags and comparing reported values to criteria that identify whether the data are within acceptable range criteria. Once data have been flagged as questionable, Air Quality Specialists evaluate the associated data to identify underlying causes and make the decision whether the data are valid. If the data are invalid, they are not used in calculations. If the data are valid, but flagged due to some extenuating circumstance, then the data will be used in calculations, accompanied by a comment documenting the situation. At any point in the verification process, the original raw data is always accessible and stored in the DMS. Every data point can use the "Restore to Original" function within the Data Editor of AirVision. This redundancy is automatically maintained and built into AirVision.

Sub-hourly data is used to validate monitoring QC/QA activities and their corresponding stabilities conducted at the monitoring sites. One minute and 5-minute data can also be used as a secondary source of data if hourly data needs to be recreated.

In order to access AirVision login and password is used to secure the data. Permissions are assigned within AirVision by the Data Manager to ensure data is not unintentionally modified or deleted. The Data Manager is the only person that can edit the raw data. Any time the data is edited, the reason for the edit is found in the data exception log that the Senior and other Air Monitoring Specialists compile and fill out.

19.4 Data Transmittal

Data transmittal is accomplished using wireless broadband which is linked to the data logger and direct polling BAMs. Downloading of collected data does not delete the data from the data logger. Data are removed from the data logger continuously by overwriting data on a first-in, first-out basis. This configuration requires that the data be extracted from the data logger on a regular basis, thus preventing any loss of data. If communications problems arise, the data will have to be retrieved either by going to the site and directly accessing the data logger, or retrieving the data remotely once the communications problems have been rectified. A site visit is mandatory if the communications problems are not expected to be corrected in time to prevent data from being overwritten. Direct polling BAMs also send data to the data loggers. This secondary data-recording process is used to augment the data integrity and to verify suspect data points in the digital database.

19.5 Data Reduction

Data reduction activities aggregate continuous raw data into hourly averages for all parameters. For all gas analyzers in the monitoring network, 1-minute, 5-minute, and hourly data are collected and saved from the analyzers. Additionally, continuous raw data for SO_2 is also aggregated into five-minute averages. These values obtained from reducing these data sets establish whether or not the NAAQS have been exceeded.   These data sets are either electronically transferred from the data recorders, or they are created manually using data validation worksheets. In either case, flags indicating the validity of the data are provided with each data point. The Senior Air Quality Specialist, Air Quality Specialists, and Data Manager review the data sets for invalid data flags. If the data are deemed invalid, they are disqualified from the data set, and consequently, not used in the calculation. Criteria for the quantity of valid data points required within a data set are defined in 40 CFR Part 50. These criteria are adhered to when performing the data reduction operations. Retaining copies of all data sets electronically recorded provides a data audit trail.

19.6 Data Analysis

The network-provided raw data sets are reduced, yielding the appropriate averaging period values. Continuous and manual method data are analyzed each month using reports from the DMS. Further analysis for exceptional events demonstrations is done on an as needed basis.

Each quarter, AQS reports are used to update the NAAQS related statistics. Annually, the AMP480, Design Value Report, is used to determine compliance with the NAAQS.

19.7 Laboratory Data Management

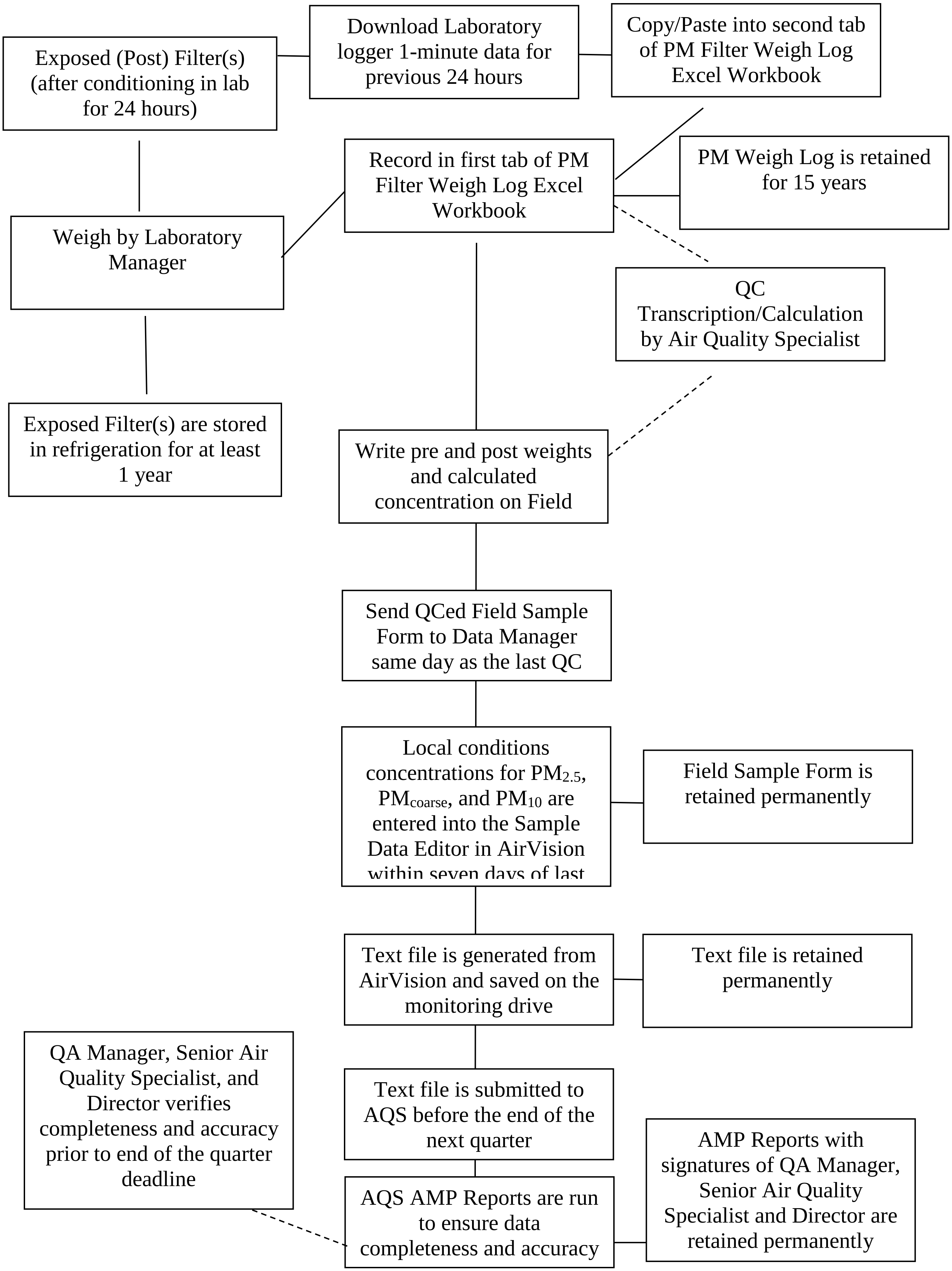
The primary support facility for the $PM_{2.5}$ and PM_{10} network is the filter conditioning and weighing room located in the office of the AQMD. This laboratory is used to conduct pre-exposure weighing and post-exposure weighing of each $PM_{2.5}$ and PM_{10} filter. The laboratory is an environmentally controlled room with temperature and humidity controls. Continuous temperature and humidity data is collected by a Dickson touchscreen data logger and manually downloaded by the Lab Manager weekly and prior to every weigh session. The 1-minute data is opened in an Excel spreadsheet to conduct the weighing of pre and post sample filters. During the weighing of pre and post filters, the 24-hour average and standard deviation of the 1-minute data is calculated in the Excel spreadsheet and inputted into the PM Filter Weigh Log Excel Workbook. Filters are weighed on a microbalance and the value from the balance is recorded onto the PM Filter Weigh Log. QC checks are completed on each batch of weighed filters. The pre and post weights are transferred onto the corresponding Field Sample Report and the sample concentrations are calculated by the Lab Manager. After pre and post filter sample concentrations are calculated, an Air Quality Specialist other than the Lab Manager re-checks the concentration calculations and completes a check for transcription errors. The Field Sample Report form is then given to the Data Manager. The data is entered into the Sample Data Editor in AirVision within 7 seven days. The Data Manager stores all the Field Sample Report forms within the AQMD office. The Text file is generated from AirVision quarterly and saved on the monitoring drive. The Text file is submitted to AQS before the end of the next quarter. For more details on Laboratory procedures refer to Appendix M and Section 13 of this QAPP. For detailed information on file generation refer to Appendix S. For a complete data flow for the laboratory, see Figure 19-2.

19.8 Collection and Management of Analytical Metadata

Gas analyzers and continuous PM monitors have the capability to record instrument settings and internal diagnostics in an internal data acquisition system. This analytical metadata has the ability to be collected and managed through the same means as concentration data, and can be available for validation or troubleshooting of the analyzer or monitor's concentration data. AQMD does not currently collect this metadata through its data management system, but it is logged and tracked through weekly instrument logbook entries. The instrument logbooks are stored with their respective instrument at each monitoring station, and are cataloged and tracked by the Senior Air Quality Specialist in a tracking binder. The analytical metadata is also recorded on weekly, bi-weekly, monthly, quarterly, semi-annual, and annual QA/QC check forms. The forms are stored electronically on AQMD's monitoring servers, as well as in hardcopy form in Data Exception Log binders and folders maintained by the Data Manager, and in station QA/QC log binders maintained by the station operator.

Laboratory metadata such as temperature and humidity readings are collected continuously by a Dickson touchscreen data logger, and downloaded manually by the Lab Manager weekly and prior to every weigh session. This data is stored on AQMD's monitoring server and backed up daily by Washoe County's Technical Services Department.

Figure 19-2 Laboratory Data Management Flow



19.9 Data Document Control

All raw data required for calculations, submission to the AQS database, and QA/QC data shall be collected electronically or on data forms. All hardcopy information shall be filled out in indelible ink. Corrections are to be made by inserting a single line through the incorrect entry and an initial and date next is to be written next to the corrected entry.

Electronic field form cells are "locked" in the calculation cells to avoid altering the equations. After completions of the field form, the form is converted to pdf. Reasonability checks are performed on each form prior to and after data entry. If errors are identified during review, the error will be fixed electronically, and the form converted to pdf and saved as a new file identifying that it is a corrected version with the editor's initials. Data collected from AirVision has a login and password to secure the data. Permissions are assigned within AirVision by the Data Manager to ensure data is not unintentionally modified or deleted. The Data Manager is the only person that can edit the raw data. If the integrity or security of AirVision is compromised, data will be retrieved via the data logger and/or the instrument and downloaded to the agency LAN.

All data electronic are stored on the agency LAN, that is backed up daily by the Washoe County IT department. All hardcopy data is stored with the Data Manager or at an off-site Washoe County document retention storage facility. The document retention storage facility has the capacity to store hardcopy data to meet data retention requirement.

Section 20: Assessments and Response Actions

This section of the QAPP describes the assessments the AQMD will perform and/or participate in, in order to ensure the air monitoring activities are being conducted as planned and are generating acceptable data. An assessment is the process used to measure the performance or effectiveness of the quality system, the Ambient Air Quality Monitoring Network and its sites, and various measurement phases of the data operation. In order to ensure the adequate performance of the quality system, AQMD will perform:

- Network reviews and assessments
- Technical systems audits
- Internal and external performance audits
- Data quality assessments

20.1 Annual Monitoring Network Plan

In conformance with network requirement as set forth in 40 CFR 58.10, beginning July 1, 2007, the AQMD adopted and submitted to EPA Region 9. The ANP provides the establishment and maintenance of the AQMD's air quality surveillance system that consists of a network of SLAMS monitoring stations that are part of SLAMS, NCore stations, STN stations, State speciation stations, and SPM monitoring stations. The plans include a statement of purposes for each monitor and evidence that siting and operation of each monitor meets the requirements of appendices A, C, D, and E of 40CFR, part 58.10, where applicable. The ANP must be made available for public inspection for at least 30 days prior to submission to EPA.

Any annual monitoring network plan that proposes SLAMS network modifications including new monitoring sites, is subject to the approval of the EPA Region 9, who shall provide opportunity for public comment and shall approve or disapprove the plan and schedule within 120 days. If the State or local agency has already provided a public comment opportunity on its plan and has made no changes subsequent to that comment opportunity, and has submitted the received comments together with the plan, the Regional Administrator is not required to provide a separate opportunity for comment.

The annual monitoring network plan must contain the following information for each existing and proposed site:

1. The AQS site identification number;
2. The location, including street address and geographical coordinates;
3. The sampling and analysis method(s) for each measured parameter;
4. The operating schedules for each monitor;
5. Siting criteria evaluations as described in 40 CFR Part 58 Appendix E;
6. Any proposals to remove or move a monitoring station within a period of 18 months following plan submittal;
7. The monitoring objective and spatial scale of representativeness for each monitor as defined in 40 CFR Part 58 Appendix D;
8. The identification of any sites that are suitable and sites that are not suitable for comparison against the annual $PM_{2.5}$ NAAQS as described in 40 CFR Part 58.30;
9. The MSA, CBSA, CSA or other area represented by the monitor;

10. The designation of any Pb monitors as either source-oriented or non-source-oriented according to Appendix D of 40 CFR Part 58;
11. Any source-oriented monitors for which a waiver has been requested or granted by the EPA Regional Administrator as allowed for under paragraph 4.5(a)(ii) of Appendix D to 40 CFR Part 58;
12. Any source-oriented or non-source-oriented site for which a waiver has been requested or granted by the EPA Regional Administrator for the use of Pb-PM_{10}monitoring in lieu of Pb-TSP monitoring as allowed for under paragraph 2.10 of Appendix C to 40 CFR Part 58; and
13. The identification of required NO_2 monitors as either near-road or area-wide sites in accordance with Appendix D, Section 4.3 of 40 CFR Part 58.

The ANP must document how States and local agencies provide for the review of changes to a $PM_{2.5}$ monitoring network that impact the location of a violating $PM_{2.5}$ monitor or the creation/change to a community monitoring zone, including a description of the proposed use of spatial averaging for purposes of making comparisons to the annual $PM_{2.5}$ NAAQS as set forth in Appendix N to Part 50 of this chapter. The affected State or local agency must document the process for obtaining public comment and include any comments received through the public notification process within their submitted plan. An ANP shall be conducted every year that the AQMD's Monitoring Network is operational. The Ambient Air Monitoring Annual Network Plan can be found on our website at OurCleanAir.com.

20.2 Network Assessment

The AQMD shall perform and submit to the EPA Region 9 an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in 40 CFR 58.10(d), whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby States and Tribes or health effects studies. For $PM_{2.5}$, the assessment also must identify needed changes to population-oriented sites. The State, or where applicable local, agency must submit a copy of this 5-year assessment, along with a revised annual network plan, to the Regional Administrator. All proposed additions and discontinuations of SLAMS monitors in annual monitoring network plans and periodic network assessments are subject to approval according to 40 CFR Part 58.14. The Ambient Air Monitoring Network Assessment can be found on our website at OurCleanAir.com.

20.3 Technical Systems Audits

TSAs shall be performed at the discretion of the EPA's Region 9 Quality Director. A technical systems audit (TSA) is a thorough and systematic on-site qualitative audit performed by EPA's Region 9, where facilities, equipment, personnel, training procedures, protocols, and record keeping are examined for conformance with the QAPP. A TSA will be performed to assist in identifying deficiencies and providing timely corrective actions. A TSA team or an individual

TSA auditor may segregate TSA activities into three categories. The categories may be audited independently, or they may be combined. The TSA categories are:

- Field activities - Handling, sampling, and shipping.
- Laboratory activities - Pre-sampling weighing, shipping, receiving, post-sampling weighing, archiving, and associated QA/QC activities.
- Data management activities – Collecting, flagging, editing, and uploading data; providing data security.

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 team will prepare a brief written summary of findings, organized into the following areas:

- planning,
- field operations,
- laboratory operations,
- QA/QC,
- data management, and
- reporting.

Problems with specific areas will be ranked and researched, and corrective actions will be implemented.

20.3.1 Post-Audit Activities

The major post-audit activity is the preparation of the systems audit report. The report will include:

- audit title, identification number, date of report, 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; and
- 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 with key personnel. Expected QAPP implementation is compared with observed accomplishments and deficiencies. The audit findings are reviewed in detail, and, within 30 calendar days of the completion of the audit, a comprehensive audit report will be generated and distributed to the AQMD staff for comment. If the affected parties have written comments or questions concerning the audit report, the audit team will review and incorporate them as appropriate. Subsequently, a modified report will be prepared and resubmitted in final form within 30 days of receipt of the written comments. The report will include an agreed-upon schedule for corrective action implementation.

20.3.2 Follow-up and Corrective Action Requirements

As part of corrective action and follow-up, an audit finding response form will be generated by the audited organization for each finding in the TSA report. The audit finding response form is signed by the Regional air quality managers and sent to the TSA team, which reviews, and accepts or rejects the corrective action. The audit response form will be completed within 30 days of acceptance of the audit report.

20.4 Performance Audits

20.4.1 Internal Audits

Internal audits are conducted quarterly of all instruments within the Air Quality Monitoring Network. Site operators are assigned to conduct audits at monitoring stations of instruments they do not operate on a daily basis. At the end of a quarter, after completion of all the audits, the Senior Air Quality Specialist reviews the audits and completes the Monitoring Quarterly Audit form (Figure 20-1). All the audit forms and Monitoring Quarterly Audit form are then reviewed and signed off by the QA Manager. When an operator conducts and audit and a problem with the instrument is encountered or any acceptance criteria falls outside the acceptable limits, the operator is required to fill out a Corrective Action Request form (Section 14, Figure 14-2). The Urgency, Nature of the Problem and the Recommended Action is documented on the form and the form is given to the site operator to complete the corrective action measure. The corrective action must be completed by the time frame indicated on the form and signed by the site operator. When the corrective action is completed by the site operator, the Corrective Action Request form is reviewed by the Senior Air Quality Specialist, QA Manager and Supervisor. Once it is determined the action is completed and the problem resolved the QA Manager and Supervisor will sign the form. The QA Manager will then review the corrective action with the Division Director and receive final signature approval. All Corrective Action Request forms are tracked and documented with the quarterly audit forms from all network instruments and stored both in hardcopy and electronically on the agencies LAN. Each instrument SOP has detailed instructions on how the operator shall proceed if an audit fails.

Figure 20-1 Monitoring Quarterly Audits Form

Monitoring Quarterly Audits Year: ________ Quarter: ________________

Parameter	Site	Instrument	Model	Serial #	Date	Avg. % Dev.	Difference	Audit Criteria	Pass / Fail	Corrective Action
CO	Reno 3	TAPI	300EU	261			---	+/- 15%	Pass	
	Sparks	TAPI	300EU	269			---	+/- 15%	Pass	
Ozone	Incline	TAPI	400E	2824			---	+/- 15%	Pass	
	Lemmon Valley	TAPI	T400	1399			---	+/- 15%	Pass	
	Reno 3	TAPI	400E	2133			---	+/- 15%	Pass	
	South Reno	TAPI	T400	1398			---	+/- 15%	Pass	
	Spanish Springs	TAPI	T400	2789			---	+/- 15%	Pass	
	Sparks	TAPI	T400	1400			---	+/- 15%	Pass	
	Toll	TAPI	400E	2607			---	+/- 15%	Pass	
SO_2	Reno 3	TAPI	100EU	157			---	+/- 15%	Pass	
NO_2	Reno 3	TAPI	200EU	222			---	+/- 15%	Pass	
NO_2(Y)	Reno 3	TAPI	200EU	109			---	+/- 15%	Pass	
Zero Air	Incline O_3	TAPI	701	2704		---		< 10 ppb	Pass	
	Lemmon Valley O_3	TAPI	701	2707		---		< 10 ppb	Pass	
	Reno 3 CO	TAPI	701H	107		---		< 0.1 ppm	Pass	
	Reno 3 O_3	TAPI	701H	107		---		< 10 ppb	Pass	
	Reno 3 SO_2	TAPI	701H	107		---		< 1 ppb	Pass	
	Reno 3 NO_2	TAPI	701H	107		---		< 10 ppb	Pass	
	Reno 3 NO_y-NO	TAPI	701H	107		---		< 10 ppb	Pass	
	South Reno O_3	TAPI	701	794		---		< 10 ppb	Pass	
	Spanish Springs O_3	TAPI	701	2946		---		< 10 ppb	Pass	
	Sparks CO	TAPI	701H	2705		---		< 0.1 ppm	Pass	
	Sparks O_3	TAPI	701H	2705		---		< 10 ppb	Pass	
	Toll O_3	TAPI	701	2195		---		< 10 ppb	Pass	
Shelt. Temp.	Incline	T Sentry	140-100HVB	91011331		---		+/- 2°C	Pass	
	Lemmon Valley	T Sentry	140-100HVB	91011333		---		+/- 2°C	Pass	
	Reno 3	T Sentry	140-100HVB	91011335		---		+/- 2°C	Pass	
	South Reno	T Sentry	140-100HVB	91011330		---		+/- 2°C	Pass	
	Spanish Springs	T Sentry	140-100HVB	91011329		---		+/- 2°C	Pass	
	Sparks	T Sentry	140-100HVB	91011332		---		+/- 2°C	Pass	
	Toll	T Sentry	140-100HVB	120315641		---		+/- 2°C	Pass	
PM_{10}	Reno 3	BGI	PQ200	794			---	+/- 4%	Pass	
	Reno 3	Met One	BAM 1020	K1287			---	+/- 4%	Pass	
	Spanish Springs	Met One	BAM 1020	N10986			---	+/- 4%	Pass	
	Sparks	Met One	BAM 1020	R10379			---	+/- 4%	Pass	
	Toll	Met One	BAM 1020	M7649			---	+/- 4%	Pass	
$PM_{2.5}$ (act. flow)	Reno 3 Des.	BGI	PQ200	790			---	+/- 4%	Pass	
	Reno 3	Met One	BAM 1020	K1286			---	+/- 4%	Pass	
	Spanish Springs	Met One	BAM 1020	N10985			---	+/- 4%	Pass	
	Sparks	Met One	BAM 1020	M4380			---	+/- 4%	Pass	
	Toll	Met One	BAM 1020	M7605			---	+/- 4%	Pass	
Speciation	Reno 3	Met One	SuperSASS	R11519			---	+/- 10%	Pass	
	Reno 3	URG	3000N	3N-B0819			---	+/- 10%	Pass	
Amb. Temp.	Balance Room	Dickson	RTRH	16323910		---		+/- 2°C	Pass	
	Reno 3	YSI	700	---		---		+/- 0.5°C	Pass	
	South Reno	YSI	700	---		---		+/- 1.0°C	Pass	
	Spanish Springs	YSI	700	---		---		+/- 1.0°C	Pass	
	Sparks	YSI	700	---		---		+/- 1.0°C	Pass	
	Toll	YSI	700	---		---		+/- 1.0°C	Pass	
RH	Balance Room	Dickson	RTRH	16323910		---		+/- 2%	Pass	
	Reno 3	Met One	083E	P18243		---		+/- 7%	Pass	
WSP/WDR	Reno 3	Met One	50.5H	N12431		---	---	Ops check	Pass	
	South Reno	Met One	50.5H	N11876		---	---	Ops check	Pass	
	Spanish Springs	Met One	50.5H	N12434		---	---	Ops check	Pass	
	Sparks	Met One	50.5H	N12432		---	---	Ops check	Pass	
	Toll	Met One	50.5H	N11877		---	---	Ops check	Pass	
Mass	Lab	Working	400 mg	83551		---		+/- 2.0µg	Pass	
	Lab	Working	300 mg	65511		---		+/- 2.0µg	Pass	

= failed audit   = audit not completed

QA Manager Signature: ______________________________ Date: ____________________

20.4.2 External Audits

EPA conducts AQMDs NPAP and PEP audits. The NPAP is a performance evaluation which is a type of audit where quantitative data are collected independently in order to evaluate the proficiency of an analyst, monitoring instrument or laboratory. Due to the implementation approach used in the program, NPAP provides a national independent assessment of performance while maintaining a consistent level of data quality. Performing audits of the primary monitors at 20 percent of monitoring sites per year, and 100 percent of the sites every 6 years. High-priority sites may be audited more frequently. Since not all gaseous criteria pollutants are monitored at every site within a PQAO, it is not required that 20 percent of the primary monitors for each pollutant receive an NPAP audit each year only that 20 percent of the PQAOs monitoring sites receive an NPAP audit. It is expected that over the 6-year period all primary monitors for all gaseous pollutants will receive an NPAP audit.

The PEP is an independent assessment used to estimate total measurement system bias. Performance evaluations will be performed annually within each PQAO. For PQAOs with less than or equal to five monitoring sites, five valid performance evaluation audits must be collected and reported each year. For PQAOs with greater than five monitoring sites, eight valid performance evaluation audits must be collected and reported each year. A valid performance evaluation audit means that both the primary monitor and PEP audit concentrations are valid and above 3 µg/m3. Additionally for every monitor designated as a primary monitor, a primary quality assurance organization must have each method designation evaluated each year and have all FRM, FEM or ARM samplers subject to a PEP audit at least once every 6 years, which equates to approximately 15 percent of the monitoring sites audited each year.

20.5 Data Quality Assessments

20.5.1 Annual Data Certification

At least one month prior to the May 1st deadline, the data certification process begins with the Data Manager running both the Data Certification (AMP600) and the Quicklook All Parameters (AMP450NC) AQS reports. The reports are reviewed by the Senior Air Quality Specialist and QA Manager. Any necessary changes are conducted by the Data Manager and reports are rerun to be reviewed again. The reports are then reviewed by the QA Manager, after the review the Monitoring and Planning Supervisor reviews and signs the certification letter indicating that the ambient concentration data and the quality assurance data are completely submitted to AQS, and the ambient data are accurate to the best of our knowledge taking into consideration the quality assurance findings. Monthly and quarterly data quality review and reports are discussed in section 21.4.

20.5.2 Annual Trends Report

After data certification is completed, the Data Manager compiles the Annual Trends Report. The Data Manager retrieves the AMP Reports (See Table 21.2). The design values, maximums, percentiles, 4^{th} highs, expected exceedances, and annual means are all gathered from AMP Reports for the previous year and summarized in Appendix A of the Annual Trends Report.

The Report is reviewed for accuracy and to verify exceedances and/or violations by the QA Manager. The Monitoring and Planning Supervisor does a final review of the Annual Trends Report before it is presented to the District Board of Health. The Air Quality Trends Report can be found on our website at OurCleanAir.com.

Section 21: Reports to Management

This section describes the quality-related reports and communications to management necessary to support SLAMS/NCore network operations and the associated data acquisition, validation, assessment, and reporting.

21.1 Quality Assurance Plans and Reports

Reports to management required for the SLAMS program in general are discussed in various sections of 40 CFR Parts 50, 53, and 58. Guidance for management report format and content is provided in reports and guidance documents developed by EPA's Quality Assurance Division. The AQMD reports to management are described in the following subsections. See Table 21-1 for a list of plans and reports to management.

Table 21-1 Plans and Reports to Management

Plans/Report	Lead Staff	Staff Review	Frequency	Final Approval
Annual Network Plan	Senior AQS	Data Manager QA Manager	Annually	Supervisor
5-Year Network Assessment	Senior AQS	Supervisor QA Manager	Every 5-years	Supervisor
Annual Trends Report	Data Manager	Supervisor QA Manager	Annually	Supervisor
QAPP/SOP	QA Manager	Supervisor Senior AQS Data Manager	Every 5-years	Division Director Supervisor QA Manager Senior AQS
QMP	QA Manager	Supervisor Senior AQS Data Manager	Every 5-years	Division Director Supervisor QA Manager Senior AQS
Data Certification	Data Manager	Supervisor Senior AQS QA Manager	Annually	Division Director Supervisor
Internal Performance Audits	Senior AQS	QA Manager	Quarterly	QA Manager
Corrective Action Request	Senior AQS	QA Manager	As Needed	Division Director Supervisor QA Manager
Technical Systems Audits	EPA	Supervisor Senior AQS AQS Data Manager QA Manager	Triennially	Supervisor

21.2 Quarterly AQS Data Reporting

Each quarter, the AQMD will report to the AQS the results of all precision, bias, and accuracy tests it has carried out during the previous quarter. The quarterly reports will be submitted consistent with the data reporting requirements specified for air quality data as set forth in 40 CFR Part 58, Appendix A, Section 5. The quarterly data reporting requirements of 40 CFR Part 58.16 apply to those stations designated SLAMS or NCore. Required accuracy and precision data are to be reported on the same schedule as quarterly monitoring data submittals. All QA/QC data collected will be reported and will be flagged appropriately. This data includes: "results from invalid tests, from tests carried out during a time period for which ambient data immediately prior or subsequent to the tests were invalidated for appropriate reasons and from tests of methods or analyzers not approved for use in SLAMS monitoring networks." (40 CFR Part 58, Appendix A, Section 5). Air quality data submitted for each reporting period will be edited, validated, and entered into the AQS using the procedures described in the *AQS Data Coding Manual*. The AQMD will be responsible for preparing the data submittals, which will be reviewed by the Data Manager before they are transmitted to the AQS.

21.3 Design Values

At the beginning of the 2nd Quarter, the AMP480 Design Value Report is run in AQS to be reviewed by the staff listed in Table 21-1. Design values for the 1 hour and 8-hour carbon monoxide NAAQS are calculated using the AMP350 and AMP350MX, respectively. Design values are recorded in the Annual Trends Report. The Data Manager is responsible to keep track of estimated design values when close to or at NAAQS violation level using AQS reports and our internal DMS with post processing if a preliminary design value is needed before all data is submitted to AQS. Table 21-2 for a list of AQS AMP Reports.

Table 21-2 AQS AMP Reports

AMP Report	Description	Lead Staff	Frequency	Review
AMP600	Data Certification Report	Data Manager	Annually	Supervisor Senior AQS QA Manager
AMP480	Design Value Report	Data Manager	Annually	Supervisor Senior AQS QA Manager
AMP450NC	Quicklook All Parameters	Data Manager	Annually	Supervisor Senior AQS QA Manager
AMP430	Data Completeness Report	Data Manager	Quarterly	Supervisor Senior AQS QA Manager
AMP350MX	Raw Data Max Values Report (CO 8hr)	Data Manager	Annually	Supervisor Senior AQS QA Manager

AMP Report	Description	Lead Staff	Frequency	Review
AMP350	Raw Data Report (CO 1hr)	Data Manager	Annually	Supervisor Senior AQS QA Manager
AMP300	Violation Day Report	Data Manager	Quarterly	Supervisor Senior AQS QA Manager
AMP256	QA Data Quality Indicator Report	Data Manager	Quarterly	Supervisor Senior AQS QA Manager

21.4 Network Reviews

The AQMD prepares an Annual Network Plan and a 5-Year Network Assessment in accordance with requirements in 40 CFR Part 58 requirements as detailed in Section 20, to determine if a system meets the monitoring objectives. The assessment identifies needed modifications to the network including termination or relocation of unnecessary stations or establishment of new stations. Within the Network Assessment, AQMD has provided a list of all monitoring sites and their AQS site identification codes to EPA Region 9 and to the AQS. Whenever there is a change in this list of monitoring sites or in a reporting organization, the AQMD reports this change to EPA Region 9 and to the AQS. More detailed information is in Section 20.

21.5 Corrective Action Request

The corrective action procedure will be followed whenever a problem is found such as a safety defect, an operational problem, a deviation from the acceptance criteria during an internal audit, or a failure to comply with procedures. A separate report will be required for each problem identified. Copies of Corrective Action Request form (Section 14, Table 14-2) 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 Corrective Action Request form will be generated by the Air Quality Specialist encountering the problem. The report will be distributed to the Air Quality Specialist assigned to the instrument or problem in question and corrective action will take place according to the time frame indicated on the form and signed by the site operator. When the corrective action is completed by the site operator, the Corrective Action Request form is reviewed by the Senior Air Quality Specialist, QA Manager and Supervisor. Once it is determined the action is completed and the problem resolved the QA Manager and Supervisor will sign the form. The QA Manager will then review the corrective action with the Division Director and receive final signature approval. The form will be filed in the instrument notebook, data exception log and the quarterly audit folder.

Section 22: Data Validation and Usability

The purpose of this section is to state the criteria for deciding the degree to which each data item has met its quality specifications. Investigators should estimate the potential effect that each deviation from the QAPP may have on the usability of the associated data item, its contribution to the quality of the reduced and analyzed data, and its effect on decisions.

22.1 Sampling Design

Sampling network design and monitoring site selection must comply with:

- 40 CFR Part 58, Appendix A - Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS).
- 40 CFR Part 58, Appendix D - Network Design for State and Local Air Monitoring Stations (SLAMS) and National Core Multi-pollutant Monitoring Station (NCore).
- 40 CFR Part 58, Appendix E - Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring.

Additional guidance is provided in *Guidance for Choosing a Sampling Design for Environmental Data Collection,* (EPA QA/G-5S). Any deviations from the minimum siting criteria (e.g., shelter location, probe placement, and/or monitor sight path requirements) shall be thoroughly documented in the site's QC documentation. Examples of deviations include, but are not limited to, insufficient distance from roadways (i.e., marginal terrain criteria) and insufficient distance from influencing objects (e.g., dripline of an adjacent tree or a cell phone tower that was installed after the monitoring site was established). The impact of the deviations should be evaluated and appropriate adjustments to the confidence intervals should be determined.

22.1.1 Sample Collection Procedures

Sample collection procedures are outlined in Section 11 of this QAPP. Potentially unacceptable data points are routinely identified in the DMS through electronic application of error flags. Each instrument-specific flag is associated with a unique error. These flags are routinely reviewed as part of the data validation process. This activity assists in identifying suspect data points that could invalidate the resulting averaging periods. A compilation of the qualifier codes is presented in Table 22-1 and a list of error codes are found in Table 23-1. Any deviation from the established sample collection plan must be documented in the appropriate logbook and on the field sample data sheet. Accurate and complete documentation of any sample collection deviations will assist in any subsequent investigations or evaluations. Investigations and evaluations may be necessary to determine whether the data obtained from a particular site may qualify as a baseline or indicator for other sites.

Table 22-1 Qualifier Codes

Type	Code	Description
IO[1]	A	High Winds
IO	B	Stratospheric Ozone Intrusion
IO	C	Volcanic Eruption
IO	D	Sandblasting
IO	F	Structural Fire
IO	G	High Pollen Count
IO	H	Chem. Spills & Indust. Accidents
IO	I	Unusual Traffic Congestion
IO	IC	Chem. Spills & Indust Accidents
IO	ID	Cleanup After a Major Disaster
IO	IE	Demolition
IO	IH	Fireworks
IO	II	High Pollen Count
IO	IJ	High Winds
IO	IK	Infrequent Large Gatherings
IO	IL	Other
IO	IM	Prescribed Fire
IO	IN	Seismic Activity
IO	IO	Stratospheric Ozone Intrusion
IO	IP	Structural Fire
IO	IQ	Terrorist Act
IO	IR	Unique Traffic Disruption
IO	IS	Volcanic Eruptions
IO	IT	Wildfire-U. S.
IO	IU	Wildland Fire Use Fire-U. S.
IO	J	Construction/Demolition
IO	K	Agricultural Tilling
IO	L	Highway Construction
IO	M	Rerouting of Traffic
IO	N	Sanding/Salting of Streets
IO	O	Infrequent Large Gatherings
IO	P	Roofing Operations
IO	Q	Prescribed Burning
IO	R	Cleanup After a Major Disaster
IO	S	Seismic Activity
IO	U	Sahara Dust
IO	Z	Other event
QA[2]	1	Deviation from a CFR/Critical Criteria Requirement
QA	2	Operational Deviation
QA	3	Field Issue

Type	Code	Description
QA	4	Lab Issue
QA	5	Outlier
QA	6	QAPP Issue
QA	7	Below Lowest Calibration Level
QA	8	QA/QC Unknown
QA	9	Negative value detected - zero reported
QA	CB	Values have been Blank Corrected
QA	CC	Clean Canister Residue
QA	CL	Surrogate Recoveries Outside Control Limits due to analytical interferences
QA	EH	Estimated; Exceeds Upper Range
QA	FB	Field Blank Value Above Acceptable Limit
QA	HT	Sample pick-up hold time exceeded; data questionable
QA	LB	Lab blank value above acceptable limit
QA	LJ	Identification Of Analyte Is Acceptable; Reported Value Is An Estimate
QA	LK	Analyte Identified; Reported Value May Be Biased High
QA	LL	Analyte Identified; Reported Value May Be Biased Low
QA	MD	Value less than MDL
QA	MX	Matrix Effect
QA	ND	No Value Detected
QA	NS	Influenced by nearby source
QA	PQ	Values Between PQL And MDL
QA	SQ	Values Between SQL and MDL
QA	SX	Does Not Meet Siting Criteria
QA	T	Multiple $PM_{2.5}$ Validity Flags
QA	TB	Trip Blank Value Above Acceptable Limit
QA	V	Validated Value
QA	VB	Value below normal; no reason to invalidate
QA	W	Flow Rate Average out of Spec.
QA	X	Filter Temperature Difference out of Spec.
QA	Y	Elapsed Sample Time out of Spec.
RE[3]	E	Forest Fire
RE	RC	Chem. Spills & Indust. Accidents
RE	RD	Cleanup After a Major Disaster
RE	RE	Demolition
RE	RH	Fireworks
RE	RI	High Pollen Count
RE	RJ	High Winds
RE	RK	Infrequent Large Gatherings
RE	RL	Other
RE	RM	Prescribed Fire
RE	RN	Seismic Activity

Type	Code	Description
RE	RO	Stratospheric Ozone Intrusion
RE	RP	Structural Fire
RE	RQ	Terrorist Act
RE	RR	Unique Traffic Disruption
RE	RS	Volcanic Eruptions
RE	RT	Wildfire-U. S.
RE	RU	Wildland Fire Use Fire-U. S.

22.1.2 Sample Handling

Section 12 of this QAPP addresses sample handling. Pertinent deviations from established sample-handling protocols for each sample physically retrieved from monitoring sites and equipment shall be recorded. These deviations shall be recorded on the sample field forms assigned to each filter for particulate matter and recorded in the applicable electronic database for all other criteria pollutants. Field sample forms for particulate matter and criteria pollutants are in the associated SOPs.

22.2 Analytical Procedures

The data obtained from the electronic evaluation of criteria pollutant concentrations shall be validated and verified utilizing both manual and electronic methods. Specific criteria listed on Table 22-2 are used that identify the range of acceptable data, the minimum and maximum acceptable values, the rate of change of specific values, and other criteria that are indicative of valid qualifying data. Suspect data are flagged utilizing the list provided in Table 22-1.

Table 22-2 Minimum and Maximum Acceptable Values

Parameter	Min	Max	Parameter Code	Method Code	Round/Truncate	Units
Ozone (O_3)	-0.004	0.5	44201	87	T	Parts per million
Carbon monoxide (COT)	-0.4	50	42101	593	R	Parts per million
Carbon monoxide (CO)	-0.4	50	42101	93	R	Parts per million
Sulfur dioxide (SO_2T)	-4	1500	42401	600	T	Parts per billion
Oxides of nitrogen (NOx)	-5	1200	42603	99	T	Parts per billion
Nitric oxide (NO)	-5	1200	42601	99	T	Parts per billion
Nitrogen dioxide (NO_2)	-5	400	42602	99	T	Parts per billion
NOy - NOtrace (NO_2y)	-5	200	42612	699	T	Parts per billion
Reactive oxides of nitrogen (NOy)	-5	520	42600	699	T	Parts per billion
Nitric oxide (NOT)	-5	1000	42601	699	T	Parts per billion
PM_{10} - LC (PM10LC)	0	5000	85101	125	T	Micrograms/cubic meter (LC)
$PM_{2.5}$- Local Conditions ($PM_{2.5}$)	0	5000	88101	142	T	Micrograms/cubic meter (LC)

Parameter	Min	Max	Parameter Code	Method Code	Round/Truncate	Units
$PM_{10-2.5}$ - Local Conditions (PMC)	-3	5000	86101	173	T	Micrograms/cubic meter (LC)
PM_{10} Total 0-10um STP (BAM10STD)	-5	5000	81102	122	T	Micrograms/cubic meter (25 C)
PM_{10} - LC (BAM10LC)	-10	5000	85101	122	T	Micrograms/cubic meter (LC)
$PM_{10-2.5}$ - Local Conditions (BAMC)	-10	5000	86101	185	T	Micrograms/cubic meter (LC)
$PM_{2.5}$ - Local Conditions (BAM2.5)	-10	975	88101	170	T	Micrograms/cubic meter (LC)
Outdoor Temperature (ATEMP)	-60	150	62101	40	R	Degrees Centigrade
Relative Humidity (RELHUM)	0	100	62201	61	R	Percent relative humidity
Wind Direction - Resultant (RWDR)	0	360	61104	61	R	Degrees Compass
Wind Direction - Scalar (WDR)	0	360	61102	61	R	Degrees Compass
Wind Speed - Resultant (RWSP)	0	90	61103	61	R	m/s
Wind Speed - Scalar (WSP)	0	90	61101	61	R	m/s

22.3 Quality Control

Section 14 and the appendices of this QAPP specify the QC checks that are to be performed during sample collection, handling, and analysis. These include analyses of check standards, lab and field blanks, 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 shall be specified. Data validation should document the corrective actions that were taken, which samples were affected, and the potential effect of the actions on the validity of the data.

22.4 Calibration

Section 16 and the appendices of this QAPP address the calibration of instruments and equipment and the information that should be presented to ensure that the calibrations performed correctly, and the results are acceptable. When calibration problems are identified, any data produced between the suspect calibration event and any subsequent recalibration should be flagged to alert data users.

22.5 Data Reduction and Processing

Both internal and external technical systems audits will be performed to ensure the data reduction and processing activities mentioned in the QAPP are being followed. Periodically, raw data will be reviewed, and final concentrations will be calculated by hand. The final values submitted to AQS should match 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.

Section 23: Verification and Validation Methods

The purpose of this section is to identify the procedures, and responsible parties who will perform data validation and verification. Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements. Data validation is an analytical and sample specific process that extends the evaluation of data beyond method, procedural or contractual compliance (i.e. data verification) to determine the analytical quality of a specific data set.

23.1 Validating and Verifying Data

The validation and verification procedures that will be employed for this operation shall conform to the AQMD's Data Validation SOP's (Appendix Q). Verification and validation issues are also discussed at length in *Guidance on Environmental Verification and Validation*, (EPA QA/G-8). All validation and verification activities shall be performed by Data Manager, Senior Air Quality Specialist, QA Manager and all site operators. Additional support, including QC/QA activities, shall be provided by the QA Manager and the Senior Air Quality Specialist. To ensure independence of the data review, the QA Manager is not a position within the monitoring branch and directly reports to the Division Director regarding data including monthly, quarterly, semi-annual, and annual data reviews, reports, field forms, and corrective actions.

The data under evaluation ("weight of evidence") to determine the suitability of data for regulatory decisions will be compared to the MQO tables against which data will be validated (See Section 7 and the QA Handbook Volume II, Appendix D Validation Templates Attachment). However, exceptional field events may occur, and field and laboratory activities may occur that negatively affect the integrity of samples. In addition, it is expected that some of the QC checks will indicate that the data fail to meet the acceptance criteria. Data identified as suspect, or that does not meet the acceptance criteria, shall be flagged as indicated in Table 23-1. The review of the routine and the associated QC data will be verified and validated on a sample batch basis. The sample batch is the most efficient entity for verification/validation activities. The hypothesis is that if measurement uncertainty can be controlled at a batch level, then the overall measurement uncertainty will be maintained within the precision and bias DQIs. For more detailed information on Data Validation refer to Appendix Q.

23.2 Verification

After a sample batch is compiled, a thorough review of the data will be conducted for completeness and data entry accuracy. All raw data that are hand entered from data sheets will be checked prior to entry to the appropriate database. Once the data are entered, the data will be reviewed for routine data outliers and conformance to acceptance criteria. Unacceptable or questionable data will be flagged appropriately. All flagged data will be re-verified during the monthly data review by all the site operators to ensure that the values were entered correctly. For any parameter that has failed a QC check (precision), data will be invalidated back to the previous passing QC check. For any parameter that has failed a QA (audit), an investigation is open into the cause with a Corrective Action Request. Data may or may not be invalidated back to the last QC or QA depending on what the investigation finds.

Data loggers and direct-polled BAMs apply power, maintenance, or over range flags to indicate an hour in which data was affected by loss of power, work was being conducted on that parameter, or values over the valid maximum. These flagged data are then edited by the Data Manager during the monthly data review with the AirVision error codes. AQS null value codes are coded into AirVision via flags that are color and character coded. If a manual method sample fails a QC check, data will be flagged as invalidated back to the previous QC check and assigned the appropriate AQS null value codes and are coded into AirVision. All raw and flagged manual method data are also included in the monthly review.

See Table 23-1 for a detailed list of the AirVision error codes and their corresponding AQS null codes. The monthly data reviews are first sent to the Senior Air Quality Specialist who then sends the reviews to the site operators. The Data Manager receives the monthly reviews and corrects any changes that need to be done and the process repeats until the monthly review has no further changes. Data is verified after AQS entry using the Data Completeness Report (AMP430) and the Data Quality Indicator Report (AMP256) before the end of each quarter.

The Data Manager applies qualifier codes to data during the monthly data review. When an exceptional events initial notification has been received and approved by EPA and a demonstration is subsequently conducted, the "I" qualifiers will be changed to "R" qualifiers indicating our request for exclusion. Data is further annotated indicating the name of the event in AQS and in AirVision.

Table 23-1 AQS Error Codes

AirVision Error Code	Error Code Descriptions	AQS Null Code
g	Precision Check	AX
P	Power Failure	AV
s	Zero/Precision/Span	BF
i	Miscellaneous	AM
+or-	Max or Min Exceeded	AN
x	Multi-Point Calibration	BC
m	Maintenance	BA
C	Calibration	AT
e	Malfunction	AN
f	Failed QC/QA Data	AS
o	Operator Error	BJ
a	Audit	AZ

23.3 Validation

Validation of measurement data requires two stages, one at the measurement value level and another at the batch level. Records of all invalid samples shall be retained in the appropriate database. Information shall include a brief summary of why the sample was invalidated along with the associated flags. Logbook notes and field data sheets shall have more detailed information regarding the reason a sample was flagged. These documents shall remain with the field operators and/or at the monitoring site or laboratory.

Certain criteria based upon federal requirements, and field and laboratory personnel judgments have been developed that will be used to invalidate a sample or measurement. The flags listed in Table 22-1 (Section 22) shall be used to indicate that individual samples, or samples from a particular instrument, have been invalidated. Filter-based samples with flags or samples in question shall be returned to the laboratory for further examination or re-weighing. Filters that have flags related to contamination, damage, or field complications shall be immediately examined. Upon concurrence of the field operator and laboratory manager, these samples shall be invalidated.

Section 24: Reconciliation with Data Quality Objectives

The purposes of this section is to identify the acceptable methods for evaluating the project results, and provide an outline for the report required to document the findings. The DQOs for the Ambient Air Quality Monitoring Network were established in Section 7 of this QAPP. The resulting DQOs are for sampling or monitoring precision and relative bias. Section 20 discusses assessment and response actions. This section of the QAPP will outline the procedures that the AQMD will follow to determine whether the monitors and laboratory analyses are producing data that comply with the DQOs, what actions will be taken as a result of the assessment process, who will perform, review, and approve this assessment and who will generate the report that documents the findings.

24.1 Reconciling Results with Data Quality Objectives

This section includes scientific and statistical evaluations of data to determine if the data are of the right type, quantity, and quality to support their intended use. The EPA document *Guidance for Data Quality Assessment* (EPA QA/G-9) focuses on evaluating data for fitness in decision-making and also provides many graphical and statistical tools. As described in *Guidance for Data Quality Assessment*, the DQA process is comprised of three steps. The steps are outlined below. Refer to *Guidance for Data Quality Assessment* for a detailed description of each step.

Step 1: Review Data Quality Objectives and Sampling Design. The Data Manager and the QA Manager shall review the project's sampling design, DQIs (precision, bias, comparability, representativeness, and completeness), and DQOs to verify that they are still applicable. Section 7 of this QAPP contains details for DQO development. Additional information contained in Section 7 includes methods for:

- Defining the primary objectives of the Ambient Air Quality Monitoring Network (e.g., NAAQS comparison).
- Translating the objectives into a statistical hypothesis (e.g., the three-year average of annual mean $PM_{2.5}$ concentrations is less than or equal to 12 µg/m3).
- Developing limits on decision errors (e.g., incorrectly conclude an area is non-attainment when it truly is attainment no more than 5% of the time, and incorrectly conclude an area is attainment when it truly is in non-attainment no more than 5% of the time).

Section 10 of this QAPP contains the details of the Ambient Air Quality Monitoring Network design, including the rationale for the design, the design assumptions, and the sampling locations and frequency. If any deviations from the sampling design have occurred, these shall be documented for the DQA, and their potential effect carefully considered throughout the entire DQA.

Step 2: Conduct Preliminary Data Review. The Data Manager, QA Manager, and the Senior Air Quality Specialist shall perform a preliminary data review to uncover potential limits on using the data and evaluate the various submitted QA reports to identify any corresponding anomalous conditions. The first phase of the preliminary data review is to review the QA reports. The second phase of the preliminary data review is to calculate basic summary statistics, generate graphical presentations of the data, and review these summary statistics and graphs.

- *Review Quality Assurance Reports* – the AQMD will review all QA reports that describe the data collection and reporting process. Particular attention will be directed to looking for anomalies in recorded data, missing values, and any deviations from SOPs. This is a quality review. Any concerns will be further investigated in the next two steps.
- *Calculate Summary Statistics and Generate Graphical Presentations* – the AQMD will generate summary statistics via AQS for each of its primary and collocated samplers. The summary statistics will be calculated at the quarterly, annual, and three-year levels and will include only valid samples. The summary statistics are:
    - Sample quantity
    - Mean concentrations
    - Median concentrations
    - Standard deviations
    - Control Charts
    - Maximum concentrations
    - Minimum concentrations

  Particular attention will be given to the impact on the statistics caused by abnormalities noted in the QA review. The AQMD may evaluate the influence of a potential outlier by evaluating the change in the summary statistics resulting from exclusion of the outlier. Additionally, basic histograms will be generated for each of the primary and QA samplers and for the percent difference at the collocated sites. The histograms will be useful in identifying anomalies and evaluating the normality assumption in the measurement errors.

Step 3: Select the Statistical Test. The Data Manager and the QA Manager will determine whether the primary objective of the AQMD's Ambient Air Quality Monitoring Network, compliance to NAAQS criteria pollutant concentrations, has been attained for the prior monitoring period. This will be accomplished by using AMP Reports generated from AQS to validate the ambient air monitoring data can be properly used for determining attainment status.

Step 4: Verify the Assumptions of the Statistical Test

The Data Manager, QA Manager and Monitoring and Planning Supervisor shall evaluate the assumptions upon which the DQOs assumptions are based. These assumptions are foundational to the statistical test. The method of verification will be addressed in this step. Note that when less than three years of data are available, this verification will be based on as much data as are available.

The DQOs are based on the NAAQS which includes the 24-hour, 8-hour, 3-hour, and 1-hour standards. It is commonly assumed that measurement errors are distributed normally in environmental monitoring. If a control chart indicates possible violations of normality and/or bias, the Senior Air Quality Specialist may need to determine the sensitivity of the DQOs to departures in normality. The data collected by an ambient air monitor is stochastic, meaning that there are errors in the measurement process. The limits on precision and bias are based on the smallest number of required sample values in a one- or three-year period. In developing DQOs, the smallest number of required samples is used to ensure that the confidence is sufficient in the minimal case. If more samples are collected, then the confidence in the resulting decision will be even higher. The AMP 430 and 256 will be retrieved each quarter from AQS to ensure that this DQO requirement is upheld. For a comprehensive list of AMP Reports run to get the summary statistics (see Section 21 Table 21.2).

As discussed in Section 20.5, at least one month prior to the May 1st deadline, the annual data certification process begins with the Data Manager running both the Data Certification (AMP600) and the Quicklook All Parameters (AMP450NC) AQS reports. The reports are reviewed by the Senior Air Quality Specialist and QA Manager. If a data error is found in the reports, an investigation begins. If necessary, corrective actions are documented and data is edited by the Data Manager. Reports will be re-run to confirm corrective actions have been addressed. If what is found on the data certification indicates the program didn't meet the DQO(s), a review of the procedures, tolerable limits, and quality control and assurance measures is conducted to determine cause and justification for adjustments if necessary to the relevant DQO(s). A corrective action for not meeting DQO(s) shall be conducted. Corrective actions may include modifying the QA monitoring network and/or reducing QC requirements. After the final review, the Monitoring and Planning Supervisor signs the certification letter indicating that the ambient concentration data and the quality assurance data are completely submitted to AQS, and the ambient data are accurate to the best of our knowledge taking into consideration the quality assurance findings. Communication with EPA Region 9 occurs throughout this process with updates on the possible corrective actions and DQO violations.

Step 5: Draw Conclusions from the Data

Perform the calculations required for the statistical test and document the inferences drawn as a result of these calculations. If the design is to be used again, evaluate the performance of the sampling design.

Based upon the evaluation of the raw data, and insight gathered from each DQI's condition, the Data Manger compiles the Annual Trends Report. A check will be performed by the QA Manager of the selected analysis methodology, verifying that the underlying assumptions are valid or whether departures are acceptable. The actual data, and resulting summary statistics, along with the QA reported information will provide the foundation for this evaluation.

Appendix BB: Met One Super Speciation Air Sampling System (SASS) – Chemical Speciation $PM_{2.5}$

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ____

Title of Author: ______________________________________

Signature: ____________________________ Date: ______________

Name: ____

Title: ____

Signature: ____________________________ Date: ______________

Name: ____

Title: ____

Signature: ____________________________ Date: ______________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:__________________________Date:____________

Name: ____

Title: ____

Signature:__________________________Date:____________

Name: ____

Title: ____

Signature:__________________________Date:____________

Name: ____

Title: ____

Signature:__________________________Date:____________

Name: ____

Title: ____

Signature:__________________________Date:____________

Acronyms and Abbreviations

ºC	Degrees Celsius
CSN	Chemical Speciation Network
CV	Coefficient of Variation
EPA	U.S. Environmental Protection Agency
FB	Field Blank
FiSH	Filter Shipping and Handling
K	Kelvin
L/min	Liters per minute
µm	micrometer
mm	millimeters
mmHg	millimeters of Mercury
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter less than or equal to 2.5 microns in aerodynamic diameter
PST	Pacific Standard Time
QA	Quality Assurance
QC	Quality Control
SASS	Speciation Air Sampling System
SCC	Sharp Cut Cyclone
SOP	Standard Operating Procedures
STN	Speciation Trends Network

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BB.1. Introduction

The Super Speciation Air Sampling System (SASS) chemical sampler collects samples for the chemical and gravimetric analysis of airborne particles with diameters smaller than 2.5 µm ($PM_{2.5}$). These particles are comprised of sulfates, nitrates, organic carbon, soot-like carbon, and metals. The Super SASS has been specifically designed to meet the needs of the U.S. EPA mandated standards for determining the concentration of $PM_{2.5}$ particles. Ambient air enters an activated canister mounted within a solar radiation shield. Particles larger than 2.5 µm diameter are removed by the cyclonic inlet mounted with each canister. Remaining $PM_{2.5}$ particles are collected on a filter media installed within each canister. The design of the Super SASS is shown in Figure 1.

Figure 1 Met One Super Speciation Air Sampling System

BB.2. Theory of Operation

The Super SASS accommodates up to eight sampling canisters with active flow controllers on each canister. The Super SASS operates in groups for each flow controller. Each canister has its own $PM_{2.5}$ sharp cutoff cyclone inlet for excluding particles above 2.5 μm, a denuder ring for removing interfering gases and a 47 mm filter holder for collecting ambient fine particles. The canisters are mounted in a wind aspirated radiation shield that maintains sampler temperature close to ambient. The sample flow rate is controlled at a flow rate of 6.7 L/min per canister depending on filter media and denuder material pressures. The $PM_{2.5}$ separation is produced by a sharp cut cyclone (SCC) that removes both solid and liquid coarse particles. The denuders are 25 mm in length and are housed in a 47-mm aluminum sleeve. The filter size (media) used in the sample canister is 47 mm. Each canister can hold either one or two 47-mm filters in tandem. The Super SASS uses four active volumetric flow controllers to provide precise flow control. Volumetric flow rate measurement is made independently for each of the active flow channels using electronic mass flow sensors. The mass flow sensors in conjunction with ambient temperature, and the barometric pressure readings, are used by the control unit microprocessor to calculate the actual volumetric flow. This provides site-specific flow measurements so no correction is needed in the field or for data reporting at true volumetric readings.

BB.3. Precautions

Disconnect the power prior to performing any maintenance activities

BB.4. Instrument Operation

BB.4.1 Sampling Procedure

The Super SASS sampler is run every three days as specified by the U.S. Environmental Protection Agency (EPA). See Figure 2 for the EPA sampling schedule. The sampling duration is 24 hours, running from midnight to midnight Pacific Standard Time (PST).

Equipment Needed

- New sampling canisters
- 4 sharp cut cyclones
- $PM_{2.5}$ CSN Custody and Field Data Form
- Field Sampling Null Value and Validity Coding Form
- Instrument log book
- Filter transport cooler bag
- 6-8 Blue Ice packs

BB.4.1.1 Installing Sampling Canisters

1. Collect the new sampling canisters shipped from AMEC Foster Wheeler with the $PM_{2.5}$ CSN Custody and Field Data Form (Figure 3) included (see section B.6.1 for receiving shipment procedures).

2. Lower the bottom portion of the radiation shield of the SASS by pulling out the locking pin.
3. Clean the top of the radiation shield with a dry cloth. Clean the interior of the lower portion of the shield with a dry cloth.
4. The top of the shield indicates which canister are to be placed in what slot. For example, canister position 1 will hold the canister with the green dot.
5. Remove the canisters for the first cycle of sequential sampling (labeled 1Q, 3Q or 5Q) with the green dot from the shipping bag.
6. Remove the caps from both ends of the canister. Install the canister by placing the alignment posts into the large holes in the mounting fixture of the inlet head in sampling position 1; ensure the marking slot is pointing out and away from the center of the support tripod. Push the canister up and then rotate it clockwise until it stops, locking the canister in place.
7. Repeat for red canister for the first cycle in the sequential sampling cycle (position 2).
8. For the second set of the sequential sampling cycle repeat steps 4-7, but install the green dot canister (labeled 2Q, 4Q, or 6Q) on Channel 3 and red dot canister on channel 4. This will be the second run of the sequential sampling cycle. On the 7Q run day an additional Field Blank will be included in the sampling cycle. See section B.4.1.3 for the sampling instructions and installation of 8Q FB.
9. Clean the sharp cut cyclones by removing the grit cap and wiping out the cap and interior with the station air compressor, dry cloth, or cotton swab.
10. Install the 4 sharp cut cyclones for each sampling position (SCC have labels for each channel) by inserting the short fitting with the two O-rings into the hole on the bottom of the canister. Rotate the cyclone until the notched corner of the cyclone mount is under the lock screw of the canister.
11. Replace the lower portion of the shield and lock into place with the locking pin, ensure the set screw is aligned with the slot in the shield before sliding it up.
12. Press any key on the Super SASS keypad to activate the screen.
13. Press Event, F4 (Event Manager), and Add. Ensure that the sampling event date, canister set (1 & 2), and event length (24 hours) is correct for the first sequential sampling run. Then press Add. The correct date, time and canister set will appear on the screen. After programming the first set on the sequential sampling schedule, program the second event in the (Event Manager). To add the second sampling run press Add. Again choose the sampling event date, canister set (3 & 4), and event length (24 hours). Press Add. The second event should now be programmed in the Super SASS. The CSN custody and field data forms will have the correct information on sample canisters and dates of the sequential sampling cycles.
14. Press Exit twice to return to the main screen.
15. Fill out the Date of Sampler set-up and Operator’s name on the 2 field forms.
16. Fold canister bags and place in large clear shipping bag along with field form and shipping information. Keep the bag in the shelter for the pulling of the canisters after the sequential sampling.
17. Record the time, date, and Sequential run numbers in the instrument log book.

BB.4.1.2 Pulling Sequential Sampling Canisters

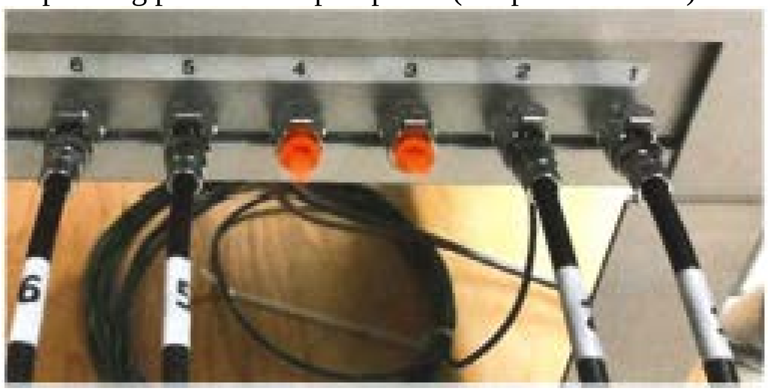
1. Lower the bottom portion of the radiation shield of the Super SASS by pulling out the locking pin.
2. Remove the cyclone from position 1 by rotating it counter clockwise.
3. Remove the canister from position 1 by rotating it counter clockwise and pull down and out of the holes in the mounting fixture.
4. Replace the caps on each end of the canister and place back in the small shipping bag. Place the bagged canister into the large shipping bag. Keep the sequential runs together in the small bag.
5. Repeat with sampling position 2, 3, and 4.
6. Press any key on the Super SASS keypad to activate the screen.
7. Press Event, then press F6 (Historical Event Summary). Locate the correct field form in the plastic bag for the first sequential run. Match up the field form Component ID # with the correct sampling canister. On this screen locate the run corresponding to the field form. Using the up/down arrow keys will scroll through the historical events.
8. Record the Start Time and Date, End Time and Date, Retrieval Time and Date, and Run Time on the field form.
9. Press the right arrow key three times to get to the Volume Summary screen. Record the Sample Volume, Average Ambient Temperature, Filter Temperature 1 and 2 (to locate Filter Temperature 2, toggle up using the arrow keys to record the second filter temperature), and Average Barometric Pressure.
10. Press the right arrow key to display the next screen. Record the Average Flow, Flow Coefficient of Variation (CV), Max/Min. Ambient Temperature, Max/Min Filter Temperature 1 and 2 (same procedures as step 9 to locate Filter Temperature), and Max/Min Barometric Pressure.
11. Press the right arrow key to view the remaining screens. Check for flow, time or temperature problems or flags. Record any Run Time Flags or ΔT Flags on the field form or record "None" if there are no problems.
12. Indicate flags on the Field Sampling Null Value and Validity Coding Form (Figure 4) or check the box for No Flags and sign and date the bottom of the form.
13. Press Exit twice to return to the main screen.
14. Take clear bag with the canisters back to the office in the transport cooler bag with ice packs and place in the refrigerator within 1 hour of pulling the canisters.

BB.4.1.3 Installation of Field Blank Canisters

The Filter Shipping Handling (FiSH) Lab sends monthly Field Blank (FB) canisters to each monitoring agency according to the established schedule. Currently, sequential l-in-3 day sampling sites receive FBs (labeled 8QFB) with sample 7Q (nylon and Teflon). The FBs should be handled identically to routine samples and remain on the sampler for the same duration as routine samples, however no air is drawn through the FB canisters.

To prepare your SASS sampler for FB collection and ensure no sample is drawn through the FB canisters:
1. Disconnect the sampling lines labeled 3 and 4 from the pump box.
2. Cap the end of these lines (see picture below).

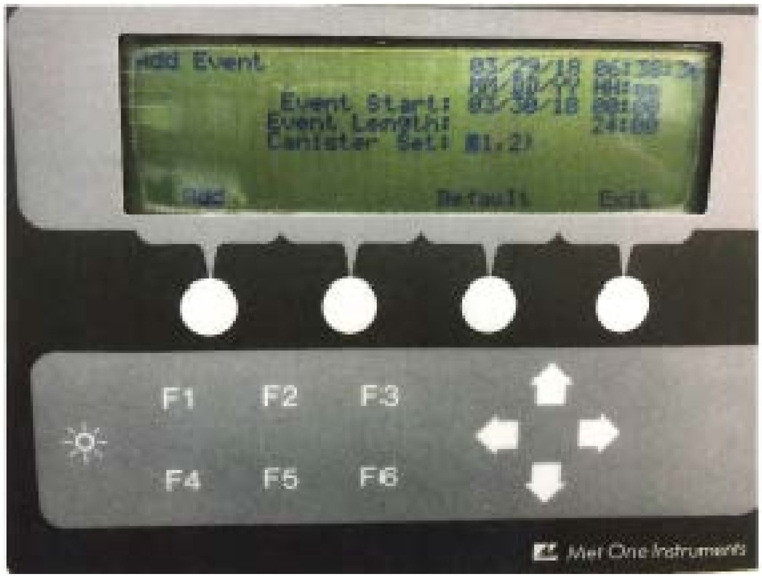
3. Cap the corresponding ports on the pump box (see picture below).



To collect Field Blanks on the SASS sampler, after installing the sampling canisters on channels 1 and 2:

1. Install the Teflon 8QFB canister (labeled with a green dot) onto channel 3 (see picture below).
2. Install the nylon 8QFB canister (labeled with a red dot) onto channel 4 (see picture below).

3. As an additional safeguard, program the sampler to only collect samples on channels 1 and 2 (see picture below).



4. Begin sampling as scheduled and document the FB sample collection and retrieval dates on the PM2.5 CSN Custody and Field Data Form when sampling is complete.

NOTE: If channels 1 and/or 2 are inoperable and channels 3 and 4 are needed for sampling, reconnect channels 3 and 4 and follow the above instructions for channels 1 and 2 to use for field blanks while utilizing channels 3 and 4 for sample collection.

Figure 2 EPA Sampling Schedule

EPA Sampling Schedule 2019

Important Dates

Notes

3-Day schedule is shown in orange, green, and purple

6-Day schedule is shown in green and purple

12-Day schedule is shown in purple

January

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

February

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

March

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

April

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

May

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

June

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

July

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

August

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

September

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

October

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

November

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

December

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Figure 3 $PM_{2.5}$ CSN Custody and Field Form

Q0712019100901

PM2.5 CSN CUSTODY AND FIELD DATA FORM

☐ White (return to lab)
☐ Yellow (site retains)

A. CUSTODY RECORD (Name, Date) Set: 7Q

	Name	Date		Name	Date
1. Laboratory Out:	LANGFORD	10/1/2019	3. Site Out:		
2. Site In:			4. Laboratory In:		

B. SITE AND SAMPLER INFORMATION

1. Site AQS Code:	320310016	5. Site Name:	Reno
2. Sampler S/N:		6. Intended date of use:	Wednesday, October 09, 2019
3. Sampler Type:	SASS	7. Date of Sampler Setup:	
4. Sampler POC:	5	8. Operator's Name:	

C. SAMPLER CHANNEL COMPONENTS

Channel No.	Component ID No	Component Description
1	I3178J	Met One/SASS Cover - Teflon
2	I3179K	Met One/SASS Cover - Nylon

D. START, END, AND RETRIEVAL TIMES

Channel No.	Start Date	Start Time	End Date	End Time	Retrieval Date	Retrieval Time
1						
2						

E. SAMPLER CHANNEL INFORMATION (Post-Sampling)

Channel No.	Run Time	Run Time Flag	Sample Volume (m3)	Avg. Flow (L/min)	Avg. Flow CV (%)	Avg. Ambient T (ºC)	Max. Ambient T (ºC)	Min. AmbientT (ºC)
1								
2								

Channel No.	DeltaT Flag	Avg. Filter T (ºC)	Max. Filter T (ºC)	Min. Filter T (ºC)	Avg. BP (mm Hg)	Max. BP (mm Hg)	Min. BP (mm Hg)
1							
2							

F: Comments

Figure 4 Field Sampling Null Value and Validity Coding Form

Chemical Speciation Network
Field Sampling Null Value and Validity Coding Form

☐ White (return to lab)
☐ Yellow (site retains)

Chain of Custody Sampling Request ID:	Q0712019100901	Intended Use Date	10/9/2019
		Sample Date (if different from Intended Use Date)	
Date Received in FiSH		Received in FiSH by:	

Instructions to Field Sampling Operator: For the sampling event identified by the Chain of Custody Sampling Request ID indicated above, please circle all applicable flags in the tables below. If no flags apply to this sampling event, please check the box below the tables.

Table A. Null Value Codes
* selection of any flag in this table will invalidate sample

Flag	Description
AB	TECHNICIAN UNAVAILABLE
AC	CONSTRUCTION/REPAIRS IN AREA
AD	SHELTER STORM DAMAGE
AE	SHELTER TEMPERATURE OUTSIDE LIMITS
AF	SCHEDULED BUT NOT COLLECTED
AG	SAMPLE TIME OUT OF LIMITS
AH	SAMPLE FLOW RATE OR CV OUT OF LIMITS
AI	INSUFFICIENT DATA (CAN'T CALCULATE)
AJ	FILTER DAMAGE
AK	FILTER LEAK
AL	VOIDED BY OPERATOR
AM	MISCELLANEOUS VOID
AN	MACHINE MALFUNCTION
AO	BAD WEATHER
AP	VANDALISM
AQ	COLLECTION ERROR
AR	LAB ERROR
AS	POOR QUALITY ASSURANCE RESULTS
AU	MONITORING WAIVED
AV	POWER FAILURE
AW	WILDLIFE DAMAGE
AZ	QC AUDIT
BA	MAINTENANCE/ROUTINE REPAIRS
BB	UNABLE TO REACH SITE
BE	BUILDING/SITE REPAIR
BI	LOST OR DAMAGED IN TRANSIT
BJ	OPERATOR ERROR
DA	ABERRANT DATA
SA	STORM APPROACHING
SV	SAMPLE VOLUME OUT OF LIMITS
TS	HOLDING TIME OR TRANSPORT TEMPERATURE OUT OF

Table B. Validity Flags
* samples marked with any of these flags will be analyzed and reported with flags noted

Flag	Description
2	Operational Deviation
3	Field Issue
4	Lab Issue
5	Outlier
6	QAPP Issue
FX	Filter Integrity Issue
IA	African Dust
IB	Asian Dust
IC	Chem. Spills and Industrial Accidents
ID	Cleanup After a Major Disaster
IE	Demolition
IF	Fire - Canadian
IG	Fire - Mexico/Central America
IH	Fireworks
II	High Pollen Count
IJ	High Winds
IK	Infrequent Large Gatherings
IL	Other
IM	Prescribed Fire
IN	Seismic Activity
IP	Structural Fire
IQ	Terrorist Act
IR	Unique Traffic Disruption
IS	Volcanic Eruptions
IT	Wildfire - U.S.
J	Construction
QP	Pressure Sensor Questionable
QT	Temperature Sensor Questionable
T	Multiple Flags: Misc
TT	Transport Temperaure is Out of Specs.
V	Validated Value
W	Flow Rate Average Out of Spec
X	Filter Temperature Difference Out of Spec
Y	Elapsed Sample Time Out of Spec

☐ No flags assigned to this sampling event   Signature ____________   Date ________

BB.4.2 Quality Control

BB.4.2.1 Monthly Checks

Monthly verifications of the Super SASS are completed near the end of the month.

Equipment Needed
- Verification Reference Standard (Alicat FP-25BT)
- Verification Filter Canisters (4)
- Flow Standard Adaptor/Attachment Hose
- QA/QC Form for SASS
- Calculator

Verification Procedure
1. Fill out the site and sampler information on the QA/QC Form for SASS (Figure 5).
2. Lower the bottom portion of the radiation shield of the Super SASS by pulling out the locking pin.
3. Press Calibrate on the Super SASS control module. Choose F1 (System Test). Four filter temperature readings will appear on the display screen. Place the Alicat FP-25 temperature probe in the sampling head on channel 1. The filter temperature sensors are located up inside the sampling head. After stability, record the filter temperature from the display screen and Alicat FP-25 on the QA/QC form.
4. Repeat the process for Channels 2, 3, and 4. Record the filter temperatures on the QA/QC form.
5. Remove the verification canister (labeled 1 and 3) from the cooler. Remove the caps from both ends of the canister. Install the canister by placing the alignment posts into the large holes in the mounting fixture of the sampling head in positions 1 or 3 (the same canister will be used for channels 1 and 3). Ensure the marking slot is pointing out and away from the center of the support tripod. Push the canister up and then rotate it clockwise until it stops, locking the canister in place.
6. Repeat for canister 2 or 4 (The same canister will be used for channels 2 and 4).
7. Install the cyclone for each sampling position by inserting the short fitting with the two O-rings into the hole on the bottom of the canister. Rotate the cyclone until the notched corner of the cyclone mount is under the lock screw of the canister.
8. Record the sampler's time and date and verification standard time and date on the QA/QC form. The sampler's time must be within +/- 5 minutes of the actual time. If the time is outside +/- 5 minutes the sampler's time must be reset. See section B.5 for Calibration Procedures.
9. Record the sampler's barometric pressure and Alicat FP-25 barometric pressure on the QA/QC form. The sampler's barometric pressure must be within +/- 10 mmHg of the Alicat FP-25 barometric pressure. If it is outside +/- 10mmHg, the barometric pressure must be recalibrated. See section B.5 for Calibration Procedures.
10. Carefully place the Alicat FP-25 thermometer probe in the ambient temperature radiation shield to obtain the ambient temperature. Record and compare the thermometer temperature to the sampler's ambient temperature. The sampler's temperature must be

within +/-2° C of the verification temperature. If it is outside +/- 2° C, the sampler's temperature must be recalibrated. See section B.5 for Calibration Procedures.

11. Press Pump at the bottom of the System Test screen. Press Continue to turn the sampler's pump on. Allow the sampler's flow to become stable at 6.7 L/min. Press the button to Leak check Status ON in the sampler display.
12. Place thumb on the bottom of the cyclone for Channel 1 to perform the leak check. Keep thumb pressed against the cyclone until the flow is stable. Record the flow from Channel 1. Repeat for Channel 2. If the flow is greater than 0.0 L/min, there is a leak in the instrument. See section B.8 for troubleshooting a leak.
13. Remove canisters from Channels 1 and 2 and install in Channels 3 and 4. Repeat step 12 for Channels 3 and 4.
14. To perform the flow checks, use the Alicat FP-25 flow standard. Attach the flow standard adaptor to the side of the speciation sampler radiation shield using the small clamp. Attach the Alicat to the top of the white adaptor fitting. Attach the hose from the bottom of the adaptor to the bottom of the sharp cut cyclone on position 1.
15. Turn the pump on by pressing Continue from the System Test screen. Allow the flow to stabilize and record the reading from the Alicat display and the sampler flow screen onto the field form. Using a calculator, calculate the standard deviation. The sampler flow must be within +/- 10% of the Alicat reference flow. Repeat for Channel 2.
16. Remove canisters from Channels 1 and 2 and install in Channels 3 and 4. Repeat steps 14 and 15 for Channels 3 and 4.
17. Press Pump, then press Continue to turn the pump off.
18. Detach the flow equipment and place the verification canisters in the cooler. Raise the radiation shield back into position and lock in place. Press Exit to return to the main screen.
19. Record the time, date, and verification result in the instrument log book.

BB.4.2.2 Quarterly Checks

Quarterly audits are performed once per quarter.

Equipment Needed

- Audit Reference Standard (Alicat FP-25)
- Verification Filter Canisters
- Flow Standard Adaptor/Attachment Hose
- QA/QC Form for SASS
- Calculator

Audit Procedures

1. Fill out the site and sampler information and quarterly check on the QA/QC Form for SASS (Figure 5). Fill out the AUDIT equipment name and ID numbers on the field form.
2. Follow steps 2 through 19 in section B.4.2.1 (Monthly Checks) with the audit equipment. If there is a parameter out of range fill out a Corrective Action Request (Figure 6) for the site operator to recalibrate the instrument.

Figure 5 QA/QC Form for SASS

Air Quality Management Division
QA/QC Form for SASS

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Verification: ____________ Audit: ________

Sampler: *Met One* Model: *SuperSASS* S/N: R11519 Site: Reno 3

Operator: [ ] Date: [ ]

Date / Time

Standard: [ ] Model: [ ] S/N: [ ]

	Display	Reference	Difference		
Date:					
Time (PST):				+ / - 5min?	Yes / No

Pressure

Standard: [ ] Model: [ ] S/N: [ ]

	Display (mmHg)	Reference (mmHg)	Difference (mmHg)		
Pressure:				+ / - 10 mmHg?	Yes / No

Temperature

Standard: [ ] Model: [ ] S/N: [ ]

	Display (°C)	Reference (°C)	Difference (°C)		
Ambient:				+ / - 2°C?	Yes / No
Filter 1				+ / - 2°C?	Yes / No
2				+ / - 2°C?	Yes / No
3				+ / - 2°C?	Yes / No
4				+ / - 2°C?	Yes / No

Leak Check

Standard: Thumb

	(L/min)		
Ch. 1		≤ 0.0 ?	Yes / No
Ch. 2		≤ 0.0 ?	Yes / No
Ch. 3		≤ 0.0 ?	Yes / No
Ch. 4		≤ 0.0 ?	Yes / No

Flow

Standard: [ ] Model: [ ] S/N: [ ]

Local Flow Actual LPM

	I_A (Sampler Display)	M_A (Transfer Standard)	I_A vs. M_A % Dev.		
Ch. 1				+ / - 10%?	Yes / No
Ch. 2				+ / - 10%?	Yes / No
Ch. 3				+ / - 10%?	Yes / No
Ch. 4				+ / - 10%?	Yes / No
		Avg. % Dev.		+ / - 10%?	Yes / No

Monthly Maintenance Completed? Yes / No

Quarterly Maintenance Completed? Yes / No

Comments: ____

File Name: SASS verif_audit
Reviewed: 10/04/19

Figure 6 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ____________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ____________________________

Problem Identification:

Site: ____________________________
System: ____________________________
Date: ____________________________
Time: ____________________________
Nature of Problem: ____________________________
____
____
____
Recommended Action: ____________________________
____

Signature: ____________________________ Date: ______________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________________
Time corrective action taken: ____________________________
Corrective Action Summary: ____________________________
____
____
____

Signature: ____________________________ Date: ______________

QA Manager Signature: ____________________________ Date: ______________

Supervisor Signature: ____________________________ Date: ______________

Director Signature: ____________________________ Date: ______________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

BB.5 Calibration Procedures

The operator will refer to this document as well as the manufacturer's operation manual to perform calibrations.

BB.5.1. Time and Date Calibration

If the time and date are out of range as specified above, a calibration must be performed before the next scheduled sample run.

1. Press Setup from the Main Screen.
2. Press F3 to select Clock.
3. Move the blinking cursor to the time and/or date.
4. Arrow up or down to change the appropriate numbers.
5. After setting the correct time and date press the Set key.

BB.5.2. Flow Calibration

1. Press Calibrate from the Main Screen.
2. Press F2 for Flow Calibration
3. The cursor will be blinking at the top of the screen, arrow over to choose the channel to be calibrated.
4. Attach the flow standard to the channel in question.
5. Press Pump, to turn the pump on.
6. Arrow over to the Ref. number. Use the arrows to change the reference number to the number obtained from the Alicat flow standard.
7. Once the Super SASS flow is stable, press Calibrate. This will calibrate the Super SASS flow to the Alicat reference flow. Follow the flow reading on the reference standard to make sure the calibration was successful. The Alicat Flow reading and instrument flow should be identical.
8. Repeat the above steps for the second third or fourth channels if needed.

BB.5.3. Temperature Calibration

1. Obtain the temperature resistance box.
2. Press Calibrate.
3. Press F3 for Temperature Calibration.
4. Remove the ambient temperature sensor from the cable.
5. Connect the cable to the top connector on the switched resistance box.
6. Disconnect the Sampling Head Cable from the Pump Box and connect the switched resistance box cable in its place.
7. Choose the appropriate channel. Channel 0 = Ambient Temp, Channel 1 = Filter 1 Temp, Channel 2 = Filter 2 Temp, etc.
8. Select -30 °C with the Temp Selector Knob.
9. Wait a few seconds for the measurement to stabilize, and then press F1 to save this value. Make sure the reference is also -30 °C on the SASS display.

10. Move the Temp Selection Knob to 50 °C. Wait for the measurement to stabilize and press F4 to save the value. Make sure the reference is also 50 °C on the SASS display.
11. Press the Calibrate button to store the calibration/resistance-equivalent data.
12. Move the Temp Selector Knob to 10 °C. The screen should display 10 °C +/- 1 °C. If the reading is outside the +/- 1 °C repeat steps 1 through 5. If the readings continue to be outside the specification contact the Met One Instruments Service Department.
13. Repeat steps 1 through 5 for channels 1 and 2 inside the sampler.
14. After channels 1 and 2 are calibrated exit out of the calibration screen into the Main Menu.

BB.5.4. Barometric Pressure Calibration

Equipment Needed

- NIST Traceable Pressure Standard
- Syringe
- Tygon tubing
- Nylon tee

Use the SASS field operation manual as an additional reference to this SOP during the pressure calibration. (See Section 6.3.2 in the operation manual).

1. Attach the syringe to the bottom of the tee and attach the tubing to either sides of the tee. Attach the tubing from one side to the pressure standard and the other tubing to the pressure port on the SASS.
2. Set the simulated pressure value to 600 mmHg as measured from the reference pressure sensor. When the measurement is stable, enter the value measured from the reference in the top reference window.
3. Press F1 to save the value.
4. Set the simulated pressure value to 800 mmHg as measure from the reference sensor. When the measurement is stable, enter the value measured from the reference in the second reference window.
5. Press F4 to save the value.
6. Press the Calibrate key and the new values will be saved in the memory of the control unit. This calibrates the pressure sensor in the pump box to the reference barometer.
7. Re-run the pressure checks to verify the new measurements are within the +/- 10 mmHg acceptance criteria. If they are not, rerun the calibration test again.
8. If the calibration fails a second time, the pressure sensor may be damaged and will need to be replaced.

BB.6 Shipping/Receiving Procedures

BB.6.1 Receiving Procedures

1. Sampling Canisters will be received on the days specified by AMEC Foster Wheeler shipping schedule (Figure 7). Shipping schedules are emailed to all Speciation operators from the Region 9 contact person. Contact Justin Knoll or the shipping manager at AMEC Foster Wheeler, to obtain a schedule if one has not been sent. The Region 9

contact person is also available to answer any problems or questions regarding STN sampling.

2. Unpack the paperwork from inside the shipping box. Sign and date “Site In” on the $PM_{2.5}$ STN Custody and Field Data Form. Separate Super SASS paperwork from URG paperwork. URG paperwork goes with the URG filter cassette. Replace all Super SASS paperwork back into the Ziploc bag separate from the URG field forms.
3. Remove the ice packs from around the canisters and place in boxes in the freezer.
4. Create two labels by writing the Set # (SEQ 1Q/2Q, SEQ 3Q/4Q, SEQ 5Q/6Q, or SEQ 7Q/8QFB), IN date, two SEQ run dates, and OUT date on two pieces of paper. Place one label with the paperwork and tape the other on the shipping box. Make sure to keep the respective set # with the appropriate box, as each box is assigned a Bin ID # that matches the BIN ID # on the paperwork. Place the Ziploc bag with all the paperwork into the plastic bag with the canisters.
5. Place the box in the filter archive/shipping/repair room until the ship date.
6. Take the plastic bag with the canisters to the site in the transport cooler bag located above the freezer. Place 6-8 blue ice packs in the transport bag. The ice packs are used for transport of field samples back to the repair room.

BB.6.2 Shipping Procedures

1. Remove the box from the filter archive/shipping/repair room on the ship date.
2. Remove the canisters to be shipped from the freezer.
3. Place the bag with the canisters in the shipping box. Place the frozen ice packs around the canisters. See figure 8 on how to correctly assemble the ice packs.
4. Twist-tie the canister bag closed.
5. Remove the forms from the Ziploc bag. Sign and date “Site Out” on the $PM_{2.5}$ STN Custody and Field Data Form. Separate the yellow and white forms on both field forms. Retain the yellow forms. Place the white forms back in the Ziploc bag. Replace foam top.
6. Tape shipping box in the center and on each side of center and place the shipping label on the top of the box.
7. Drop-off shipping box at the UPS drop box located just outside the mail room on the receiving dock. Drop-off must be done before 3:30 pm local time. Shipping box can also be taken to a UPS store for drop-off.
8. Place the yellow copies of the $PM_{2.5}$ STN Custody and Field Data Form and the Field Sampling Null Value and Validity Coding Form in the Speciation binder located in the repair room.

Figure 7 Chemical Speciation 1/3 Sequential Sampling Schedule

Chemical Speciation Network | Seq. Schedule Through Oct 2019

OCTOBER 2019

Shipping, Receiving and Sampling Schedule for CSN sites using Sequential 1-in-3 Day Sampling

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Date			**Oct 1**	**Oct 2**	**Oct 3**	**Oct 4**	**Oct 5**
Shipped from WOOD					7Q		
Received by State						7Q	
Sampling					**5Q**		
Shipped from State				3Q4Q			
Received by WOOD					3Q4Q		
Date	**Oct 6**	**Oct 7**	**Oct 8**	**Oct 9**	**Oct 10**	**Oct 11**	**Oct 12**
Shipped from WOOD		1Q2Q					
Received by State			1Q2Q				
Sampling	**6Q**			**7Q**			**1Q**
Shipped from State			5Q6Q				
Received by WOOD				5Q6Q			
Date	**Oct 13**	**Oct 14**	**Oct 15**	**Oct 16**	**Oct 17**	**Oct 18**	**Oct 19**
Shipped from WOOD		3Q4Q			5Q6Q		
Received by State			3Q4Q			5Q6Q	
Sampling			**2Q**			**3Q**	
Shipped from State		7Q			1Q2Q		
Received by WOOD			7Q			1Q2Q	
Date	**Oct 20**	**Oct 21**	**Oct 22**	**Oct 23**	**Oct 24**	**Oct 25**	**Oct 26**
Shipped from WOOD					7Q8Q FB		
Received by State						7Q8Q FB	
Sampling		**4Q**			**5Q**		
Shipped from State				3Q4Q			
Received by WOOD					3Q4Q		
Date	**Oct 27**	**Oct 28**	**Oct 29**	**Oct 30**	**Oct 31**		
Shipped from WOOD		1Q2Q					
Received by State			1Q2Q				
Sampling	**6Q**			**7Q8Q FB**			
Shipped from State			5Q6Q				
Received by WOOD				5Q6Q			

Figure 8 Icepack for Shipping Memo

amec
foster
wheeler

Memo

To: **To CSN Site Operators & Shippers**
From: **Justin Knoll**
Date: **November 15, 2017**

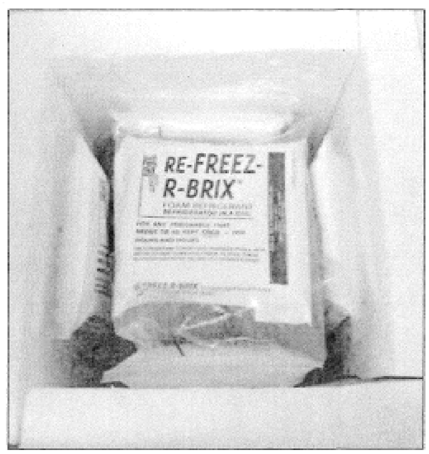
cc: **Beth Landis**
landis.elizabeth@epa.gov

Subject **icepack for shipping**

As you may have noticed, we are now using a different type of icepack for shipping. We expect this product will reduce the number of shipments that we receive from the field above the 4°C criteria. The Polar Tech Re-Freez-R-Brix are packaged with foam and a refrigerant. In our studies, they have shown to stay colder for a longer time period.

Unfortunately these packs are not as durable as the previous type which were made of hard plastic. We have already discarded a number of new icepacks because they were loaded into the bottom of the shipping boxes and they were pierced by the MetOne components. For this reason, we are asking that you please **do not load icepacks under the components**. There are 5 icepacks included with every shipment. Please load one on each of the four sides and place the remaining icepack on top of the components and under the foam lid. We hope that this will effectively protect these icepacks and the components. Below is an example of a properly packaged shipment.

Please contact Justin Knoll (knoll.justin@woodplc.com) or Beth Landis (landis.elizabeth@epa.gov) with any questions or concerns.



Thank You

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Program Manager CSN FiSH Unit
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BB.7 Routine Maintenance

After each sequential sampling run, use a cloth and/or the station air compressor to remove dirt and debris from the solar radiation shield, the sampling head (inside and out), and the grit caps on each of the four sharp cut cyclones.

BB.7.2. Quarterly Maintenance

Completely disassemble all four cyclones and clean all parts with a dry cloth, cotton swabs, and/or compressed air once per quarter. Inspect the cyclone and all O-rings. Replace O-rings when cracks appear. Reassemble the cyclones. Remove the cover to the pump box and blow out interior of the box with the station air compressor.

BB.8 Troubleshooting

The operator will refer to the manufacturer's operation manual for troubleshooting.

Appendix CC: Sequential URG 3000N

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ____

Title of Author: ____

Signature: ______________________________ Date: ____________________

Name: ____

Title: ____

Signature: ______________________________ Date: ____________________

Name: ____

Title: ____

Signature: ______________________________ Date: ____________________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:_______________________________________Date:___________________

Name: ____

Title: ____

Signature:_______________________________________Date:___________________

Name: ____

Title: ____

Signature:_______________________________________Date:___________________

Name: ____

Title: ____

Signature:_______________________________________Date:___________________

Name: ____

Title: ____

Signature:_______________________________________Date:___________________

Acronyms and Abbreviations

BP	Barometric Pressure
ºC	Degrees Celsius
CSN	Chemical Speciation Network
CV	Coefficient of Variation
EPA	U.S. Environmental Protection Agency
K	Kelvin
L/min	Liters per minute
MFC	Mass Flow Controller
µm	micrometers
mm	millimeters
mmHg	millimeters of Mercury
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter less than or equal to 2.5 microns in aerodynamic diameter
PST	Pacific Standard Time
QA	Quality Assurance
QC	Quality Control
SOP	Standard Operating Procedures
STN	Speciation Trends Network
TOA	Thermal Optical Analysis
URG	URG-3000N Sequential Particulate Speciation System

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CC.1. Introduction

The URG-3000N Sequential Particulate Speciation System (URG) collects $PM_{2.5}$ particles (airborne particles with diameters smaller than 2.5 µm) on quartz filters. The filters are analyzed for organic and elemental carbon using the Thermal Optical Analysis (TOA) method. The URG has been specifically designed to meet the needs of the U.S. Environmental Protection Agency (EPA) mandated standards for determining the concentration of carbon $PM_{2.5}$ particles. The design of the URG is shown in Figures 1, 1a, and 1b.

Figure 1 URG-3000N Sequential Particulate Speciation System

Figure 1a Controller Module

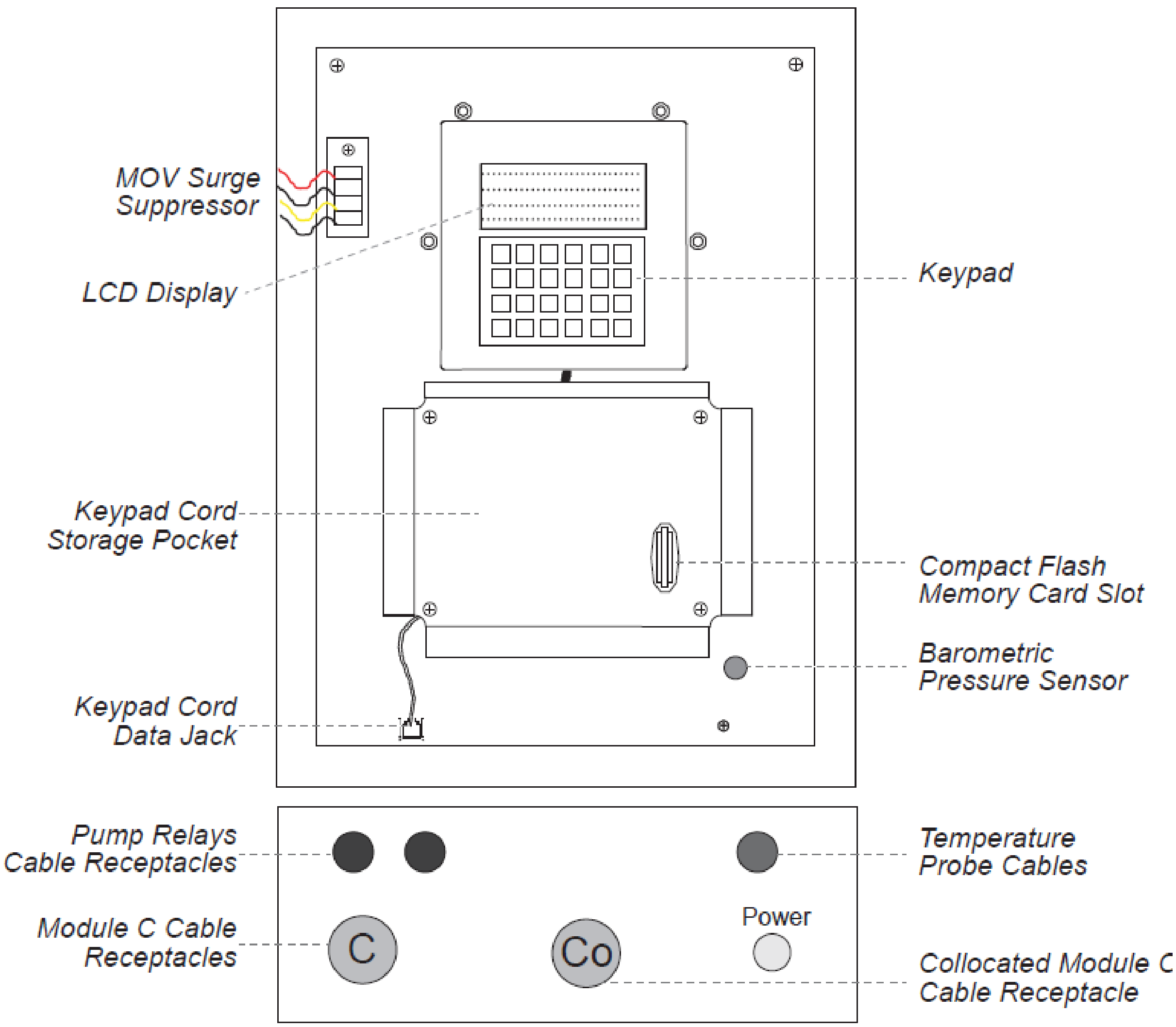
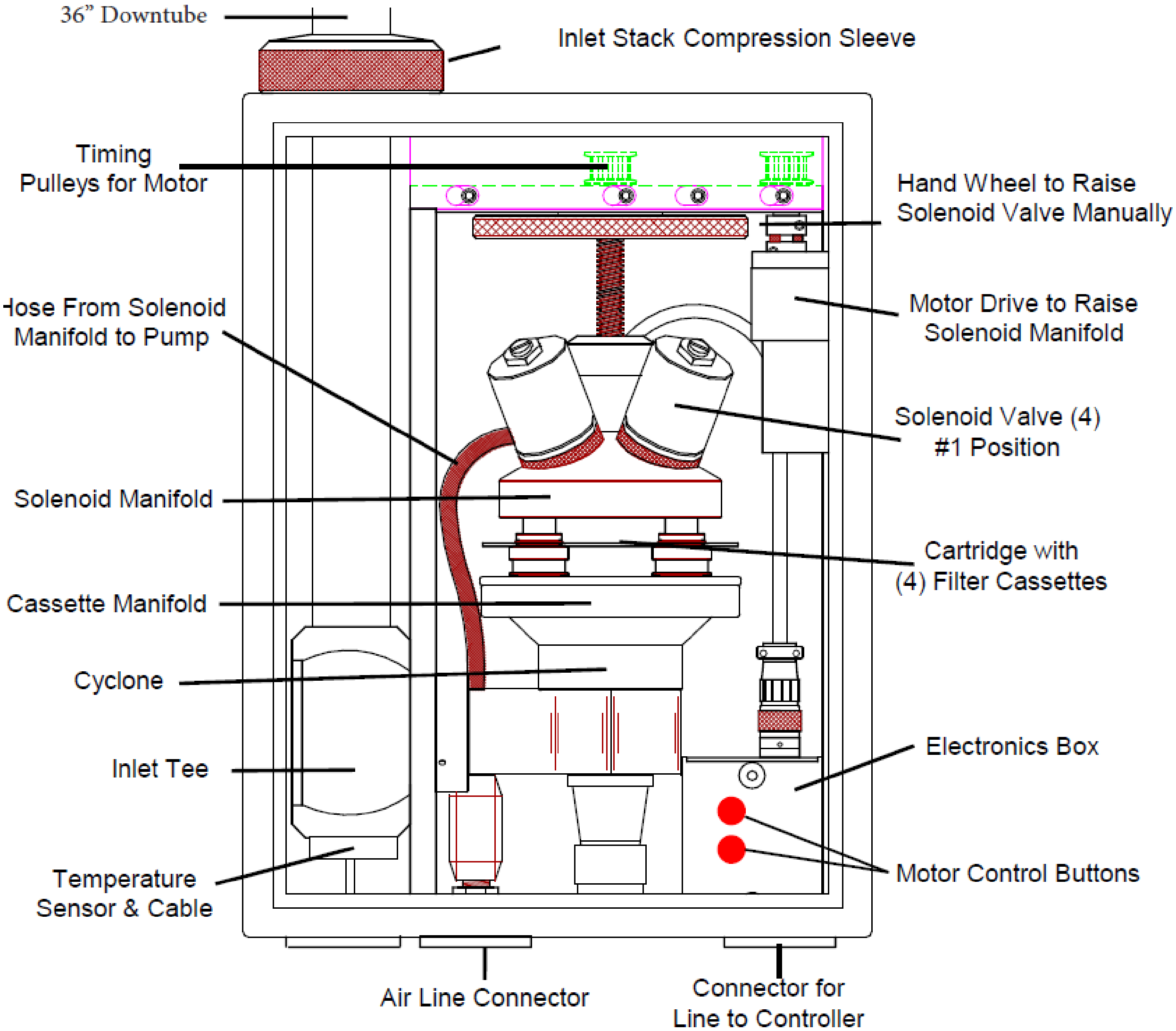


Figure 1b Sample Module C



CC.2. Theory of Operation

The URG accommodates up to four sequential sampling filters located within the sampling module portion of the instrument. Ambient air enters through a screened inlet on the top of the stack. The screened inlet removes bugs, rain and particles larger than approximately 15 µm. The air stream then passes through a cyclone that removes particles larger than 2.5 µm. The cyclone is 50% efficient at removing particles with aerodynamic diameters larger than 2.5 µm at the nominal flow rate of 22.0 liters per minute (L/min). It is volumetric flow controlled using a mass flow controller and corrections are made for temperature and barometric pressure variations. A temperature probe is located in the inlet tee of the Module C (Figure 1b). The temperature probe is situated in the air stream just prior to the cyclone. The controller portion of the instrument (Figure 1a) contains the timer, keypad and memory card slot. This portion of the instrument also houses the barometric pressure sensor. The lower portion of the instrument contains the vacuum pump as well as the mass flow controller, which maintains a constant flow rate during the sampling period.

CC.3. Precautions

Disconnect the power prior to performing any maintenance activities.

CC.4. Instrument Operation

CC.4.1 Sampling Procedure

The URG sampler is run every three days as specified by the EPA. See Figure 2 for the sampling schedule. The sampling duration is 24 hours, running from midnight to midnight Pacific Standard Time (PST).

Equipment Needed
- New filter cartridge
- New memory card
- $PM_{2.5}$ CSN Custody and Field Data Form
- Field Sampling Null Value and Validity Coding Form
- Instrument log book
- Filter transport cooler bag
- 6-8 Blue Ice packs

CC.4.1.1 Pulling and Installing Sample Filters and Memory Cards

1. Collect the new filter cartridges shipped from AMEC Foster Wheeler with the $PM_{2.5}$ CSN Custody and Field Data Form (Figure 3).
2. Open the Controller Module and remove the keypad from the inside of the instrument.
3. Open the Sampling Module and place the keypad on the inside of the sampling module door for ease of operation.
4. Ensure the previous run was completed.
5. Press Enter to go to the operator screen.

6. Press the key associated with the operator initials.
7. Press F1 key to "Change Filter".
8. Press "YES to continue" to filter change menu.
9. The sampler will read the barometric pressure and temperature for the exposed filter and record the information on the memory card.
10. Record the Start and End Date and Time of the run. This will be the run date and 0000 to 0000 hours.
11. Record the Retrieval Date and Time on the field form.
12. The MFC will then initiate a 5 minute warm-up.
13. After the warm-up the screen will show the final flow rate and vacuum pressure.
14. Press Enter to store the final flow rates to the memory card.
15. The next screen will display the Elapsed Time. Record this information on the field form.
16. Press F4. The next screen will display the Elapsed Time (Total) of the run. Record on field form.
17. Press F4. The next screen will display the Elapsed Time (After). Record the on field form.
18. Press F4 to continue to the next screen. Record the Sample Volume on the field form.
19. Press F4 to view the Average Flow and CV. Record on the field form.
20. Press F4 to view the Average, Max, and Min Temperatures. Record on the field form.
21. Press F4 to view the Average, Max, and Min Barometric Pressures. Record on the field form.
22. Indicate flags on the Field Sampling Null Value and Validity Coding Form (Figure 4) or check the box for No Flags and sign and date the bottom of the form.
23. For sequential sampling the second filter run will initiate.
24. Follow (steps 10-22) for second run of the sampling period.
25. Press Enter. The screen will prompt the operator to replace the controller's flash card.
26. Remove the flash card from the controller and place in the anti-static bag provided by the laboratory.
27. Install the new memory card.
28. The sampler will reset showing the URG-3000N boot screen.
29. The sampler will check the card and display "Memory Card OK", if the card is not detected, the operator will have to remove and reinstall the memory card.
30. Choose the correct sampling schedule for (SEQ 1Q & 2Q), (SEQ 3Q & 4Q), and (SEQ 5Q & 6Q). Choose F1= SEQ.
31. For (SEQ 7Q & 8QFB), choose F2=ALT Samp Date. At this time choose the No. of Filters, which is 1. Enter the correct sampling date and time of start. Press Enter.
32. Duration 1440 minutes. Press YES to continue.
33. The New Filter menu screen will appear, prompting the operator to "Remove Exposed and Insert New Filter".
34. Press the red "up" button located in Sample Module C (see Figure 1b) to raise the filter cartridge.
35. Remove the filter cartridge and replace the red caps on the filter holders.
36. Place the exposed filter cartridge in the shipping bag provided by the laboratory.
37. Remove the new filter cartridge from the shipping bag and remove all four red caps.
38. Install the new filter cartridge into the cassette manifold.

39. Press the red “down” button to secure the manifold on the new filter cartridge.
40. Press the Enter key when filter installation is complete to advance to the next screen.
41. Enter the Q Number for the new filter using the keypad, this number is found at the top of the new field form.
42. Press Enter to display the Comp ID screen, using the keypad enter the Comp ID number. This number is found in the field form for the quartz URG 3000N cartridge in component description.
43. Press Enter to advance to the next screen. The sampler will read ambient temperature and barometric pressure for the new filter for 10 seconds.
44. Repeat (steps 41-43) for the second filter of the sequential run.
45. Press Enter and the final flow rates will be displayed. If the vacuum check is satisfactory, press the Enter key to return the sampler to the Auto Mode and the next sample date is displayed.
46. Record the Date of Sampler Set-up and Operator’s name on the new field form.
47. Return the keypad to the Controller Module and latch the door.
48. Close and latch the Sampling Module.
49. Return all bags and field forms to the appropriate shipping bag.
50. Return filter transport cooler bag with 6-8 Blue Ice packs to the office freezer prior to shipping.

Figure 2 EPA Sampling Schedule

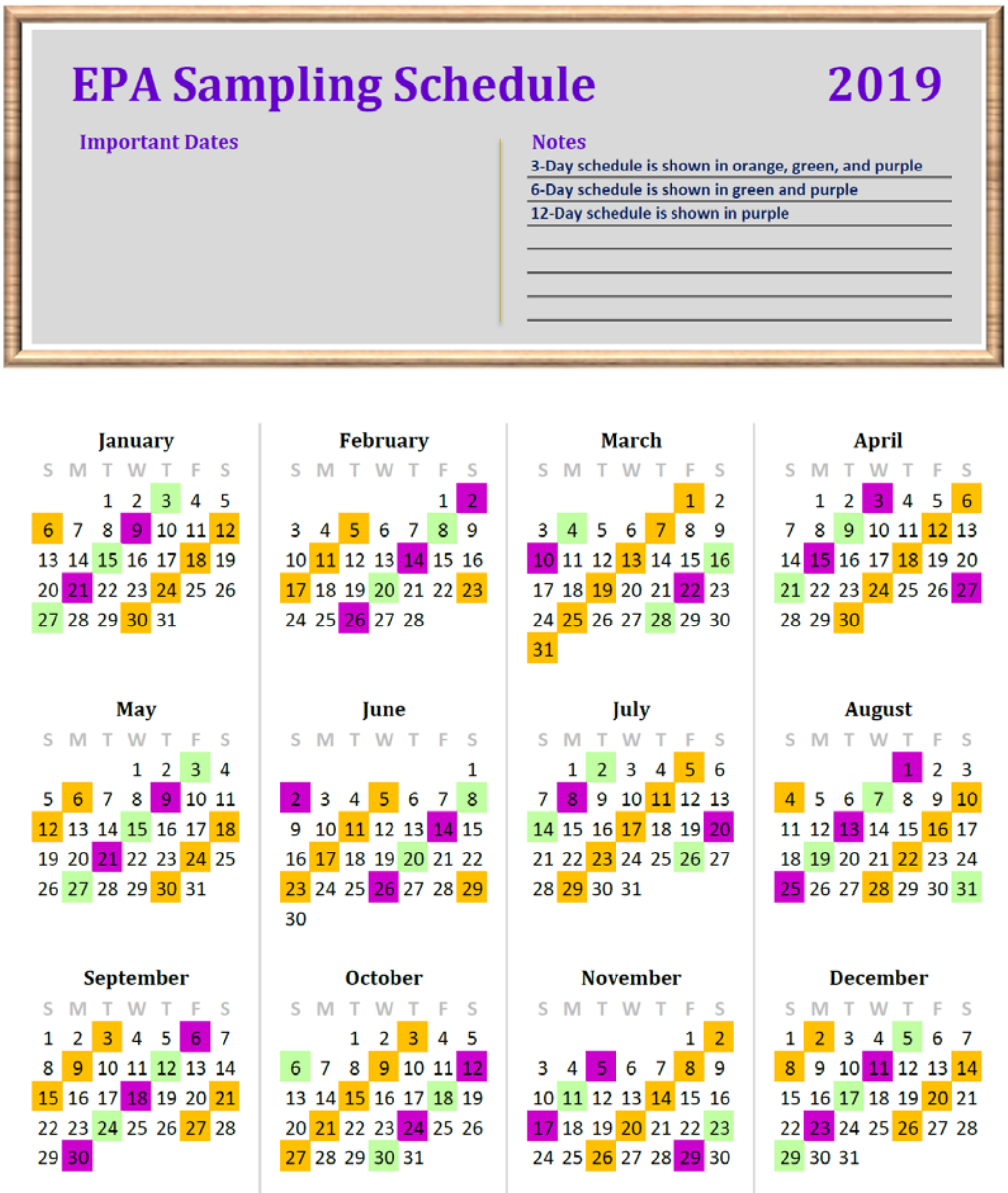


Figure 3 $PM_{2.5}$ CSN Custody and Field Form

Q0712019100902

PM2.5 CSN CUSTODY AND FIELD DATA FORM

☐ White (return to lab)
☐ Yellow (site retains)

A. CUSTODY RECORD (Name, Date)

Set: 7Q

	Name	Date		Name	Date
1. Laboratory Out:	LANGFORD	10/1/2019	3. Site Out:		
2. Site In:			4. Laboratory In:		

B. SITE AND SAMPLER INFORMATION

1. Site AQS Code:	320310016	5. Site Name:	Reno
2. Sampler S/N:		6. Intended date of use:	Wednesday, October 09, 2019
3. Sampler Type:	URG 3000N	7. Date of Sampler Setup:	
4. Sampler POC:	5	8. Operator's Name:	

C. SAMPLER CHANNEL COMPONENTS

Channel No.	Component ID No	Component Description
1	I119408	CF Memory Card
1	I122967	URG 3000N cartridge

D. START, END, AND RETRIEVAL TIMES

Channel No.	Start Date	Start Time	End Date	End Time	Retrieval Date	Retrieval Time
1						

E. SAMPLER CHANNEL INFORMATION (Post-Sampling)

Channel No.	Run Time	Run Time Flag	Elapsed Time (Total)	Elapsed Time (After)	Sample Volume (m3)	Avg. Flow (L/min)	Avg. Flow CV (%)
1							

Channel No.	Avg. Ambient T (ºC)	Max. Ambient T (ºC)	Min. AmbientT (ºC)	DeltaT Flag	Avg. BP (mm Hg)	Max. BP (mm Hg)	Min. BP (mm Hg)
1							

F: Comments

Figure 4 Field Sampling Null Value and Validity Coding Form

Chemical Speciation Network
Field Sampling Null Value and Validity Coding Form

☐ White (return to lab)
☐ Yellow (site retains)

Chain of Custody Sampling Request ID:	Q0712019100901	Intended Use Date	10/9/2019
	Sample Date (if different from Intended Use Date)		
Date Received in FiSH		Received in FiSH by:	

Instructions to Field Sampling Operator: For the sampling event identified by the Chain of Custody Sampling Request ID indicated above, please circle all applicable flags in the tables below. If no flags apply to this sampling event, please check the box below the tables.

Table A. Null Value Codes
* selection of any flag in this table will invalidate sample

Flag	Description
AB	TECHNICIAN UNAVAILABLE
AC	CONSTRUCTION/REPAIRS IN AREA
AD	SHELTER STORM DAMAGE
AE	SHELTER TEMPERATURE OUTSIDE LIMITS
AF	SCHEDULED BUT NOT COLLECTED
AG	SAMPLE TIME OUT OF LIMITS
AH	SAMPLE FLOW RATE OR CV OUT OF LIMITS
AI	INSUFFICIENT DATA (CAN'T CALCULATE)
AJ	FILTER DAMAGE
AK	FILTER LEAK
AL	VOIDED BY OPERATOR
AM	MISCELLANEOUS VOID
AN	MACHINE MALFUNCTION
AO	BAD WEATHER
AP	VANDALISM
AQ	COLLECTION ERROR
AR	LAB ERROR
AS	POOR QUALITY ASSURANCE RESULTS
AU	MONITORING WAIVED
AV	POWER FAILURE
AW	WILDLIFE DAMAGE
AZ	QC AUDIT
BA	MAINTENANCE/ROUTINE REPAIRS
BB	UNABLE TO REACH SITE
BE	BUILDING/SITE REPAIR
BI	LOST OR DAMAGED IN TRANSIT
BJ	OPERATOR ERROR
DA	ABERRANT DATA
SA	STORM APPROACHING
SV	SAMPLE VOLUME OUT OF LIMITS
TS	HOLDING TIME OR TRANSPORT TEMPERATURE OUT OF

Table B. Validity Flags
* samples marked with any of these flags will be analyzed and reported with flags noted

Flag	Description
2	Operational Deviation
3	Field Issue
4	Lab Issue
5	Outlier
6	QAPP Issue
FX	Filter Integrity Issue
IA	African Dust
IB	Asian Dust
IC	Chem. Spills and Industrial Accidents
ID	Cleanup After a Major Disaster
IE	Demolition
IF	Fire - Canadian
IG	Fire - Mexico/Central America
IH	Fireworks
II	High Pollen Count
IJ	High Winds
IK	Infrequent Large Gatherings
IL	Other
IM	Prescribed Fire
IN	Seismic Activity
IP	Structural Fire
IQ	Terrorist Act
IR	Unique Traffic Disruption
IS	Volcanic Eruptions
IT	Wildfire - U.S.
J	Construction
QP	Pressure Sensor Questionable
QT	Temperature Sensor Questionable
T	Multiple Flags: Misc
TT	Transport Temperaure is Out of Specs.
V	Validated Value
W	Flow Rate Average Out of Spec
X	Filter Temperature Difference Out of Spec
Y	Elapsed Sample Time Out of Spec

☐ No flags assigned to this sampling event   Signature ____________   Date ________

CC.4.2 Quality Control

CC.4.2.1. Monthly Checks

Monthly verifications of the URG are completed near the end of the month.

Equipment Needed
- Verification Reference Standard (Alicat FP-25BT)
- Verification Filter Cartridge
- URG Stopcock with Adapter
- QA/QC Form for URG
- Calculator

Verification Procedure
1. Fill out the Site and Sampler information as well as the verification standard information on the QA/QC Form for URG (Figure 5).
2. Open the Controller Module and remove the keypad from the inside of the instrument.
3. Open the Sampling Module and place the keypad on the inside of the sampling module door for ease of operation.
4. Complete the date and time section on the QA/QC form. The time must be +/- 5 minutes when compared to the standard. If the time is outside the specifications a time calibration must be performed (see section C.5 for Calibration Procedures).
5. Press Enter to go to the operator screen.
6. Press Enter to bypass the password screen or enter the password.
7. Press the key associated with the operator initials.
8. Press F4 More, F3 Audit, and F3 Temp.
9. Place the verification filter cartridge into the cassette manifold.
10. Remove the ambient temperature probe located at the base of the inlet inside the sample module. Press the lock release button located at the base of the inlet. While holding onto the temperature sensor cable, gently push the black disk located below the cable through the base of the sample module.
11. Place the Alicat FP-25 thermometer probe next to the URG temperature probe to get a collocated temperature reading.
12. Once the probes have equilibrated and stabilized, enter the Alicat temperature reading on the keypad.
13. After entering the reference value the screen will show the sampler and reference value differences.
14. Record the sampler and reference values on the QA/QC form. The difference should be within +/- 2°C. If the values do not agree perform a temperature calibration (see section C.5 for Calibration Procedures). Press enter to proceed to the next screen.
15. Press the Yes key to save the audit results to the memory card.
16. Press Enter to return to the Audit screen.
17. Replace the samplers ambient temperature probe back into the base of the inlet. Ensure the black disc is secure and the temperature lock is clicked into place.
18. Press F4 for the Barometric Pressure audit screen.

19. Enter the Barometric Pressure from the Alicat using the keypad and record the sampler and Alicat values onto the QA/QC form.
20. The screen will show the barometric pressure difference, the difference should be +/- 10mmHg. If the values do not agree, perform a barometric pressure calibration (see section C.5 for Calibration Procedures).
21. Press Enter to proceed to the next screen.
22. Press the Yes key to save the audit results to the memory card.
23. Press Enter to return to the Audit screen.
24. Press F1 to proceed to the Leak Check screen.
25. Press Enter to begin the leak check.
26. The screen will request the operator to install the flow audit adapter. Remove the inlet cap from the top of the downtube and place the flow audit adapter on the top of the inlet. Ensure it is in the open position.
27. Press Enter to proceed to the next screen.
28. The screen will display that the valve is open and a pump warm-up will occur for 15 seconds.
29. Press Enter to proceed to the next screen.
30. The screen will request the operator to close the flow audit adapter at the top of the inlet. Close the adapter and press Enter to proceed to the next screen.
31. The vacuum will begin to increase and the instrument will countdown for 15 seconds.
32. The screen will then request the operator to close the pump shutoff valve. Close the shutoff valve then press Enter to begin the leak check.
33. The pump will stop and the vacuum will decrease, the timer will countdown for at least 35 seconds and the results “Passed” or “Failed” will be displayed.
34. Record the Max/Min difference in pressure drop on the QA/QC form.
35. If the leak check fails, attempt another check. If both fail refer to the Troubleshooting guide in the operators’ manual.
36. Press Enter to advance to the next screen. The screen will request the operator to slowly release both valves. Do so slowly or the filter in the cassette may rupture.
37. Press “Yes” to save to memory card.
38. Press Enter to proceed and select the Flow option F2.
39. The screen will give a warning that a leak check must precede a flow check. Press Yes to continue to proceed with the flow check.
40. Attach the Alicat to the top of the flow adapter and press Enter to continue.
41. The MFC will set the flow and go through a pump warm-up.
42. The instrument flow rate will appear at the bottom of the screen and a space will be available for entering the transfer flow rate.
43. Enter the Alicat flow rate using the keypad.
44. The next screen will show sample, reference and difference. Calculate the percent deviation with a calculator. The agreement must be within +/- 10%. If the values do not agree within the acceptance criteria perform a flow calibration (see section C.5 for Calibration Procedures).
45. Record the flow rates on the QA/QC form and press Yes to save the results to the memory card.
46. Press Enter to return to the Audit Menu and press Enter to return to the main Menu.

Figure 5 QA/QC Form for URG

Air Quality Management Division
QA/QC Form for URG

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Verification: ________ Audit: ________

Sampler: *URG* Model: *3000N* S/N: 3NB0819 Site: Reno 3

Operator: [ ] Date: [ ]

Date / Time

Standard: [ ] Model: [ ] S/N: [ ]

	Display	Reference	Difference		
Date:					
Time (PST):				+ / - 5min?	Yes / No

Pressure

Standard: [ ] Model: [ ] S/N: [ ]

	Display (mmHg)	Reference (mmHg)	Difference (mmHg)		
Pressure:				+ / - 10 mmHg?	Yes / No

Temperature

Standard: [ ] Model: [ ] S/N: [ ]

	Display (°C)	Reference (°C)	Difference (°C)		
Ambient:				+ / - 2°C?	Yes / No

Leak Check

	Max	Min	Diff		
Standard: Stopcock				< 225?	Yes / No

Flow

Standard: [ ] Model: [ ] S/N: [ ]

	I_A (Sampler Display)	M_A (Transfer Standard)	I_A vs. M_A % Dev.		
Local (Act.) Flow (L/min):				+ / - 10%?	Yes / No

Monthly Maintenance Completed? Yes / No

Quarterly Maintenance Completed? Yes / No

Comments: ______________________________

File Name: URG verif_audit
Reviewed: 10/09/19

CC.4.2.2. Quarterly Checks

Quarterly audits are performed once per quarter.

Equipment Needed

- Audit Reference Standard (Alicat FP-25)
- Audit Filter Cartridge (Located in Sampler Module)
- URG Stopcock
- QA/QC Form for URG
- Calculator

Audit Procedures

1. Fill out the Site and Sampler information section on the QA/QC Form for URG (Figure 5). Fill out the audit Alicat information on the field form.
2. Open the Controller Module and remove the keypad from the inside of the instrument.
3. Open the Sampling Module and place the keypad on the inside of the sampling module door for ease of operation.
4. Complete the date and time audit on the field form. The time must be within +/- 5 minutes. If the time is outside the specifications a corrective action request must be completed for the site operator.
5. Press Enter to go to the operator screen.
6. Press Enter to bypass the password screen or enter the password.
7. Press the key associated with the operator initials.
8. Press F4 More, F3 Audit and F3 Temp.
9. Place the Audit filter cartridge into the cassette manifold.
10. Remove the ambient temperature probe located at the base of the inlet inside the sample module. Press the lock release button located at the base of the inlet. While holding onto the temperature sensor cable, gently push the black disk located below the cable through the base of the sample module.
11. Place the audit Alicat thermometer probe next to the URG temperature probe to get a collocated temperature reading.
12. Once the probes have equilibrated and stabilized enter the Alicat temperature reading on the keypad.
13. After entering the reference value, the screen will show the sampler and reference value differences.
14. Record the sampler and reference values on the QA/QC form. The difference should be within +/- 2°C. If the values do not agree complete a Corrective Action Request (Figure 6) for the operator. Press Enter to proceed to the next screen.
15. Press the Yes key to save the audit results to the memory card.
16. Press Enter to return to the Audit screen.
17. Replace the sampler's ambient temperature probe back into the base of the inlet. Ensure the black disc is secure and the temperature probe is locked into place.
18. Press F4 for the barometric pressure audit screen.
19. Enter the barometric pressure from the audit Alicat using the keypad and record the sampler and audit Alicat values onto the QA/QC form.

20. The screen will show the BP difference, the difference should be +/- 10mmHg. If the values do not agree, complete a Corrective Action Request for the operator.
21. Press Enter to proceed to the next screen.
22. Press the Yes key to save the audit results to the memory card.
23. Press Enter to return to the Audit screen.
24. Press F1 to proceed to the Leak Check screen.
25. Press Enter to begin the leak check.
26. The screen will request the operator to install the flow audit adapter. Remove the inlet cap from the top of the downtube and place the flow audit adapter on the top of the inlet. Ensure it is in the open position.
27. Press Enter to proceed to the next screen.
28. The screen will display that the valve is open and a pump warm-up will occur for 15 seconds.
29. Press Enter to proceed to the next screen.
30. The screen will request the operator to close the flow audit adapter at the top of the inlet. Close the flow audit adapter and press Enter to proceed to the next screen.
31. The vacuum will begin to increase and the instrument will countdown for 15 seconds.
32. The screen will then request the operator to close the pump shutoff valve. Close the shutoff valve then press Enter to begin the leak check.
33. The pump will stop and the vacuum will decrease, the timer will countdown for at least 35 seconds and the results "Passed", or "Failed" will be displayed.
34. Record the Max/Min difference in pressure drop on the QA/QC form.
35. If the leak check fails, attempt another check. If both fail, complete a Corrective Action Request for the operator.
36. Press Enter to advance to the next screen. The screen will request the operator to slowly release both valves. Slowly release or the filter in the cassette may rupture.
37. Press "Yes" to save to memory card.
38. Press Enter to proceed and select the Flow option F2.
39. The screen will give a warning that a leak check must precede a flow check; press yes to continue to proceed with the flow check.
40. Remove the top portion of the flow audit adapter and attach the audit Alicat to the top of the flow adapter and press Enter to continue.
41. The MFC will set the flow and go through a pump warm-up.
42. The instrument flow rate will appear at the bottom of the screen and a space will be available for entering the Alicat flow rate.
43. Enter the standard flow rate using the keypad.
44. The next screen will show sample, reference and difference. Calculate the percent deviation. The agreement must be within +/- 10%. If the values are outside the acceptance criteria, a Corrective Action Request must be completed for the site operator.
45. Record the flow rates on the field form and press yes to save the results to the memory card.
46. Press Enter to return to the Audit menu and press Enter to return to the main screen.

Figure 6 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ____________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ____________________________

Problem Identification:

Site: ____________________________
System: ____________________________
Date: ____________________________
Time: ____________________________
Nature of Problem: ____________________________

Recommended Action: ____________________________

Signature: ____________________________ Date: ________________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________________
Time corrective action taken: ____________________________
Corrective Action Summary: ____________________________

Signature: ____________________________ Date: ________________

QA Manager Signature: ____________________________ Date: ________________

Supervisor Signature: ____________________________ Date: ________________

Director Signature: ____________________________ Date: ________________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

CC.5 Calibration Procedures

CC.5.1. Time and Date Calibration

If the time and date are out of range as specified above, a calibration must be performed before the next scheduled sample run.

1. From the Main Menu choose the operator, and press F2 for Set Time and Date.
2. Use the arrow keys to change the date and time.
3. Press Enter to save the changes.

CC.5.2. Barometric Pressure Calibration

1. From the Main Menu Press F4 for More, choose F1 for Calibration.
2. At the Calibration Menu, press the F2 key to proceed to the barometric pressure calibration screen.
3. Press the Space key to continue with the calibration. The Raw Offset BP screen will appear.
4. Record the sampler and the reference standard BP values in mmHg on the URG Flow Calibration form (Figure 7).
5. Enter the barometric pressure of an equilibrated NIST-traceable Alicat using the keypad.
6. After entering the reference standard's barometric pressure, the next screen will show the sampler's calibrated barometric pressure.
7. Press the Yes key to save to the memory card. After a brief pause the screen will return to the calibration menu.

CC.5.3. Temperature Calibration

1. From the Main Menu Press F4 for More, choose F1 for Calibration and choose F1 for the Temperature Calibration.
2. Remove the ambient temperature probe from the base of the inlet tee and place next to an NIST-traceable Alicat thermometer probe. Allow both temperatures to equilibrate.
3. Press F1 to continue to the ambient temperature calibration screen.
4. Press the Space key to begin the ambient temperature calibration.
5. After the two probes equilibrate, record the sampler and Alicat values in °C on the URG Flow Calibration form.
6. Enter the Alicat temperature value in ºC. Press the F1 key to toggle between positive and negative values and press the F2 key to toggle between °C and °F. The next screen will show the sampler's calibrated temperature.
7. Press the Yes key to save to the memory card. After a brief pause, the screen will return to the Calibration Menu.

CC.5.4. Flow Calibration

Prior to conducting flow rate verification, a successful leak check must be completed. The operator should use a NIST-traceable Alicat FP-25BT. The flow rate calibration must be conducted with the “AUDIT” cartridge located in the sampler module. Attach the Alicat to the flow audit adapter and begin the flow rate verification.

1. At the Calibration Menu, press the F3 key and then the Enter key to proceed to the flow rate calibration screen.
2. A screen will appear warning the operator to perform a leak check prior to performing a flow calibration. The next screen will ask the operator to continue press Yes to continue with the flow calibration.
3. The next screen will show the first calibration point of 19.80 L/min, press the Enter key to advance to the next screen. Press the Enter key again to proceed to the first calibration point.
4. The screen will prompt the operator to connect the flow meter, ensure the Alicat is attached properly and press Enter to continue.
5. The sampler will initiate an MFC 5 minute warm-up. At the end of the warm-up, the screen will show the sampler’s flow rate and vacuum at that time. Press Enter to continue.
6. The next screen will prompt the operator to enter the Alicat FP-25BT flow rate in L/min. Enter the flow rate using the keypad. Record the sampler and reference standard value on the URG calibration form.
7. After entering the information for the first calibration point, the screen will show the next calibration point of 22.0 L/min. Press the Enter key and complete the second and third calibration points as described above.
8. After entering the information for the third calibration point, a screen will appear showing the new Gain, Offset and Correlation Coefficient. Press Yes to save to the memory card and press Enter to return to the Calibration screen. Press the Enter key twice to return to the Main Screen.

Figure 7 URG Flow Calibration Form

Air Quality Management Division
URG Flow Calibration

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Sampler: *URG* Model: *3000N* S/N: 3NB0819 Site: Reno 3

Start Time (PST): ______ Date: ______ Operator: ______
End Time (PST): ______

Flow Standard: ______ Model: ______ S/N: ______

Ambient Temperature Cal	Display (°C)	Standard (°C)
Ambient:		

Barometric Pressure Cal	Display (mmHg)	Standard (mmHg)
Pressure:		

Flow (22.0 L/min)

	Display (L/min)	Standard (L/min)	SASS vs. Ref Std % Dev.		
Act. Flow:				+ / - 10% ?	Yes / No

Post Cal Flow Verification (22.0 L/min)

	Display (L/min)	Standard (L/min)	SASS vs. Ref Std % Dev.		
Act. Flow:				+ / - 10% ?	Yes / No

Comments: ______

File Name: URG Flow Cal
Reviewed: 10/09/19

CC.6 Shipping/Receiving Procedures

CC.6.1. Receiving Procedures

1. URG filters will arrive with SASS Sampling Canisters and will be received on the days specified by AMEC Foster Wheeler shipping schedule (Figure 8). Shipping schedules are emailed to all Speciation operators from the Region 9 contact person. Contact Justin Knoll at AMEC Foster Wheeler, to obtain a schedule if one has not been sent. The Region 9 contact person is also available to answer any problems or questions regarding Speciation sampling.
2. Unpack the paperwork from inside the shipping box. Sign and date the Site In on the PM2.5 CSN Custody and Field Data Form (Figure 3). Staple the White and yellow forms together for field procedures. Replace all paperwork back into the Ziploc bag.
3. Remove the ice packs from the shipping container and place in the freezer.
4. Write the SEQ #, In date, Run date, and Ship date on two pieces of blank paper. Place one in with the paperwork and tape one on the box. Make sure to keep the SEQ # with the appropriate box. Place the Ziploc bag with the paperwork in with the filters.
5. Place the box in the shipping/receiving room until the ship date.
6. Remove the bag and use the filter transport cooler bag to take filters to the site.

CC.6.2. Shipping Procedures

1. Remove the box from the shipping/receiving room on the ship date.
2. Remove the bag to be shipped from the freezer.
3. Place the bag with the URG filters and SASS canisters in the shipping box see Figure 9.
4. Twist-tie the canister bag closed.
5. Remove the forms from the Ziploc bag. Sign and date the Site Out on the PM2.5 CSN Custody and Field Data Form. Separate the yellow and white copies of both field forms. Retain the yellow forms. Place the white forms bag in the Ziploc bag. Replace foam top.
6. Tape shipping box and place the shipping label on the top of the box.
7. Transport the box to the Washoe County UPS drop box located on the shipping and receiving dock by 3:00pm. Drop-off at a UPS Store before 5:00pm is also acceptable.
8. Place the yellow copies of the PM2.5 CSN Custody and Field Data Forms and the Field Sampling Null Value and Validity Coding Forms in the Speciation binder located in the repair room.

Figure 8 Chemical Speciation 1/3 Sequential Sampling Schedule

Chemical Speciation Network

Seq. Schedule Through Oct 2019

OCTOBER 2019

Shipping, Receiving and Sampling Schedule for CSN sites using Sequential 1-in-3 Day Sampling

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Date			**Oct 1**	**Oct 2**	**Oct 3**	**Oct 4**	**Oct 5**
Shipped from WOOD					7Q		
Received by State						7Q	
Sampling					**5Q**		
Shipped from State				3Q4Q			
Received by WOOD					3Q4Q		
Date	**Oct 6**	**Oct 7**	**Oct 8**	**Oct 9**	**Oct 10**	**Oct 11**	**Oct 12**
Shipped from WOOD		1Q2Q					
Received by State			1Q2Q				
Sampling	**6Q**			**7Q**			**1Q**
Shipped from State			5Q6Q				
Received by WOOD				5Q6Q			
Date	**Oct 13**	**Oct 14**	**Oct 15**	**Oct 16**	**Oct 17**	**Oct 18**	**Oct 19**
Shipped from WOOD		3Q4Q			5Q6Q		
Received by State			3Q4Q			5Q6Q	
Sampling			**2Q**			**3Q**	
Shipped from State		7Q			1Q2Q		
Received by WOOD			7Q			1Q2Q	
Date	**Oct 20**	**Oct 21**	**Oct 22**	**Oct 23**	**Oct 24**	**Oct 25**	**Oct 26**
Shipped from WOOD					7Q8Q FB		
Received by State						7Q8Q FB	
Sampling		**4Q**			**5Q**		
Shipped from State				3Q4Q			
Received by WOOD					3Q4Q		
Date	**Oct 27**	**Oct 28**	**Oct 29**	**Oct 30**	**Oct 31**		
Shipped from WOOD		1Q2Q					
Received by State			1Q2Q				
Sampling	**6Q**			**7Q8Q FB**			
Shipped from State			5Q6Q				
Received by WOOD				5Q6Q			

Figure 9 Icepack for Shipping Memo

amec foster wheeler

Memo

To: **To CSN Site Operators & Shippers**
From: **Justin Knoll**
Date: **November 15, 2017**

cc: **Beth Landis**
landis.elizabeth@epa.gov

Subject **icepack for shipping**

As you may have noticed, we are now using a different type of icepack for shipping. We expect this product will reduce the number of shipments that we receive from the field above the 4°C criteria. The Polar Tech Re-Freez-R-Brix are packaged with foam and a refrigerant. In our studies, they have shown to stay colder for a longer time period.

Unfortunately these packs are not as durable as the previous type which were made of hard plastic. We have already discarded a number of new icepacks because they were loaded into the bottom of the shipping boxes and they were pierced by the MetOne components. For this reason, we are asking that you please **do not load icepacks under the components**. There are 5 icepacks included with every shipment. Please load one on each of the four sides and place the remaining icepack on top of the components and under the foam lid. We hope that this will effectively protect these icepacks and the components. Below is an example of a properly packaged shipment.

Please contact Justin Knoll (knoll.justin@woodplc.com) or Beth Landis (landis.elizabeth@epa.gov) with any questions or concerns.

Thank You

Justin Knoll
Program Manager CSN FiSH Unit
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Newberry, Florida
USA 32669-3000
Tel + 1 352 332 3318
Fax + 1 352 333 6622

CC.7 Routine Maintenance

Weekly maintenance of the sampler should include a complete wipe-down of the interior and exterior of the sampler before each run. Additionally, check the inside of the sampler for signs of water intrusion and dust and debris accumulation.

CC.7.1. Quarterly Maintenance

CC.7.1.1 Downtube Maintenance

Downtube maintenance should be completed quarterly. The downtube maintenance kit is located in the shelter. Remove the inlet from the downtube. Remove the downtube from the shield of the URG. Place a dry cloth through the slip-loop on the end of the rope opposite the weight. Gently ease the weight with the cloth down the downtube, removing and dust or debris. Replace the downtube and the inlet.

CC.7.1.2 Rotate Audit Filter

The audit filter in the audit cartridge must be rotated every quarter to ensure equal wear on the filters. Remove the white filter holder in the cartridge and rotate one position. Return the damaged audit cartridges to the laboratory.

CC.7.1.2 Pump Box Cleaning

Take the 4 top screws off of the Pump enclosure. There are two sides that need removal. Use the station air compressor to blow off the dust and debris accumulation. Wipe off the rest of the debris with a cloth.

CC 7.2 Annual Maintenance

1. Cyclone O-ring replacement.
2. Audit cassette O-ring & filter media replacement.

Contact URG for information regarding their cyclone and audit cassette exchange programs.

CC 7.3 Bi-Annual Maintenance

1. Vacuum pump rebuild.
2. Vacuum pump inline filter replacement.
3. Motor timing belt replacement.

CC.8 Troubleshooting

Refer to the manufacturer’s operation manual for troubleshooting.

Appendix D: Beta Attenuation Monitors – $PM_{2.5}$ and PM_{10}

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ____

Title of Author: ____

Signature: ____________________________ Date: ______________

Name: ____

Title: ____

Signature: ____________________________ Date: ______________

Name: ____

Title: ____

Signature: ____________________________ Date: ______________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Abbreviations and Acronyms

AT	Ambient Temperature
BAM	Beta Attenuation Monitor
BP	Barometric Pressure
ºC	Degrees Celsius
DAS	Data Acquisition System
EPA	U.S. Environmental Protection Agency
K	Kelvin
L/min	Liters per minute
mmHg	millimeters of Mercury
NAAQS	National Ambient Air Quality Standards
NIST	National Institute of Standards and Technology
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter less than or equal to 2.5 microns in aerodynamic diameter
PM_{10}	Particulate Matter less than or equal to 10 microns in aerodynamic diameter
PM_{COARSE}	PM_{10} minus $PM_{2.5}$
PST	Pacific Standard Time
QA	Quality Assurance
QC	Quality Control
SOP	Standard Operating Procedures
VSCC	Very Sharp Cut Cyclone

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D.1 Introduction

The Beta Attenuation Monitor (BAM)-1020 Continuous Particulate Monitor automatically measures and records airborne particulate concentrations in micrograms per cubic meter using beta ray attenuation. The BAM-1020 operates continuously providing particulate readings every hour. The purpose of this document is to supplement the manufacturer's manual with instructions for operating the monitor.

D.2 Theory of Operation

The BAM-1020 Particulate Monitor automatically measures and records dust concentration by using the principle of beta ray attenuation to provide a simple determination of mass concentration. A small amount of ^{14}C emits a constant source of beta particles that are efficiently detected by an ultra-sensitive scintillation counter. An external pump pulls a measured amount of air through filter tape. The filter tape impregnated with ambient dust is placed between the source and the detector causing the attenuation of the measured beta-particle signal. The degree of attenuation of the beta-particle signal is used to determine the mass concentration of particulate matter on the filter tape and the volumetric concentration of particulate matter in the ambient air. The BAM-1020 is certified as an Equivalent Method for PM_{10} and $PM_{2.5}$ by the US EPA when equipped with the PM10 sampling inlet and/or the PM2.5 Very Sharp Cut Cyclone (VSCC) and when operated under specific conditions.

D.3 Precautions

- To avoid injury, always use two people to lift and carry the monitor.
- Ensure monitor and external pump is set up for proper voltage and frequency.
- Ensure power plug has a grounded lug.
- Remove power from the monitor before service is performed.
- Take care to avoid falling when working on roofs, ladders and/or towers.

D.4 Monitor Operation

D.4.1 Quality Control

D.4.1.1 Site Checks

Perform Site Checks during each visit to the site. Complete each category in one column of the BAM Routine Check Form (Figure 1) approximately three times per week. Shelter conditions are also noted and logged on the Station Log Report (Figure 2). Error codes, changes in diagnostics or work performed on the BAM is also noted in the Station Log Report.

Figure 1 BAM Routine Check Form

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Air Quality Management Division
BAM Routine Check Form

Site: ____________________

Date of Last Routine Check: ____________________

Instrument
Manufacturer: ____________________
Model: ____________________
Serial Number: ____________________

Date										
Time (PST)										
Operator's Initials										
Instrument Date										
Instrument Time (PST)										
Inst. Concentration ($\mu g/m^3$)										
DAS Concentration ($\mu g/m^3$)										
Instrument Flow (act. L/min)										
Tape Condition										
Trouble Lights/ Error Codes										
Last Calibration Factor										

Comments: ____________________

File Name: BAM routine check form
Last Revision: 10/01/19

Figure 2 Station Log Report

Washoe County Health District - Air Quality Management Division

Station Log Report

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site: ____________________

	Operator(s):												
	Date:												
	Time (PST):												
		Y	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**
1	Outside Good Repair:												
2	Inside Good Repair:												
3	All Settings Correct:												
4	Heat/Air Working:												
5	A/C Clean Filter Light Off:												
6	Analyzer Fault Lights Off:												
7	Analyzer Date/Time +/- 1 min:												
8	Gas Analyzer Multipoint Current:												
9	Datalogger Date/Time +/- 1 min:												
10	UPS Battery Status Light Green:												
11	T° Sentry Status Light Green:												
12	Station Inside Temperature (°C):												
13	Instruments Adjusted:												

Additional Comments:

Station Log Report
Last Revision: 09/05/17

D.4.1.2 Bi-Weekly Flow Check

Perform an inlet flow verification to ensure a flow rate of 16.67 actual L/min (+/- 4 percent) every other week. Record all information on the BAM Worksheet (Figure 3) and save to the AQMonitoring$ drive, Field Mgmt Functions, QA-QC, BAM QA-QC, and the site of flow check for current year and date. Remove only the PM10 inlet when measuring flow.

Equipment Needed

- NIST Traceable Alicat FP-25BT
- Stopcock
- Time piece accurate to +/- 1 min.
- Laptop with BAM worksheet
- Smart Phone with Alicat Bluetooth application

1. Place the Alicat FP-25BT on the roof for a few minutes prior to the flow check for equilibration.
2. Put the site instrument in maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS and enter the Password to get to the Home Menu. From the Home Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press I for Put Channel In Maintenance, choose the parameter (BAM25RAW and/or BAM10RAW) plus BAM10-2.5 for coarse sites and press Enter.
3. Record the "Start Time" in PST on the BAM Worksheet.
4. Complete the required information on the BAM Worksheet, including the instrument's displayed flow in actual L/min.
5. Record Date/Time from instrument display and accurate time piece. Calculate the difference between the two. Acceptance criteria are +/- 2 min. If not within specification, see section D.5.1 for setting the instrument clock.
6. Record ambient pressure from instrument display (OPERATE>NORMAL screen) and pressure standard (in mmHg). Calculate the difference between the two. Acceptance criteria are +/- 10 mmHg. If not within specification, see section D.5.2 for pressure calibration.
7. Record ambient temperature from the instrument display (OPERATE>INST screen) and temperature standard (in °C). Ensure that the temperature standard probe is securely collocated inside the instrument's gill shield. Calculate the difference between the two. Acceptance criteria are +/- 2°C. If not within specification, see section D.5.3 for temperature calibration.
8. Remove PM_{10} inlet from top of down tube while leaving the VSCC in place (if a $PM_{2.5}$ monitor). Attach the Alicat FP-25BT to the top of the down tube.
9. Allow the reading to stabilize and hit Start Avg., then take the 5 second average off the Alicat. Record measured flow on BAM Worksheet.
10. Calculate percent deviation between indicated and measured flow. Acceptance criteria are +/- 4%. If not within specification, see section D.5.4 for flow calibration.
11. Calculate percent deviation between measured flow and set point (16.67 L/min). Acceptance criteria is +/- 5%. If not within specification, see section D.5.4 for flow calibration.

12. Remove the Alicat from the top of the down tube. Install a BX-305 or BX-302 leak test valve (or equivalent valve for auditing FRM samplers) onto the inlet tube. Turn the valve to the OFF position to prevent any air from entering the inlet tube.
13. In the TEST > TAPE menu, advance the tape forward to a fresh, unused spot.
14. In the TEST > PUMP menu, turn on the pump. The flow rate should drop below 1.5 L/min. If the leak flow value is 1.5 L/min or greater, then the nozzle and vane need cleaning, or there may be another small leak in the system.
15. Resolve the leak and perform the check again. A properly functioning BAM with a clean nozzle and vane will usually have a leak value of about 1.0 L/min or less using this method.
16. Turn the pump off, remove the leak test valve, and re-install the inlet heads if monthly maintenance is already complete.
17. **NOTES:** The reason for the 1.5 L/min leak flow allowance is due to the test conditions. With the inlet shut off the vacuum in the system is very high, about 21 inHg. This is many times greater than the BAM-1020 will encounter during normal sampling. If the leak reading during this test is less than 1.5 L/min, there should not be a significant leak during normal operation.
18. Complete the monthly inlet and down tube maintenance (if due) before placing the inlet back on the downtube (see section D.6 for Routine Maintenance).
19. Replace the inlet on the downtube and press Tape on the front of the instrument.
20. Press Self-Test to engage the sampler in the self-test procedure.
21. Record the pass/fail of the self-test on the field form. If the self-test fails, refer to the Troubleshooting section of the Met One BAM 1020 Operation Manual.
22. Note the end time on the field form.
23. Take the instrument out of maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS and enter the Password to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press O for Take Channel Out of Maintenance, choose the parameter and press Enter. ESC back to the Main Menu and press D, then L to return to displaying the parameters on the screen.
24. Print two copies of the BAM Worksheet; one for the instrument QA/QC binder located at the site and one for the data exception log binder located in the office.
25. Record the date, start time, end time, and parameter on the Data Exception Log (Figure 4). Circle the appropriate error code.

Figure 3 BAM Worksheet

Washoe County Health District - Air Quality Management Division
BAM Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Flow Check:		Calibration:		Audit:	
Manufacturer:	Met One	Model:	BAM 1020	S/N:	
ID:					
Start Time (PST):		Date:		Operator:	
End Time (PST):		Site:			

Date / Time

Standard: ______ Model: ______ S/N: ______

	Display	Reference	Difference		Yes	No
Date:			-			
Time (PST):			0	+/- 2 min?	X	

Pressure

Standard: ______ Model: ______ S/N: ______

	Display (mmHg)	Reference (mmHg)	Difference (mmHg)		Yes	No
Pressure:			0	+/- 10mmHg?	X	

Temperature

Standard: ______ Model: ______ S/N: ______

	Display (°C)	Reference (°C)	Difference (°C)		Yes	No
Ambient:			0.0	+/- 2°C?	X	
Low:			0.0	+/- 2°C?	X	
High:			0.0	+/- 2°C?	X	

Flow

Standard: ______ Model: ______ S/N: ______

T_A: 0.0 °C + 273 = 273.0 K P_A: 0 mmHg / 760 = 0.000 atm

	I_A (Inst. Ind. Flow)	M_A (Measured Flow)	I_A vs. M_A % Dev.		Yes	No
Local (Act.) Flow (LPM):			#DIV/0!	+/- 4%	#DIV/0!	#DIV/0!
			M_A vs. 16.67			
			-100.0	+/- 5%		X

Std. Flow (LPM):				Yes	No
	M_S (standard measured flow) = $M_A(P_A/T_A)(298/760)$	0.00			
	I_S (instrument indicated flow) = $I_A(P_A/T_A)(298/760)$	0.00			
	I_S vs. M_S	#DIV/0!	+/- 4%	#DIV/0!	#DIV/0!

Leak Check

As Found (Std. LPM)	After Maint. (Std. LPM)		Yes	No
		< 1.5 LPM?	X	

Maintenance

	Yes	No	N/A
Monthly PM_{10} Inlet Maintenance Completed?			
Monthly $PM_{2.5}$ VSCC Maintenance Completed?			
Monthly Nozzle, Vane, Capstan Shaft, and Pinch Roller Maint. Completed?			
Quarterly PM_{10} Inlet Maintenance Completed?			

	Yes	No	Date
Semi-annual Smart Heater, RH, and Filter Temperature Test?			
Annual Span Membrane Foil Check and Beta Detector/Dark Count?			
Annual Vertical Inlet Tube and Internal Debris Filter Cleaning?			

	Yes	No
Self Test Passed?		

Comments: ______________________________

File Name: BAM Worksheet_Alicat
Reviewed: 03/20/19

Figure 4 Data Exception Log

Site: Year: Quarter:

Date	Begin Time	End Time	Parameter	Error Code											
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a

Notes:

D.4.2 Quarterly Audits

Equipment Needed

- NIST Traceable Alicat FP-25
- Thermos container with ice bath
- Thermos container with hot water
- Stopcock
- Laptop with BAM Worksheet (Figure 3)

D.4.2.1 Quarterly Flow Audit

1. Audit is performed by another member of program other than current instrument operator.
2. Follow steps 1 through 24 in Section D.4.1.2 (Bi-Weekly Flow Checks) using the audit standards instead of the verification standards.
3. **NOTE:** Do not make any adjustments to the instrument using the audit standards or perform any maintenance on the nozzle, vane, inlet, or cyclone. If any acceptance criteria falls outside acceptable limits, fill out a Corrective Action Request (see Figure 6) and return to the instrument operator for corrective action.

If the flow audit fails, issue a Corrective Action Request form to the station operator. The station operator should verify functionality using the Bi-weekly Flow Check procedure in Section D.4.1.2, and recalibrate if necessary.

D.4.2.2 Quarterly Temperature Audit

Quarterly 3-point temperature audits are required on $PM_{2.5}$ and PM_{coarse} BAM-1020 units using the BX-596 AT/BP sensor.

1. Prepare one Thermos container by filling it with a slurry of shaved ice and water.
2. Prepare another Thermos container by filling it with hot water, approximately 40-50^{o}C.
3. Put the appropriate BAM channel(s) in the data logger into Maintenance Mode (BAM10RAW, BAM25RAW, and/or BAM10-25). From the data logger Home Menu, choose Configuration Menu, Configure (Data) Channels, Put Channel in Maint. Highlight the appropriate channel(s) and press Enter.
4. Log “Start Time” on the BAM Worksheet.
5. Insert the probe of the “Audit” Alicat temperature standard into the gill shield.
6. Wait approximately 2 minutes for stabilization.
7. Record the temperature readings from the BAM display and the audit standard in the Ambient Temperature section of the BAM Worksheet.
8. Remove the stop screw from the bottom of the BX-596 AT/BP sensor mounting bracket so that the electronics module is free to rotate. Rotate the module counter-clockwise until it disengages from the keyhole slots and comes free from the radiation shield.
9. The sensor comes with an 18 inch long ice bath extension harness (Figure 5). This may be used to allow the temperature bead to reach the ice bath/hot water if necessary.

Carefully unplug the black temperature bead assembly from the top of the electronics module and install the harness between the bead and the module.

10. Insert the temperature bead into the ice water bath along with the audit standard. Avoid immersing the bead assembly past the connector. Slight stirring may be required for both probes to stabilize.
11. Record the temperature readings from the BAM display and the audit standard in the Low Temperature section of the BAM Worksheet.
12. Insert the temperature bead into the hot water along with the audit standard. Avoid immersing the bead assembly past the connector. Slight stirring may be required for both probes to stabilize.
13. Record the temperature readings from the BAM display and the audit standard in the High Temperature section of the BAM Worksheet.
14. All three points (ambient, low, and high) must be +/-2^{o}C to pass.
15. Remove the ice bath harness and reassemble the sensor.
16. Take the appropriate channel(s) in the data logger out of Maintenance Mode. From the data logger Home Menu, choose Configuration Menu, Configure (Data) Channels, Take Channel out of Maint. Highlight the appropriate channel(s) and press Enter.
17. Log “End Time” on the BAM Worksheet.
18. Print three copies of the audit form for the instrument binder, data exception log located in the office, and the Senior Air Quality Specialist for tracking.
19. Record the Date, Start Time, End Time, and Parameter affected on the Data Exception Log. Circle the appropriate Error Code.

During operation of the BAM-1020, the output from the BX-596 can be viewed from the main flow statistics screen or the OPERATE screens. See the BAM-1020 manual.

If the temperature audit fails, issue a Corrective Action Request form to the station operator. The station operator should verify functionality using the Bi-weekly Flow Check procedure in Section D.4.1.2, and recalibrate if necessary.

Figure 5 Ice Bath Extension Harness

Figure 6 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ______________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ______________________________

Problem Identification:

Site: ______________________________
System: ______________________________
Date: ______________________________
Time: ______________________________
Nature of Problem: ______________________________

Recommended Action: ______________________________

Signature: ______________________________ Date: ________________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ______________________________
Time corrective action taken: ______________________________
Corrective Action Summary: ______________________________

Signature: ______________________________ Date: ________________

QA Manager Signature: ______________________________ Date: ________________

Supervisor Signature: ______________________________ Date: ________________

Director Signature: ______________________________ Date: ________________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

D.5 Calibration Procedures

Equipment Needed

- NIST Traceable Alicat FP-25BT
- BAM Calibration Flow Worksheet (Figure 7)

D.5.1. Time and Date Calibration

1. From the main menu press SETUP> CLOCK.
2. Use the arrow keys to select and increase/decrease the desired field.
3. Press the Save key to adjust the time entered.
4. The DAS time can also be adjusted and will send a triggered event once a day to the BAM instrument adjusting the BAM times.

D.5.2. Barometric Pressure Calibration

1. From the Main screen press Test then press Flow.
2. Unit will prompt for password, enter F1, F2, F3, F4
3. The Multipoint Flow Calibration screen will appear.
4. Press the NEXT key until the <CAL> symbol appears next to the BP parameter.
5. Measure the barometric pressure with the standard.
6. Enter the value from the standard into the STD field using the arrow keys.
7. Press CAL key to correct the BAM reading. The BAM and STD values should now be the same.
8. A barometric pressure calibration directly affects the instrument's flow rate. The flow rate after a barometric calibration must be verified to determine the BAM is still within the +/- 4% deviation. Refer to 4.1.2 (steps 6-11) to verify the flow. If the flow is outside the +/- 4% deviation, a flow calibration must be performed. Refer to D.5.4.

D.5.3. Temperature Calibration

1. From the Main screen press Test then press Flow.
2. Unit will prompt for password, enter F1, F2, F3, F4.
3. The Multipoint Flow Calibration screen will appear.
4. Press the NEXT key until the <CAL> symbol appears next to the AT parameter.
5. Measure the ambient temperature with the reference standard. Position the thermometer near the ambient temperature probe.
6. Enter the value from the reference standard into the STD field using the arrow keys.
7. Press CAL key to correct the BAM reading. The BAM and STD values should now be the same.
8. A temperature calibration directly affects the instruments flow rate. The flow rate after a temperature calibration must be verified to determine the BAM is still in within the +/- 4% deviation. Refer to 4.1.2 (steps 6-11) to verify the flow. If the flow is outside the +/- 4% deviation, a flow calibration must be performed. Refer to D.5.4.

D.5.4. Flow Calibration

Note: The ambient temperature and pressure are always calibrated before the flow, because the BAM uses these parameters to calculate the air flow rate in actual mode.

1. Enter the TEST > FLOW menu as shown above. The nozzle will lower automatically when this screen is entered.
2. Select the AT parameter if not already selected. Measure the ambient temperature with the reference standard probe collocated in the BAM-1020 ambient temperature gill shield. Enter the value from your reference standard into the STD field using the arrow keys. Press the CAL soft key to calibrate the BAM reading. The BAM and STD temperature values should now be the same.
3. Press the NEXT key to select the BP field. Enter the barometric pressure value from the reference standard into the STD field, and press the CAL soft key to calibrate the BAM reading. The BAM and STD pressure values should now be the same.
4. After the temperature and pressure readings are both correct, remove the PM10 head from the inlet tube and install the Alicat FP-25 flow standard onto the inlet in its place. If the BAM is a PM2.5 unit, leave the VSCC attached to the downtube.
5. Press the NEXT key to select the first flow point of 15.0 L/min. The pump will turn on automatically. Allow the unit to regulate the flow until the BAM reading stabilizes at the target flow rate. Record the flow, temperature, and pressure readings from the Alicat on the BAM Flow Calibration Worksheet (Figure 7). Enter flow value from the worksheet into the STD field using the arrow keys, and then press the CAL soft key. Note: The BAM flow reading will not change to match the STD until after you have entered all three flow calibration points.
6. Press the NEXT key to select the second flow point of 18.4 L/min. Allow the flow to stabilize again. Record the flow, temperature, and pressure readings from the Alicat on the BAM Flow Calibration Worksheet. Enter the calculated flow value from the worksheet and press the CAL key. Note: If the BAM-1020 is unable to achieve flow regulation at the 18.4 L/min point, this could be an early indication that the vacuum pump needs to be serviced.
7. Press the NEXT key to select the third flow point of 16.7 L/min. Allow the flow to stabilize again. Record the flow, temperature, and pressure readings from the Alicat on the BAM Flow Calibration Worksheet. Enter the calculated flow value from the worksheet and press the CAL key. After this third flow point is calibrated, the BAM flow reading will change to show the corrected flow, and then the BAM-1020 will quickly re-regulate the flow to 16.7 L/min based on the new calibration.
8. A final post-calibration flow verification of the 16.7 L/min point must be completed. Record the flow, temperature, and pressure readings from the Alicat on the BAM Flow Calibration Worksheet in the Post Cal Flow Verification section. The BAM-1020 flow reading should now match your flow standard device at 16.7 L/min, +/- 4%. Exit the calibration menu.

Figure 7 BAM Flow Calibration Worksheet

Washoe County Health District - Air Quality Management Division
BAM Calibration Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Manufacturer: Met One | Model: BAM 1020 | S/N: | ID:

Start Time (PST): | Date: | Operator: | Site:
End Time (PST):

Flow Standard: | Model: | S/N:

Barometric Pressure Cal

	BAM (mmHg)	Standard (mmHg)	Difference (mmHg)		Yes	No
Pressure:			0	+/- 10mmHg?	X	

Ambient Temperature Cal

	BAM (°C)	Standard (°C)	Difference (°C)		Yes	No
Ambient:			0.0	+/- 2°C?	X	

Flow 1 (15.0 LPM)

	BAM (LPM)	Standard (LPM)
Act. Flow:		

Flow 2 (18.4 LPM)

	BAM (LPM)	Standard (LPM)
Act. Flow:		

Flow 3 (16.7 LPM)

	BAM (LPM)	Standard (LPM)
Act. Flow:		

Post Cal Flow Verification (16.7 LPM)

	BAM (LPM)	Standard (LPM)	% Dev.		Yes	No
Act. Flow:			#DIV/0!	+/- 4%	#DIV/0!	#DIV/0!

	Yes	No
Self Test Passed?		

Comments: ______________________________

File Name: BAM Calibration Worksheet_Alicat
Reviewed: 03/20/19

D.6 Routine Maintenance

Table 1 Maintenance Items and Frequency

Maintenance Item	Frequency
Clean PM10 inlet collection assembly	Monthly
Clean PM2.5 VSCC	Monthly
Nozzle and vane cleaning	Monthly
Clean capstan shaft and pinch roller tires	Monthly
Replace filter tape roll	Approx every 2 months or as needed
Completely disassemble and clean PM10 inlet	Quarterly
Test smart heater function	6 months
Test filter RH and filter temperature sensors	6 months
Remove and check membrane span foil	12 months
Beta detector count rate and dark count test	12 months
Perform 72 hour BKGD test (BX – 302 zero filter)	12 months
Clean vertical inlet tube (BX – 344 cleaning kit)	12 months
Clean internal debris filter	12 months

D.6.1 Monthly Maintenance

The collection assembly (lower portion) of the PM_{10} inlet and the $PM_{2.5}$ VSCC need to be cleaned every month as part of the maintenance schedule. In addition the nozzle, vane, capstan shaft and pinch roller should be cleaned monthly.

D.6.1.1 Monthly PM_{10} Inlet Maintenance

1. Remove the condensation jar and set it aside.
2. Unscrew the collector assembly (bottom portion of inlet) from acceleration assembly (top portion of inlet).
3. Use compressed air, a brush, lint free cloth and/or cotton swabs to clean the bottom collector plate and the collector assembly walls around the three vent tubes, and the weep hole in the collector plate.
4. Clean inside the vent tubes by running a cotton swab through them.
5. At the bottom of the collector assembly, wipe out the inside area where the two O-rings are situated.
6. Inspect the O-rings and replace if needed. Apply a thin film of grease on the O-rings.
7. Wipe out the condensation jar and the jar lid. Apply a thin film of grease to the cork seal inside the lid.

D.6.1.2 Monthly $PM_{2.5}$ VSCC Maintenance

1. Remove the VSCC from its installed position on the instrument.
2. Pull off the side transfer tube. If it is too tight to remove by hand, pry it off with a rigid plastic lever. Care should be taken to not damage the two O-ring seals.

3. Unscrew the top cap and the grit pot.
4. Use compressed air, a cloth, and/or cotton swabs to remove all visible deposits. These deposits are most likely to be found at the bottom of the cone (located beneath the grit pot) and inside the grit pot.
5. Inspect all O-rings for shape and integrity. If at all suspect, replace. Lubricate all O-rings with light grease. It is important to well lubricate the transfer tube to avoid difficult disassembly.
6. Assemble in reverse order and re-install.

D.6.1.3 Nozzle and Vane Cleaning

The nozzle and tape support vane (located under the nozzle) must be cleaned regularly to prevent leaks. The cleaning must be done at least when the filter tape is changed, but monthly cleaning is also required. Some sites will require more frequent cleaning as determined by the site operator. The worst environment for debris buildup seems to be in humid, hot areas, because the filter tape fibers more easily adhere to the nozzle and vane. The fibers can build up and dry out into a hard mass which can create flow leaks or punch small holes in the filter tape. This can cause measurement errors. Use the following steps to clean the nozzle and vane parts:

1. Latch up the tape pinch rollers (see Figure 8), and raise the nozzle in the TEST > PUMP menu. Slide the filter tape out of the slot in the beta block nozzle area. It is not necessary to completely remove the filter tape from the unit.
2. With the nozzle up, use a small flashlight to inspect the vane. Any debris will usually be visible. Clean the vane surface with a cotton-tipped applicator and isopropyl alcohol. Hardened deposits may have to be carefully scraped off with a dental pick or similar apparatus. Take care not to damage the vane.
3. Lower the nozzle in the TEST > PUMP menu. Lift the nozzle with your finger and insert another wet cotton applicator between the nozzle and the vane. Let the nozzle press down onto the swab with its spring pressure. Use your thumb to rotate the nozzle while keeping the swab in place. A few rotations should clean the nozzle lip.
4. Repeat the nozzle cleaning until the swabs come out clean, then inspect the nozzle lip and vane again, looking for any burrs which may cause tape damage.

D.6.1.4 Capstan Shaft and Pinch Roller Tires

Figure 8 shows the location of the pinch rollers. The capstan shaft is the stainless steel shaft that the rubber pinch roller rests on. Use a cotton tipped swab moistened with distilled water to wipe down the pinch roller tires and the capstan shaft. This action is easiest to do when the pinch roller is latched in the UP position.

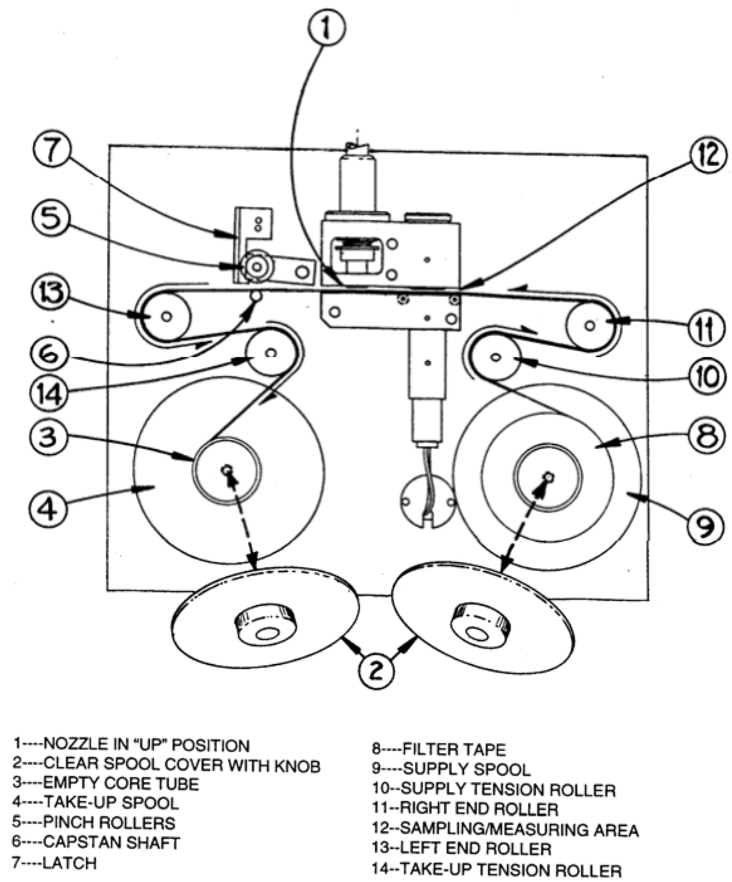
D.6.2 Filter Tape Replacement

The BAM filter tape needs to be replaced approximately every two months. Use the following steps to load a roll of filter tape:

1. Enter the TAPE menu from the main screen.

2. Press the TENSION key to raise the nozzle.
3. Lift the rubber pinch roller assembly and latch it in the up position.
4. Unscrew and remove the clear plastic spool covers.
5. Install an empty core tube on the left reel hub, providing a surface for the tape to spool-up on.
6. Load the new roll of filter tape onto the right reel and route the tape through the transport assembly as shown in Figure 8 below.
7. Attach the loose end of the filter tape to the empty core tube with a small piece of scotch tape.
8. Rotate the tape roll by hand to remove excess slack then install the clear plastic spool covers.
9. Align the filter tape so that it is centered on all of the rollers by using the score marks.
10. Unlatch and lower the pinch roller assembly onto the tape.
11. Press the TENSION key in the TAPE menu. The BAM will then set the tape to the correct tension.
12. Press EXIT to exit this menu.

Figure 8 Filter Tape Loading Diagram



D.6.3 Quarterly Maintenance

The acceleration assembly (upper portion) of the PM_{10} inlet needs to be cleaned quarterly.

D.6.3.1 Quarterly PM_{10} Inlet Maintenance

1. Remove the four screws at the top of the top plate.
2. Lift the top plate off of the acceleration assembly and carefully remove the insect screen.
3. Clean all the inlet parts of the acceleration assembly inside and out (top plates, insect screen, and the accelerator assembly body). Parts may only need to be wiped with brushes or a lint-free cloth, or blown out with the station compressor. Pay special attention to the acceleration nozzle at the base of the cone-shaped body.
4. Inspect the large diameter O-ring at the base of the accelerator assembly and replace the O-ring if necessary, or apply a thin film of O-ring grease on the O-ring and a thin film on the aluminum threads of the acceleration assembly.
5. Reassemble the PM10 inlet.

D.6.4 Semi-Annual Maintenance

The following procedures need to take place every 6 months: Test the smart heater, filter temperature sensor and filter RH sensor.

D.6.4.1 Smart Heater Function

From the Main menu, select TEST and then HEATER. This screen is used to force the Smart Heater ON or OFF for testing purposes. The heater takes several minutes to heat up or cool down noticeably.

1. If the heater is on (warm to the touch), force it off to allow it to cool for several minutes. Turn it back on and verify that it warms up.
2. If the heater is cool to the touch when it is initially checked, force the heater on and verify that it warms after several minutes.
3. The heater automatically turns back off upon exit from the screen.

D.6.4.2 Filter temperature and RH sensors

To test the filter temperature sensor:

1. From the Main menu, select TEST and then FILTER-T. This screen is used to calibrate the filter temperature sensor located in the air stream beneath the filter tape. When this screen is entered, the BAM will automatically raise the nozzle and turn the pump on. This action allows the filter temperature sensor to equilibrate with ambient room air without the heating effects of the Smart Heater.
2. Allow the pump to run for at least 5 minutes to allow the sensor to equilibrate. During this same period, allow the reference standard temperature sensor to equilibrate with the room temperature.

3. Press the RESET hot key to clear out any past calibration values.
4. Enter the ambient room temperature from the reference standard into the REFERENCE field and press the CALIBRATE hot key. The BAM reading should change to match within +/- 1°C.
5. The RESET hot key can be used to revert to default calibrations and start over if difficulty is encountered.

To test the filter RH sensor,

1. From the Main menu, select TEST and then RH. This screen, which functions exactly like the FILTER-T screen, is used to calibrate the filter RH sensor located in the air stream beneath the filter tape.
2. Allow the pump to run for at least 5 minutes to allow the sensor to equilibrate.
3. Press the RESET hot key to clear out any past calibration values.
4. Enter the ambient room relative humidity from the reference standard into the REFERENCE field and press the CALIBRATE hot key. The BAM reading should change to match within +/- 4% RH.
5. The RESET hot key can be used to revert to default calibrations and start over if difficulty is encountered.

D.6.5 Annual Maintenance

There are a number of procedures and tests that should be performed once a year. While most of these annual routines are based on recommendations from Met One, the 72-hr BKGD or zero-filter test is required by EQPM-0308-170 at the time the BAM-1020 is installed at the monitoring site, and "annually" thereafter.

D.6.5.1 Membrane span foil

The membrane span foil is made of cellophane material that provides a span reference for the BAM-1020. The typical calibrated value of the membrane is around 800 µg, but this value is specific to each instrument (also known as the ABS value). The BAM-1020 performs a span check each hour by extending the reference membrane so that it is positioned between the beta source and the scintillation counter. A complete description of this span check process is given in the BAM-1020 Operation Manual. The value of this measurement is displayed on the NORMAL screen as the "LAST m". The LAST m value should be very close or equal to the ABS value given on the Calibration certificate. Values in excess of ±5% are flagged as errors (a "D" error for "Deviant Membrane Density"; also known as "Cal error").

To check the membrane span foil,

1. from the Main menu, choose TEST > CALIBRATE, bringing up the CALIBRATION MODE screen for the reference membrane;
2. press the START Soft Key to begin the 8-minute test;
3. when complete, record the Calibration mass;
4. repeat the test two more times (total three tests);
5. calculate the average mass; and
6. compare this value with the ABS value in the SETUP >>CALIBRATE screen.

If the calculated average mass is higher than the ABS value for a particular instrument, this may indicate that there is a buildup of material on the membrane; either dirt, or water marks, or some other marking. An average lower than the ABS value could indicate that the high voltage to the Beta Detector tube is low, the count circuit is malfunctioning, or there is a hole or tear in the cellophane material. Inspect the reference membrane for signs of damage. If there is damage, call the Met One Service department.

D.6.5.2 Beta Detector

The TEST > COUNT screen allows the user to check the function of the beta detector and beta source separate from the rest of the mechanical or flow operations. Each count test will take 4 minutes, and will show the number of beta particles counted as they accumulate. The final count value will stay on the display after the counting is finished, and up to six count tests can be displayed on the screen at once. Count tests are usually performed with a clean section of filter tape between the source and detector, as in normal operation. The test also allows the membrane to be extended between the source and detector as well, if desired.

Press the GO Soft Key to start the 4-minute count test. The counting will immediately begin. After four minutes the counting will stop and wait for the operator to initiate another cycle or EXIT. The resulting COUNT value is the total number of beta particles counted during the four-minute test. This count will increment rapidly during the test. Typical 4-minute count values are between 600,000 and 1,000,000 counts through clean filter tape. The count total will be lower if the span membrane is extended. If the count total is less than 500,000, the beta detector is possibly wearing out.

D.6.5.3 72 hour BKGD test

The Background (BKGD) value is the zero correction (slope offset) for all BAM-1020 concentration data. This is determined by running the unit for two to three days with a HEPA zero filter installed on the inlet so that no particulate enters the instrument. The concentration data values over this time are averaged, and the BKGD value is the negative of this average. All of the subsequently stored concentration data contains this correction. The BKGD value varies from unit to unit, and is typically a number between +0.001 and -0.005 mg/m3. **Warning: This is a user-settable calibration value which may significantly affect the accuracy of the unit.**

Equipment Required:

- BX-302 Zero Filter Calibration Kit.
- Fully installed and operational BAM-1020 monitor.
- Computer with Comet or HyperTerminal communication software, a spreadsheet program such as Microsoft Excel, and a BAM-1020 serial communication cable.
- Temperature cable
- Screwdriver

Test Setup:

The BAM-1020 should be installed in its normal shelter at the field site where sampling is to be performed. The unit must be configured for normal operation in its usual environment. The BAM-1020 and especially any shelter temperature control system should ideally be powered up for about one day before starting the zero test, or the first day of data after power-up can be ignored. This allows the temperatures in the BAM and the shelter to equilibrate to a stable state for optimal accuracy and stability.

The Smart Inlet Heater must be installed and operating normally. It must be set for the normal control parameters per the BAM-1020 manual, such as the normal RH set point of 35%. Remove the PM10 and PM2.5 inlets, and install the BX-302 zero filter assembly onto the short inlet tube inside the shelter. Install the white plastic sun/rain shield by screwing it onto the filter. This keeps rain out of the filter and shades it to help prevent condensation from forming inside. **Note:** The 90 degree nylon inlet fitting and short length of clear tubing that used to be supplied with the filter kit is no longer recommended due to the fact that it does not reliably keep moisture out of the filter under some conditions.

As an alternative preferred setup, the zero filters may be installed inside the BAM shelter, on a short inlet tube just above the smart heater. This requires the downtube to be removed from the extension and locked into place on the roof at the roof flange. See (D 6.5.4) for proper downtube removal. Also an alternative preferred setup is removing the site BX-596 electronics module from the gill shield. Take the electronics module into the shelter and disconnect the temperature cable on the back of the BAM on Channel 6. Install the backup temperature cables from the repair room to the electronics module. The inlet heater must be installed and running normally.

The BKGD (Background) value is located in the SETUP > CALIBRATE menu. **Record the previous BKGD value, and then change it to 0.0000**, so that the BAM is not performing any background corrections during the test. This simplifies the math and reduces mistakes. Exit back to the main menu.

Background Test Process:

1. Perform as found leak test on the BAM before beginning the test. Put the instrument into maintenance mode on the DAS. Start the BAM sampling for about 72 hours. The unit should be operating just like it would for regular PM2.5 sampling, only with the zero filter installed instead of the PM10 inlet and cyclone.
2. After at least 72 hours of sampling, download the hourly concentration data from the unit (.csv output per the manual) using Comet or HyperTerminal and import it into Excel for analysis. An Excel template to expedite the zero test data evaluation (shown below Figure 9) is available from Met One Instruments.
3. The data should not contain error flags during the test period. Investigate any errors.
4. The first four hours of data may optionally be discarded and the remaining hours used for analysis. This sometimes improves the data set because of the tape tracking for the first few hours, if not perfectly centered when installed.
5. Graph the concentration data. The zero noise levels of the BAM-1020 from the test will be visible. The example below shows a typical zero data set from a BAM-1020.

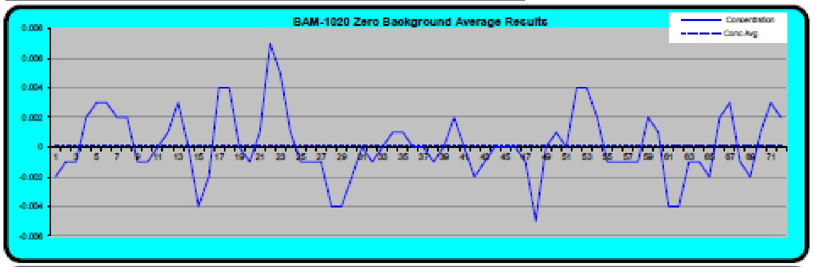
6. Calculate the average of the zero data to four decimal places. Calculate a new **BKGD** value for the unit by taking the negative of the average. For example, on the data below the average of the zero data was +0.0016 (+1.6g), so the correct new BKGD value is -0.0016 (-1.6g). Enter the new BKGD value into the BAM in the SETUP > CALIBRATE menu. **Note:** Be careful to observe the decimal point position, because the BKGD value in the BAM is always entered in milligrams, not micrograms.
7. Compare the new BKGD to the previous BKGD value recorded before the test. The two values should usually be similar within a microgram or two. If the values are considerably different, check the BAM for leaks at the nozzle and verify the temperature stability of the shelter. **Note:** The initial field BKGD value will often be several micrograms different than the factory value, because the factory value is set without an inlet heater.
8. Calculate the standard deviation of the data (STDEV function in Excel) to four decimal places. This value varies from unit-to-unit, but should usually be less than 2.4 micrograms. The lower the number, the better the noise characteristics. A large standard deviation of noise is a clue that the test data average may not be ideal for setting a new BKGD correction. Noisy data should be investigated and resolved. Check for BAM or inlet tube grounding problems, leaks, zero filter condensation, close RFI or EMI sources, large changes in shelter temp or pressure, improper filter RH control, etc. Excessive noise can also indicate a failing beta detector.
9. **Make a record of the test results and any BKGD value changes, and keep it with the other calibration records for the BAM-1020.** The Met One Excel template shown below can serve as a good test record.
10. After the test, remove the BX-302 filter and reinstall the PM10 and PM2.5 inlets. Resume normal operation.

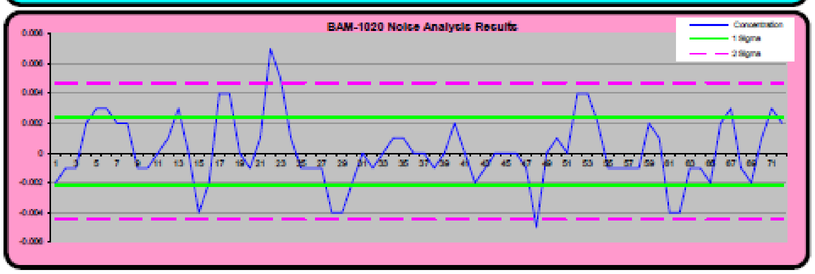
Figure 9 Met One Zero Data Analysis Excel Template Sample

Time	Concentration
5/3/2019 6:00	-0.002
5/3/2019 7:00	-0.001
5/3/2019 8:00	-0.001
5/3/2019 9:00	0.002
5/3/2019 10:00	0.003
5/3/2019 11:00	0.003
5/3/2019 12:00	0.002
5/3/2019 13:00	0.002
5/3/2019 14:00	-0.001
5/3/2019 15:00	-0.001
5/3/2019 16:00	0
5/3/2019 17:00	0.001
5/3/2019 18:00	0.003
5/3/2019 19:00	0
5/3/2019 20:00	-0.004
5/3/2019 21:00	-0.002
5/3/2019 22:00	0.004
5/3/2019 23:00	0.004
5/4/2019 0:00	0
5/4/2019 1:00	-0.001
5/4/2019 2:00	0.001
5/4/2019 3:00	0.007
5/4/2019 4:00	0.005
5/4/2019 5:00	0.001
5/4/2019 6:00	-0.001
5/4/2019 7:00	-0.001
5/4/2019 8:00	-0.001
5/4/2019 9:00	-0.004
5/4/2019 10:00	-0.004
5/4/2019 11:00	-0.002
5/4/2019 12:00	0
5/4/2019 13:00	-0.001
5/4/2019 14:00	0
5/4/2019 15:00	0.001
5/4/2019 16:00	0.001
5/4/2019 17:00	0
5/4/2019 18:00	0
5/4/2019 19:00	-0.001
5/4/2019 20:00	0
5/4/2019 21:00	0.002
5/4/2019 22:00	0
5/4/2019 23:00	-0.002
5/5/2019 0:00	-0.001
5/5/2019 1:00	0
5/5/2019 2:00	0
5/5/2019 3:00	0
5/5/2019 4:00	-0.001
5/5/2019 5:00	-0.005
5/5/2019 6:00	0
5/5/2019 7:00	0.001
5/5/2019 8:00	0
5/5/2019 9:00	0.004
5/5/2019 10:00	0.004
5/5/2019 11:00	0.002
5/5/2019 12:00	-0.001
5/5/2019 13:00	-0.001
5/5/2019 14:00	-0.001
5/5/2019 15:00	-0.001
5/5/2019 16:00	0.002
5/5/2019 17:00	0.001
5/5/2019 18:00	-0.004
5/5/2019 19:00	-0.004
5/5/2019 20:00	-0.001
5/5/2019 21:00	-0.001
5/5/2019 22:00	-0.002
5/5/2019 23:00	0.002
5/6/2019 0:00	0.003
5/6/2019 1:00	-0.001
5/6/2019 2:00	-0.002
5/6/2019 3:00	0.001
5/6/2019 4:00	0.003
5/6/2019 5:00	0.002

Test Records	
BAM-1020 Serial Number:	M4380
Test Performed By:	DRT
Test Start Date:	5/3/2019
Test End Date:	5/6/2019
Previous BKGD Value:	-0.0012
BKGD Value During Test:	0.0000

Dataset Statistics (milligrams)		
Zero Data Average	0.0001	
Hourly Standard Deviation (σ)	0.0023	Within Lab Spec < .0024 mg
Background Setting (BKGD)	-0.0001	Set this value in the BAM-1020





Test Instructions

1) The BAM-1020 should be completely installed and operational at its field site before starting a zero test.
2) Allow the BAM-1020 to warm up for several hours before starting a zero test, or plan on discarding the first 4 hours.
3) Perform a leak check, nozzle and vane cleaning, and flow check on the unit. See manual section 5.
4) In the SETUP > CALIBRATE menu, record the existing BKGD value, then set the BKGD to 0.0000 mg.
5) Remove the PM10 inlet and install the BX-302 zero filter. Run the BAM for at least 72 hours with the zero filter.
6) Download the data from the BAM-1020 serial port in .csv format. See manual Section 9.4.
7) Copy the 72 hourly concentration data points into this sheet and analyze the results.
8) The negative of the zero average is the correct BKGD (background) setting. Enter it into the BAM-1020.
9) Remove the BX-302 zero filter and resume normal BAM operation.
10) Save the results of this test. The test may be performed annually to audit the performance of the BAM.

D.6.5.4 Vertical inlet tube

Annual cleaning of the inlet tube is recommended in the BAM-1020 Operation Manual, but the site administrator should determine what frequency is most appropriate.
Proper cleaning of the inlet tube requires that the tube be lifted out of the inlet at the top of the BAM-1020.
Note: take care to protect the inlet of the BAM-1020 receiver from any debris.
To clean the inlet tube,

1. loosen the set screws in the BAM-1020 inlet receiver;
2. loosen the white cap on the roof mounting flange;
3. loosen the clamp securing the support struts to the inlet tube;
4. drop a rope down the tube, and at the bottom end, tie on a clean cloth that can be pulled up through the tube to clean the walls;
5. repeat until clean.

D.6.5.5 Internal debris filter

An internal debris filter is located in the flow path of the BAM-1020 (see diagram in BAM-1020 Operation Manual). This filter should be cleaned or replaced annually. The filter element can only be replaced (Met One PN 580292).

D.7 Troubleshooting

Refer to the Met One BAM-1020 operation manual for troubleshooting.

D.8 Direct Polling of BAM-1020

D.8.1 Introduction

Air Vision has the capability to directly download data from BAM-1020s. Scheduled downloads can be used in conjunction with AirNow transfers or other real-time processes.
The process takes place in three steps:

1. Via a scheduled task, AirVision opens up connection to the instrument using a configured route (modem, TCP, etc.).
2. AirVision sends the commands to retrieve the data file in native format.
3. AirVision then runs the File Import Tool against an instrument-specific import template to import the data into the AirVision database.

D.8.2 Procedure

1. Request an IP address(s) for a BAM (coarse pair or stand-alone BAM) from Tech Services that is associated with the network configuration at the particular site of the direct polling instrument. This address will also provide the Mask and gateway numbers which will be needed for programming.

2. Purchase a Direct Poll license(s) for a Coarse pair or stand-alone BAM and a pre-programmed VESP 211 terminal server(s) (includes programming IP address(s), Port #, Mask, and Gateway for the assigned network) from Agilaire. Port # is usually 3000 or 4000.
3. Install the terminal server(s) at the site using a RS-232 and Ethernet cable. The RS-232 cable plugs into the VESP 211 and into the RS-232 port on the back of the BAM. The Ethernet cable plugs in to network router box and VESP 211. Plug the power supply into an electrical outlet. On the BAM under SETUP>SAMPLE, ensure the configuration of the baud rate matches the VESP 211. It is usually 9600. Also, under SETUP>SENSORS on the BAM, ensure unused sensors are set to manual mode and not auto ID. The AT sensor or CH6 must be set to Auto ID for the PM hourly sampling. Refer to the BAM Operation Manual for the touchscreen sensor setup or for troubleshooting this setup.
4. In the AirVision Software, the next step is configuring the Site Parameter Template. This template is determined by which type of monitoring is being configured. The two configurations are a PM_{coarse} pair configuration or a stand-alone PM_{10} configuration.
5. Select *Site Parameter* in the Configuration Editor in AirVision. Highlight *System* and *Add a New Site*. Name the site and choose the correct time zone (Pacific). Highlight the new site name in the list of sites. Select *Add a New Parameter*. The parameters will be determined by the instrument setup.

   In a PM_{coarse} pair, the two instruments act independently, thus requiring each instrument to be configured separately. For these instruments, the site parameters are:

   BAM 10 (Master)

   A. ATEMP
   B. BAM_LC
   C. BAM_10_STD
   D. BAM10-2.5
   E. BAM2.5
   F. QT10
   G. QT10s
   H. RELHUM
   I. FT (touchscreen only)*

   For non-touchscreen BAM's do not configure a FT parameter

   BAM 2.5 (Slave)

   A. ATEMP
   B. BAM2.5
   C. QT10
   D. RELHUM
   E. FT (touchscreen only)

   In a stand-alone PM_{10} instrument, the site parameters are:

   BAM 10 (Stand-alone unit)

   A. BAM_STD
   B. ATEMP
   C. QT10

D. RELHUM

6. For each of these site parameters, AirVision requires the site name, parameter measured, parameter template used (see #7), and reported units. If the instrument's units are in milligrams, then that selection must be made as different from the reported units on the BAM. The parameter must be enabled by checking the box. Click the save key in the upper left corner. Now repeat this process for all the parameters listed in the template.
7. After configuring the parameters select *Data Source Details* in the configuration editor. Highlight the new site and choose *Add an Instrument* at the top of screen. Choose the *Instrument* selection under this tab. Give the instrument the same name as the site. Choose *BAM-1020* under instrument type. Next to source is a *Communication* tab, select this and choose *Create New Route.* Click the box TCP. Give the route a name, keep it consistent with the site name and instrument type. Type in the IP address and polling port that was pre-programmed into the VESP 211. Make the emulation port empty and uncheck the emulation box. Click the save key again.
8. After configuring the communication route, the next step is to schedule the task. In the configuration editors, double click *Task Scheduler*. On the top in the task schedule options choose *Add*, and select *Instrument Poll Task.* In the task schedule details select a start time. Pick a start time that does not conflict with the other instrument poll tasks. Consult with the Data Manager to make sure these tasks do not interrupt the AirNow reporting. Next, select the repeat interval which is 1 Hour(s). Name the task to be consistent with the site name. Under the instrument polling options select *Instrument*. A list will come up with different instruments, choose the source name of the communication link that was created in step 5. The instrument poll type is Poll Averages (1h). For the file import template choose the correct template. Templates have been created that are instrument specific. Choose the correct template for the instrument. For touchscreen coarse monitoring, choose BAM1020_CoarsePair_PM10 touchscreen (Master). Same for the (Slave) $PM_{2.5}$ monitoring choose BAM1020_CoarsePair_PM25 touchscreen. For the non-touchscreen BAM's choose BAM1020_CoarsePair_PM10 and for $PM_{2.5}$ choose BAM1020_CoarsePair_PM25. For standalone PM_{10} monitoring, choose the BAM1020_PM10. Check the task enabled box. The templates can be viewed under the configuration editors (File Import Configuration). Changes to the file import configuration can be made in this section. The logic behind the template configurations is the data being used off the BAM in native format must be in the identical rows and columns. This file template in Air Vision allows the rows and columns to be configured to match the BAM data.
9. In the Configuration Editors, choose *Utilities*. In the Utilities choose *Manual Instrument Poll*. Under this section, locate the site and source name. Highlight that newly created instrument task. In poll type highlight *Poll Averages (1h).* In the date range select a small sample size, around 4 days' worth of data. For example 11/01/14 0000 to 11/05/14 0000. Finally execute the poll by clicking in the upper left hand corner on *Start Manual Poll*. The instrument at this point will ping the data logger on the BAM. A log viewer will appear showing the current progress. After the attempt, the Time Initiated, Device, Type, Item Information, and Status will be updated. To conclude the setup a status of GOOD will be displayed. At this point the logger will call up every hour requested from the task scheduler. For problems or other status issues, contact Agilaire for support.

Appendix E: BGI Particulate Matter Samplers PQ200 - $PM_{2.5}$ and PM_{10}

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ______________________________

Title of Author: ______________________________

Signature: ______________________ Date: ____________

Name: ______________________________

Title: ______________________________

Signature: ______________________ Date: ____________

Name: ______________________________

Title: ______________________________

Signature: ______________________ Date: ____________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:____________________________Date:______________

Name: ____

Title: ____

Signature:____________________________Date:______________

Name: ____

Title: ____

Signature:____________________________Date:______________

Name: ____

Title: ____

Signature:____________________________Date:______________

Name: ____

Title: ____

Signature:____________________________Date:______________

Acronyms and Abbreviations

AC	Alternating Current
BP	Barometric Pressure
ºC	Degrees Celsius
CFR	Code of Federal Regulations
CV	Coefficient of Variation
DVM	Digital Volt Meter
EPA	U.S. Environmental Protection Agency
I.D.	Identification
K	Kelvin
L/min	Liters per minute
mmHg	millimeters of Mercury
NAAQS	National Ambient Air Quality Standards
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter less than or equal to 2.5 microns in aerodynamic diameter
PM_{10}	Particulate Matter less than or equal to 10 microns in aerodynamic diameter
PMcoarse	PM_{10} minus $PM_{2.5}$
QA	Quality Assurance
QC	Quality Control
SOP	Standard Operating Procedures
VSCC	Very Sharp Cut Cyclone

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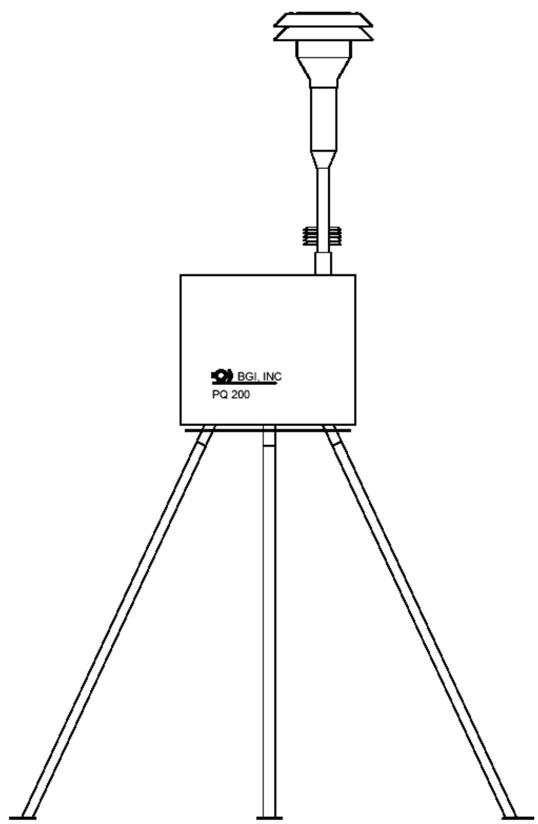
E.1. Introduction

The BGI PQ200 Ambient PM Federal Reference Method Sampler System is designed to meet exacting criteria for collecting 24-hour samples of ambient "Fine Particulate," according to the U.S. National Ambient Air Quality Standards (NAAQS), published July 18, 1997 and the requirements for ambient particulate sampling dictated by U.S. Environmental Protection Agency (EPA) according to 40 CFR Part 53. The federal reference method for the measurement of $PM_{2.5}$ and PM_{10} (particulate matter with a mean aerodynamic diameter of 2.5 and 10 micrometers (µm) or less) is presented in 40 CFR Part 50, Appendix L. Sampler siting, operation, and quality assurance (QA) regulations are presented in 40 CFR Part 58. The operating procedures presented in this standard operating procedure (SOP) are derived from the cited regulations and the guidance presented in the manufacturer's instructions and the EPA *Quality Assurance Handbook for Air Pollution Measurement Systems*, Section 2.12. The design of the BGI-PQ200 is shown in Figure 1.

Figure 1 Drawing of Assembled BGI-PQ200



E.2. Theory of Operation

BGI has developed the Very Sharp Cut Cyclone (VSCC) for the $PM_{2.5}$ sampling system which replaces the WINS impactor and allows 30 days between cleaning intervals. $PM_{2.5}$ and PM_{10} samples are collected on 47 mm PTFE (polytetrafluoroethylene) membrane media at a volumetric sample rate of 16.67 L/min after being size discriminated through two EPA designed inertial separators. Ambient temperature and barometric pressure measurements are made at actual sample conditions. A microprocessor and sophisticated volumetric flow control system are integrated to maintain precise sampling parameters while sampling data are continuously logged into the processor memory. Five minute actual ambient temperature and pressure conditions with volumetric sample flow rate, filter temperature, and pressure are recorded. Measured values and identification of flags indicating any anomalies are recovered by the operator by recording the instrument information on field data forms or downloading a sample summary to a laptop or handheld computer.

E.3. Precautions

The PQ200 should only be operated as described and for its intended use. Because the PQ200 runs primarily from battery power, all of the typical hazards associated with high voltages and internal A.C. wiring have been reduced or eliminated. Personal injury, damage to the instrument, or fire can occur if the following electrical precautions are not observed:

- Caution should always be given when attaching the Alternating Current (AC) main power connection. Do not attempt to connect main power if the plug or wire are cracked or frayed.
- Do not attempt to connect main power if the power cord, leads, or outlet are wet. Do not immerse power cords in water or other liquids.
- Place power cords away from traffic and do not allow anything to rest on them during operation.
- Do not overload AC outlets.
- Do not attach improperly wired external batteries, solar panels or power sources.
- Allow a few inches for ventilation at the rear of the instrument. Do not allow the fan opening to become clogged or blocked.
- Do not open the control panel or handle any other of the electrical parts while power is applied to the PQ200. Always disconnect the power supply first.

In addition, personal injury or damage to the instrument could occur if the following precautions are not observed:

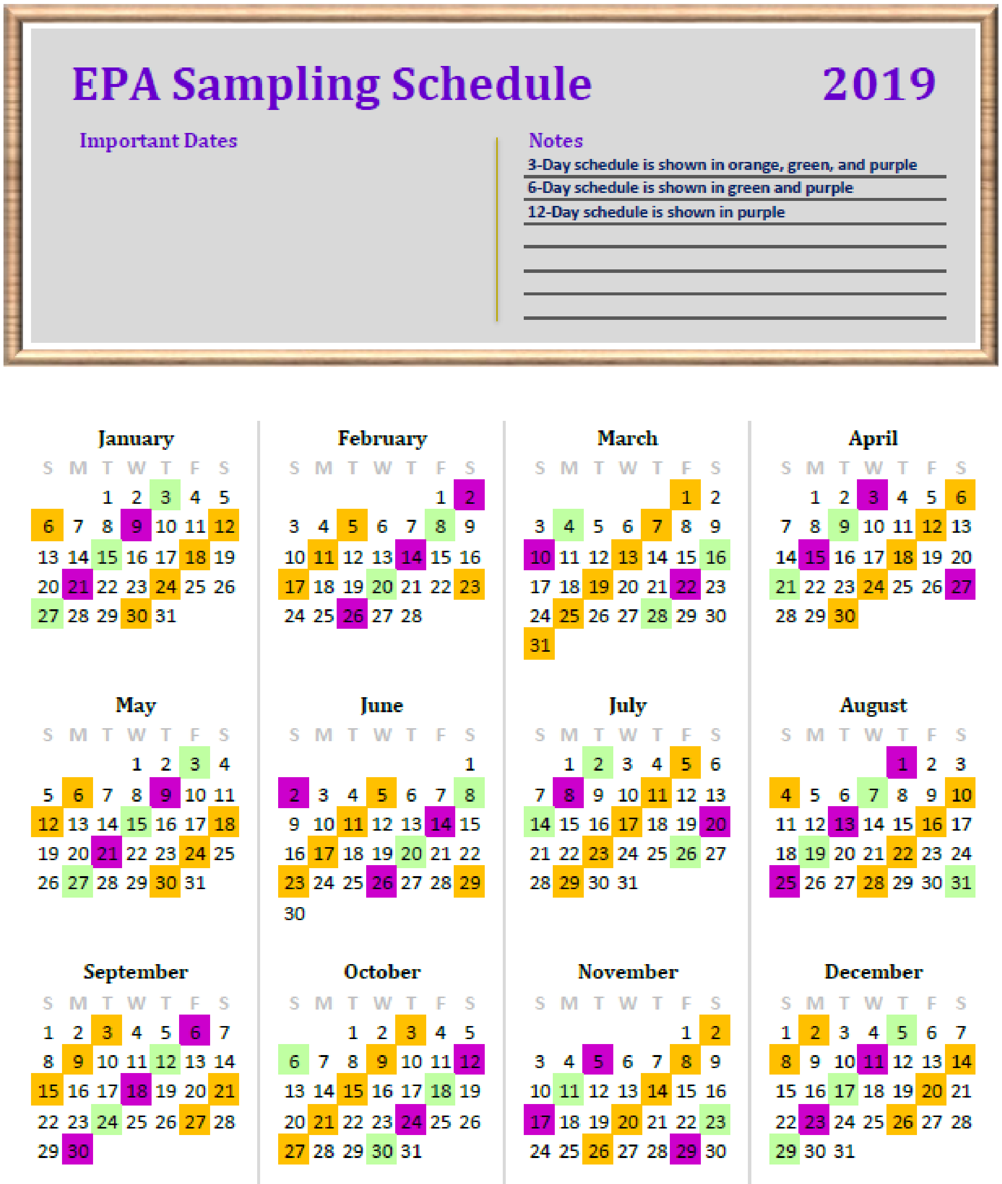
- Always operate the PQ200 in a normal, upright position. The legs should be bolted down to prevent tipping in conditions of high winds.
- Do not operate the PQ200 if any of the parts are defective, damaged, or missing.
- Take care during the opening of the filter housing.

E.4. Instrument Operation

E.4.1 Sampling Procedure

The BGI-PQ200 $PM_{2.5}$ and PM_{10} samplers are run every third day as specified by the EPA. See Figure 2 for an example sampling schedule. The sampling duration is 24 hours, running from midnight to midnight PST.

Figure 2 EPA Sampling Schedule



Equipment Needed

- Clean Filters (pre-weighed)
- Filter Cassettes and Caps
- Filter Transport Case
- Filter Transport Case Cooler (post sampling)
- Min/Max Thermometer (post sampling)
- Blue Ice (post sampling)
- Field Data Form

E.4.1.2 Preparing Clean Filters

1. Collect clean filters from the pre-weighed filter tray located in the laboratory.
2. Clean the prep surface, filter cassettes and filter cassette caps with anti-static cleaner.
3. Mark the clean filter Petri slide with the sample run date, day, and filter cassette cap ID.
4. Place filter in the filter cassette and snap the filter cassette together.
5. Install the filter cassette caps with the correct cap ID on the top and bottom of the filter cassette.
6. Place all prepared filters into the filter transport case.
7. Complete the PM Field Sample Report (Figure 3) with the filter number, sample date, and day and circle the corresponding instrument ID.
8. Place the field forms in the respective folders corresponding to the appropriate instrument ID.
9. Gather the field forms and filter transport case for filter installation in the field.

Figure 3 PM Field Sample Report

Washoe County Health District - Air Quality Management Division
Field Sample Report

Site: *Reno 3*
Sampler: *BGI, Inc.* Model: *PQ 200*

S/N: ID:	*790* *$PM_{2.5}$*	*794* *PM_{10}*	*FB*

Filter Number:
Sample Date: Su M T W Th F Sa
Weigh by:
Pre Weighed on:
Post Weighed on:

Chain of Custody

Action	Date	Time (PST)	Cap ID	Operator
Sample Installed				
Sample Removed				
Sample Refrigerated				

Conditioning

Pre Conditioning Start			---	
Pre Conditioning End			---	
Post Conditioning Start			---	
Post Conditioning End			---	

Sample Summary

	Date	Time (PST)
Sample Start:		
Sample Stop:		
Elapsed Time:		
Total Volume:		m³
Flow Rate CV:		%

	Avg.	Max.	Min.	
T_A:				°C
Press:				mmHg
Flow:		---	---	lpm

Flags:
Max Transport Temp: °C

Operator Comments:

Filter Loading and Concentration

	Mass	Reweigh	Date	Analyst
Post-Sample:	. mg	. mg		
Pre-Sample:	. mg	. mg		
Loading:	µg			

Concentration: . µg/m³

PM_{10} . µg/m³ - $PM_{2.5}$ Designated . µg/m³ = PM_{COARSE} . µg/m³

Laboratory Comments:

File Name: FIELD SAMPLE REPORT 3
Reviewed: 10/02/19

E.4.1.3 Installing Filters

1. Open the front of the BGI by opening the latches on both sides of the instrument.
2. Wipe down instrument interior and exterior with a dry cloth and brush.
3. Release the filter holder by twisting the filter holder handle to the left.
4. Remove the filter cassette from the filter transport case and remove top and bottom filter cassette caps.
5. Place the filter cassette corresponding to the correct instrument in the filter holder.
6. Close the filter holder by twisting the handle to the right, ensure the handle is locked into place.
7. Note the installation date, time, filter cassette cap ID, and operator initials on the field form.
8. When installing the filter the day before the run day, press Menu, use the arrow keys until Run Sampler from Midnight to Midnight flashes, press Select.
9. The download screen will appear, press Reset. The instrument will then power down and the next sample run will be set.
10. When installing the filter the day after the previous run day, the next sample run date and time must be set.
11. To set the sample run date and time, from the Main Menu use the arrow keys until Setups and Downloads flashes and then press Select. Use the arrow key until Run w/ User Defined Start/Stop flashes and then press Select.
12. Set the Sample Start Date and Time message will appear, press Next to cursor to the date and/or time until that value stop flashing. Use the up and down arrow keys to change the value.
13. Press Exit.
14. The download screen will appear, press Reset.
15. Set the Sample Stop Date and Time message will appear, press Next to cursor to the date and/or time until that value stops flashing. Use the up and down arrow keys to change the value.
16. Press Exit. The instrument will then power down and the next sample run will be set.

E.4.1.4 Pulling Filters

1. Open the front of the BGI by opening the latches on both sides of the instrument.
2. Release the filter holder by twisting the filter holder handle to the left.
3. Remove the filter cassette from the instrument.
4. Remove filter cassette caps from filter transport case and reinstall onto filter cassette.
5. Place filter cassette into filter transport case and close.
6. Place filter transport case into cooler with blue ice, press “CLR” button on min/max thermometer to reset min/max values, and immediately close cooler (see Figure 4).
7. Record the date and time the filter was removed, the filter cassette cap ID, and operators initials on the Field Sample Report.
8. Press the Menu key from the Sample Run Screen.
9. Choose Review Last Run Data and Conditions by pressing Select.
10. Record the sample start and stop date and time, elapsed time (ET), flow rate CV (CV) total volume (TV), and average flow (Avg) on the Field Sample Report.

11. Press Next. Record the min., max., and avg., temperature and barometric pressure on the field data form.
12. Close the front of the instrument and reconnect the latches.
13. Return the filter transport case cooler to the AQMD laboratory.
14. Obtain the Petri slides with the filter ID corresponding to the exposed filters.
15. Open filter transport case cooler, read max temperature on the min/max thermometer, and log "Max Transport Temp" on the Field Sample Report.
16. Remove the filter cassette caps from both sides of the filter cassette.
17. Slide the filter cassette into the filter cassette opener. Carefully slide the filter cassette towards the top of the opener until the cassette has opened.
18. Remove the filter from the top of the screen inside the filter cassette by using forceps.
19. Place the exposed filter into the Petri slide with the corresponding filter ID number marked on the slide.
20. Remove the remaining filters from the filter cassettes and place in the corresponding Petri slides.
21. Place the Petri slides into the refrigerator. Exposed filters are placed in the refrigerator until a batch of 10 filters is ready for post weight. Note: filters must be removed from the refrigerator and weighed within 30 days.
22. Note the refrigerated time on the Field Sample Report.

Figure 4 Filter Transport Case Cooler

E.4.2 Quality Control

E.4.2.1. Monthly Verifications

Monthly verifications of the BGI's are completed near the end of the month.

Equipment Needed
- NIST Traceable Flow Standard
- NIST Traceable Temperature Standard
- NIST Traceable Pressure Standard
- Stopcock
- QC Filter Cassette
- Monthly Verification Form

Verification Procedure
1. Fill out the instrument identification information, date, time and operator on the Monthly Verification Form (Figure 5). Fill out the verification standard information on the field form.
2. Record the sampler's time and date from the main screen and actual time and date on the field form. The sampler's time must be within 1 minute of the actual time. If the time is outside +/- 1 minute, the sampler's time must be reset. See section E.5 for Calibration Procedures.
3. Record the sampler's barometric pressure from the main screen and the actual barometric pressure from the pressure standard on the field form. The sampler's barometric pressure must be within +/- 10 mmHg of the verification barometric pressure. If it is outside +/- 10 mmHg, the barometric pressure must be recalibrated. See section E.5 for Calibration Procedures.
4. Place the temperature standard probe in the ambient temperature radiation shield and allow the temperature to stabilize to obtain the ambient temperature. Record the sampler's ambient temperature from the main screen and the actual temperature from the temperature standard on the field form. The sampler's temperature must be within +/- 2°C of the verification temperature. If it is outside +/- 2°C, the sampler's temperature must be recalibrated. See section E.5 for Calibration Procedures.
5. Place the temperature standard probe next to the filter temperature sensor in the filter holder and allow the temperature to stabilize to obtain the filter temperature. Record the sampler's filter temperature from the main screen and the actual temperature from the temperature standard onto the field form. The sampler's temperature must be within +/- 2°C of the verification temperature. If it is outside +/- 2°C, the sampler's filter temperature must be recalibrated. See section E.5 for Calibration Procedures.
6. To perform the leak check, remove the inlet from the downtube and place the stopcock that is located inside the sampler on the top of the downtube.
7. From the Main Menu use arrow keys until "Test Menu" flashes; press Select.
8. From the Test Menu, press down arrows until "Leak Test" flashes; press Select.
9. Follow the prompts on the screen to perform the Leak Test. The sampler will automatically evaluate the performance of the system and report whether it has passed or failed. This is a 2 minute test. After the test is complete, record the initial and final

pressure from the display onto the field form. If the test failed, investigate and correct any malfunction as described in section 3.2 of the manufacturer's manual.

10. To verify the flow rate, attach the flow standard to the top of the downtube.
11. From the main menu, use the arrow keys until "Test Menu" flashes. Press Select to enter the Test Menu.
12. From the Test Menu, press the down arrow key until "Verify Flow Calibration" flashes. Press Select. The sampler will begin to pump air at the current selected flow rate. The screen will display "Check Flow Now!" when flow is stable.
13. Record the sampler's flow from the display and the actual flow from the flow standard on the field form. The sampler's flow must be within +/- 4% deviation of the verification flow. If it is outside +/- 4%, the sampler's flow must be recalibrated. See section E.5 for Calibration Procedures.
14. Press On/Off key to exit this function.
15. Press the menu button to return to the Main Menu.
16. Detach the flow equipment and replace the inlet to the top of the downtube.
17. Close the front of the instrument and reconnect the latches.

Figure 5 Monthly Verification Form

Washoe County Health District - AQMD
Monthly Verifications

Site: Reno 3
Sampler: *BGI, Inc.* Model: *PQ 200*

Date:
Time: PST
Operator:

S/N:	*790*	*794*
ID:	*Designated*	*PM 10*

Date / Time

Standard: Model: S/N:

	Display	Reference	Difference	
Date:				
Time:	PST	PST	min.	Pass / Fail[1]

Standard: **Model:** **S/N:**

Pressure

	Display	Reference	Difference	
Pressure:	mmHg	mmHg	mmHg	Pass / Fail[1]

Temperature

	Display	Reference	Difference	
Ambient:	°C	°C	°C	Pass / Fail[1]
Filter:	°C	°C	°C	Pass / Fail[1]

Maintenance

Monthly PM10 Inlet and Downtube? Yes / No
Monthly PM2.5 VSCC? Yes / No / N/A
Qtrly PM10 Inlet? Yes / No
Annual Cooling Fan Filter? Yes / No

Leak Check

	Initial	Final	Difference	
Pressure:	cm	cm	cm	Pass / Fail[1]

Flow

	Display (I_A)	Reference (M_A)	% Deviation	
Flow (actual):	lpm	lpm	%	Pass / Fail[1]

Comments

[1]Acceptance Criteria

Date / Time	Pressure	Temperature	Leak Check	Flow
+/- 1 min	+/- 10 mmHg	+/- 2°C	< 5 cm (2 min)	+/- 4%

File Name: BGI VERIFICATION3
Reviewed: 10/02/19

E.4.2.2. Quarterly Checks

Equipment Needed
- NIST Traceable Audit Flow Standard
- NIST Traceable Audit Temperature Standard
- NIST Traceable Audit Pressure Standard
- Stopcock
- QC Filter Cassette
- Quarterly Audit Form

Audit Procedures
1. Fill out the instrument identification information, date, and time on the Quarterly Audit Form (Figure 6). Fill out the audit equipment information on the field form.
2. Follow steps 2 through 5 in section E.4.2.1 (Monthly Checks) with the audit equipment. If there is a parameter out of range fill out a Corrective Action Request (Figure 7) for the site operator to recalibrate the instrument.
3. Remove the sampler’s ambient temperature sensor from the radiation shield and remove the filter temperature sensor from the filter holder.
4. Repeat step 5 in section E.4.2.1 by immersing the ambient and filter temperature sensors in a hot water bath and an ice bath. Also, immerse the temperature standard into the same baths and compare the record the temperatures from the sampler and the standard onto the field form. If a temperature is out of range fill out a Corrective Action Request for the site operator to recalibrate the temperature.
5. Continue the audit by following steps 6 through 17 in section E.4.2.1 (Monthly Checks) with the audit equipment to complete the audit.

Figure 6 Quarterly BGI PQ200 Audit Form

Air Quality Management Division
Quarterly BGI PQ200 Audits

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Sampler: *BGI, Inc.* Model: *PQ 200*

S/N:	*700*	*704*
ID:	*$PM_{2.5}$*	*PM_{10}*

Date: ______
Time: ______ PST
Operator: ______

Date / Time

Standard: ______ Model: ______ S/N: ______

	Display	Reference	Difference		
Date:					
Time (PST):				+ / - 1 min?	Yes / No

Pressure

Standard: ______ Model: ______ S/N: ______

	Display (mmHg)	Reference (mmHg)	Difference (mmHg)		
Pressure:				+ / - 10 mmHg?	Yes / No

Temperature

Standard: ______ Model: ______ S/N: ______

Ambient	Display (°C)	Reference (°C)	Difference (°C)		
Ambient:				+ / - 2°C?	Yes / No
Low:				+ / - 2°C?	Yes / No
High:				+ / - 2°C?	Yes / No

Filter					
Ambient:				+ / - 2°C?	Yes / No
Low:				+ / - 2°C?	Yes / No
High:				+ / - 2°C?	Yes / No

Leak Check

	Initial (cm)	Final (cm)	Difference (cm)		
Pressure:				<5 cm (2 min.)?	Yes / No

Flow

Standard: ______ Model: ______ S/N: ______

	Display (Lpm)	Reference (Lpm)	% Difference		
Act. Flow:				+ / - 4% ?	Yes / No

	Reference (Lpm)	Design (Lpm)	% Difference		
Act. Flow:		16.67		+ / - 5% ?	Yes / No

Comments ______

File Name: BGI Audit 2
Reviewed: 09/26/19

Figure 7 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ____________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ____________________________

Problem Identification:

Site: ____________________________
System: ____________________________
Date: ____________________________
Time: ____________________________
Nature of Problem: ____________________________
____
____

Recommended Action: ____________________________
____
____

Signature: ____________________________ Date: ________________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________________
Time corrective action taken: ____________________________
Corrective Action Summary: ____________________________
____
____
____

Signature: ____________________________ Date: ________________

QA Manager Signature: ____________________________ Date: ________________

Supervisor Signature: ____________________________ Date: ________________

Director Signature: ____________________________ Date: ________________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

E.5 Calibration Procedures

E.5.1. Flow Calibration

Equipment Needed

- NIST Traceable Flow Standard
- NIST Traceable Temperature Standard
- NIST Traceable Pressure Standard
- QC Filter Cassette
- PM Calibration Worksheet

1. Complete all information on the PM Calibration Worksheet (Figure 8).
2. From the Main menu, use the arrow keys until Test Menu flashes.
3. Press Select to enter the Test Menu.
4. From the Test menu, use the arrow keys until Calibrate Flow flashes.
5. Press Select to enter Flow Calibration mode.
6. The Volume or Mass Control message will be displayed. The current selection will be flashing on the second line. Select (MASS) or (VOLUME).
7. The next screen will display Target Q: 16.7 LPM (and the selected calibration method, Mass or Volume) on the first line. The numeric value will be flashing. The second and third lines display the current ambient temperature and barometric pressure, and the ambient temperature and barometric pressure for the current calibration.
8. Press Select (NEXT). The value preceding the decimal place will stop flashing, indicating it can be edited.
9. Use the arrow buttons to increase or decrease the selected value. When done press Select (NEXT). The value following the decimal will then stop flashing.
10. Use the arrow keys to select a new value. Press Exit. The calibration screen will then be displayed.
11. Press the ON/OFF (PUMP) button to turn on the pump. The Corrected Q: message will then be displayed (the value for corrected Q that is shown is for reference only).
12. Use the arrow keys to adjust the pump speed to obtain the required flow rate on the calibration device. The arrow keys alone will fine adjust the speed. To coarse adjust, hold the Select key and the up or down arrow key simultaneously.
13. When satisfied that the flow rate is sufficient and stable, press the blank (OK) button to lock the calibration into memory. NOTE: Calibrations must be performed at 3 separate flow rate measurements, evenly spaced within the range of +/- 10 percent of the operational flow rate of 16.7 L/min.

Figure 8 PM Calibration Worksheet

Washoe County Health District - Air Quality Management Division
PM Calibration Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Manufacturer: ______ Model: ______ S/N: ______ ID: ______

Start Time (PST): ______ Date: ______ Operator: ______ Site: ______
End Time (PST): ______

Flow Standard: ______ Model: ______ S/N: ______

Barometric Pressure Cal

	Display (mmHg)	Standard (mmHg)	Difference (mmHg)		Yes	No
Pressure:			0	+/- 10mmHg?	X	

Ambient Temperature Cal

	Display (°C)	Standard (°C)	Difference (°C)		Yes	No
Ambient:			0.0	+/- 2°C?	X	

Pre Flow Cal Leak Check

	Initial (cm)	Final (cm)	Difference (cm)		Yes	No
Pressure:			0	<5 cm	X	

Flow 1 (15.0 LPM)

	Display (LPM)	Standard (LPM)
Act. Flow:		

Flow 2 (18.4 LPM)

	Display (LPM)	Standard (LPM)
Act. Flow:		

Flow 3 (16.7 LPM)

	Display (LPM)	Standard (LPM)
Act. Flow:		

Post Flow Cal Verification (16.7 LPM)

	Display (LPM)	Standard (LPM)	% Dev.		Yes	No
Act. Flow:			#DIV/0!	+/- 4%	#DIV/0!	#DIV/0!

Comments: ____________________

File Name: PM Calibration Worksheet_Alicat
Reviewed: 03/20/19

E.5.2. Temperature Calibration

Equipment Needed

- NIST Traceable Temperature Standard
- 4 + ½ Digit, Precision, Calibrated Volt Meter
- Small slotted screwdriver

The filter temperature sensor board is located on the front panel and the ambient sensor board is located on a bracket that is attached to the ambient sensor gauge connector.

1. Hang the total immersion thermometer somewhere close to the Gill screen (preferably at about the same height) where it can be read without handling (handling will cause abrupt false readings).
2. Set-up the PQ200 to run for about 3 or 4 hours to attain equilibration of the sensors and the thermometer.
3. When confident that the devices are equilibrated and stable, and while the unit is still running, carefully open the front panel of the PQ200 and locate JP4 on the main PC board.
4. Set up the DVM (digital volt meter) for a range that will allow a reading of +2.389 VDC.
5. Attach the negative (black) lead of the meter to the black wire connection of JP4. Touch the positive (red) lead to the test point labeled TP1 on the TEMP SENSOR board to be calibrated. If the voltage reads somewhere between +2.388 and +2.390, the span will not have to be set. A higher or lower reading will have to be adjusted.
6. Use a small slotted screwdriver to adjust the "SPN" trimmer pot on the sensor board. Compare the displayed readings to that of the total immersion thermometer. Adjust the "OFST" trimmer pot until the readings agree +/- 0.1° C.

E.5.3. Barometric Pressure Calibration

Equipment Needed

- NIST Traceable Pressure Standard
- NIST Traceable Temperature Standard
- Small slotted screwdriver
- A “T” adapter for the hose
- A pair of hemostats

1. At the Main screen, compare the PQ200 barometric reading to that of the NIST traceable barometer (if the barometer reads in inches (typical US readings) multiply by 25.4 to obtain millimeters).
2. Adjust the "OFFSET" until they do agree.
3. Remove the tubing that is attached to the P1 port of the barometric pressure sensor and attach a piece of hose to this port. At the end of the hose attach a "T" adapter and attach pieces of hose to the other two ends. Attach one of the hoses to the manometer negative pressure fitting. Apply light suction to the last hose until the manometer reads 100 mmHg. Clamp off the hose with the hemostats to prevent leakage.

4. Observe the displayed value. It should be 100 mmHg less than the current, ambient, barometric pressure. If not, adjust the "GAIN". After making a gain adjustment, the “OFFSET” may require re-adjustment. Work back and forth a few times to obtain a 100mm span and an ambient reading that agrees with the NIST barometer.

E.5.1. Time and Date Calibration

1. From the Main menu, use the arrow keys until Set-Ups and Download flashes.
2. Press Select to enter the Set-ups and Download menu.
3. From the Set-Ups and Download menu, with More Selections flashing, press the down arrow until Set Date and Time flashes. Press Select.
4. The Set the current DATE and TIME message will be displayed. The current date and time will be flashing.
5. Press Select (NEXT). The first value (date) will stop flashing (it can now be edited).
6. Use the arrow (EDIT) buttons to increase or decrease the selected value. When done press Select (NEXT).
7. Continue to press the Select (NEXT) and arrow (EDIT) buttons in this fashion to enter the desired date and time.
8. When done, press the blank (EXIT) button to return to the second Set-Ups and Download screen. Select More Selections, then Return to Main Screen or press the blank (EXIT) button.

E.6 Routine Maintenance

E.6.1 Weekly Maintenance

Before the installation of the new set of filters, wipe down the exterior of the instrument with a dry cloth and clean the interior of the instrument with a brush.

E.6.2. Monthly Maintenance

Monthly PM_{10} inlet, downtube and $PM_{2.5}$ Very Sharp Cut Cyclone (VSCC) maintenance is usually completed at the same time as monthly verifications.

Equipment Needed

- Inlet Cleaning Kit
- Bottle brush
- Acid brush
- Rag
- Lint free wipes
- Cotton swabs
- Silicone vacuum grease
- Distilled water / alcohol solvent (optional)
- Compressed air

E.6.2.1 PM_{10} Inlet Maintenance

1. Remove the PM_{10} size selective inlet from the top of the downtube by gently pulling upward.
2. Access the particle trap by unscrewing the upper assemble from the lower assembly. Thoroughly clean inside the particle trap and nozzle, and down the three collection tubes using a small brush, cotton swabs, and/or compressed air. Alcohol or distilled water may be used as a solvent.
3. Lubricate the large particle trap O-ring and threads with a small amount of silicone vacuum grease before threading the two halves back together.
4. Lubricate the two smaller O-rings in the bottom of the assembly with a small amount of silicone vacuum grease.
5. Remove the four screws on the top of the inlet and remove the top plate assemble.
6. Clean the inside of the upper acceleration funnel using a small brush, dry cloth, and/or compressed air.
7. Clean the debris screen with a brush.
8. Reassemble the top plate and upper acceleration funnel.
9. Clean out glass drip jar and make sure seal is good before re-installing.

E.6.2.2 Downtube Maintenance

1. Remove one-foot long sample transport tube by gently pulling upward.
2. Run bottle brush through tube to clean stubborn deposits.

3. Run a rag through tube until it is free of dust.
4. Lubricate two small O-rings at bottom of tube with a small amount of silicone vacuum grease.

E.6.2.3 $PM_{2.5}$ VSCC Maintenance

1. Remove VSCC from sampler cabinet by loosening the round knurled tension knob and lifting out the VSCC.
2. Pull off the side transfer tube.
3. Remove the top cap and grit pot by unscrewing.
4. Use a lint free cloth, cotton swab, and/or compressed air to remove all visible deposits. These are most likely to be found at the bottom of the cone and inside the grit pot. Distilled water may be used as a solvent.
5. Inspect all O-rings for shape and integrity. If any O-rings are suspect, replace them. Lubricate all O-rings with a small amount of silicone vacuum grease.
6. Assemble in reverse order and reinstall.

E.8 Troubleshooting

Refer to BGI PQ200 Instruction Manual section 3.0 for troubleshooting.

Appendix F: Carbon Monoxide Analyzers

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ______________________________

Title of Author: ______________________________

Signature: ______________________________ Date: ______________

Name: ______________________________

Title: ______________________________

Signature: ______________________________ Date: ______________

Name: ______________________________

Title: ______________________________

Signature: ______________________________ Date: ______________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:____________________________Date:____________

Name: ____

Title: ____

Signature:____________________________Date:____________

Name: ____

Title: ____

Signature:____________________________Date:____________

Name: ____

Title: ____

Signature:____________________________Date:____________

Name: ____

Title: ____

Signature:____________________________Date:____________

Acronyms and Abbreviations

AQMD	Washoe County Air Quality Management Division
CO	Carbon Monoxide
DAS	Data Acquisition System
EPA	U.S. Environmental Protection Agency
ESC	Environmental Systems Corporation
GFW	Gas Filter Wheel
IR	Infrared
LPM	Liters per minute
NO	Nitrogen Oxides
N_2	Nitrogen
PSI	Pounds per Square Inch
ppm	Parts per Million
QC	Quality Control
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedures
TAPI	Teledyne Advanced Pollution Instrumentation
Z/P/S	Zero, Precision, Span

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F.1 Introduction

The Teledyne Advanced Pollution Instrumentation (TAPI) Model 300 series analyzers measure the amount of carbon monoxide (CO) based on the amount of infrared (IR) radiation absorbed by CO molecules at a specific wave length in the IR spectrum. The amount of light absorbed is proportional to the concentration of CO in the ambient air sample. For additional information, a detailed discussion of the analyzers principle of operation can be found in the TAPI manufacturers' manual. The purpose of this document is to supplement the manufacturers' manual with instructions for operating the analyzer.

F.2 Theory of Operation

The analyzer generates broad-band IR light with a high energy heated element. The light is then passed through a rotating gas filter wheel (GFW) causing the beam to alternate between a nitrogen (N_2) gas filled cell (Measure) and a cell mixed with CO and N_2 gases (Reference). When the beam passes through the Reference cell, the CO strips the beam of all IR energy at wavelengths where CO can absorb. This "optically scrubbed" portion of the light is the reference beam. The beam then passes through the Measure cell of the GFW. The nitrogen in the Measure cell does not affect the beam and therefore allows a measure beam that can be absorbed by CO in the sample cell. The beam then enters a multi-pass sample cell, which uses mirrors to generate a 14-meter absorption path length to maximize sensitivity, then passes through a filter to limit the light to the wavelength of interest. The light is then converted into a voltage signal when the beam strikes the detector. Two voltages are generated, the CO MEAS and CO REF voltages. The difference in intensity between the two voltages is proportional to the concentration of the CO in the ambient air sample.

F.3 Precautions

1. To avoid injury, always use two people to lift and carry the analyzer.
2. Connect the exhaust fitting on the rear panel to a vent outside the analyzer area.
3. Ensure analyzer is set up for proper voltage and frequency.
4. Ensure power plug has a ground lug.
5. Hazardous voltages exist within the instrument chassis.
6. Do not exceed 15 Pounds per Square Inch (PSI) of pressure within the instrument.
7. Remove power from the instrument before service is performed.

F.4 Instrument Operation

F.4.1 Quality Control

F.4.1.1 Site Checks

Perform Site Checks during each visit to the site. Check the instrument's front panel display for indication of analyzer malfunction or warning messages. Compare the instrument front panel concentration to the Data Acquisition System (DAS) concentration to check for deviations. Check all analyzer diagnostics by pressing the <TST> button on the front of the analyzer to ensure all diagnostics are within range. Refer to the instrument diagnostics page located at the front of the instrument manual for diagnostics specific to each instrument. Shelter conditions are noted and logged on the Station Log Report (Figure 1). Warning messages, changes in diagnostics or work performed on the analyzer is also noted on the Station Log Report and the Instrument Log Book.

Figure 1 Station Log Report

Washoe County Health District - Air Quality Management Division

Station Log Report

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site: ____________________

	Operator(s):											
	Date:											
	Time (PST):											
		Y	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**
1	Outside Good Repair:												
2	Inside Good Repair:												
3	All Settings Correct:												
4	Heat/Air Working:												
5	A/C Clean Filter Light Off:												
6	Analyzer Fault Lights Off:												
7	Analyzer Date/Time +/- 1 min:												
8	Gas Analyzer Multipoint Current:												
9	Datalogger Date/Time +/- 1 min:												
10	UPS Battery Status Light Green:												
11	T° Sentry Status Light Green:												
12	Station Inside Temperature (°C):												
13	Instruments Adjusted:												

Additional Comments:

Station Log Report
Last Revision: 09/05/17

F.4.1.2 Weekly Checks

F.4.1.2.1 Diagnostic Checks

The CO analyzer diagnostics are checked at the beginning of every week.

1. Note the date, time and operator in the instrument log book.
2. Record the Sample Flow and Reference Voltage off of the analyzer display by scrolling through the <TST> functions. The sample flow must be 1800 cc/min +/- 20%. The CO reference voltage must be within 3000-4000 mv.
3. Record the concentration in parts per million (ppm) of CO off of the analyzer display and the DAS. These must be within +/- 0.1 ppm.
4. Ensure there are no major changes in these diagnostics from last week's readings.

F.4.1.3 Bi-weekly Checks

F.4.1.3.1 Calibration Checks

Perform a zero/precision/span (Z/P/S) check of the analyzer every 14 days. Record all readings on the CO Worksheet on the field issued computer. (Figure 2).

1. Put the site instrument in maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS, press L to Login, and enter the Password to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press I for Put Channel In Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, then L to return to displaying the parameters on the screen. The parameter chosen (CO) should appear on the screen in red indicating they are in maintenance mode. (See Appendix V for the SOP on this instrument).
2. Ensure the valve to the CO cylinder is open and the regulator pressure is at 30 PSI.
3. Ensure the pressure on the zero air generator is at 30 PSI.
4. Using an Ethernet cable, connect laptop to the firewall network router box. Locate the AQMonitoring drive on the computer. Open the Field Management Functions folder, QA/QC folder, then CO QA/QC folder. Open the respective site folder and current year folder. Find the latest form and open. Click file and SAVE AS, save the file with the current date, parameter, and site (ex 20190912_CO_Sparks). Clear the contents from the old data sheet and input all the new information on the CO worksheet. Ensure the instrument's reference voltage and sample flow is within the instrument's diagnostic range. Record "Start Time" on the CO worksheet from when you put the channel in maintenance on the DAS.
5. Span Check: From the standby screen on the Teledyne T700 Dilution Calibrator (see Appendix LL for the SOP on this instrument), press GEN, and then press AUTO. Update the touchscreen buttons to read 45.0 ppm CO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 5 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 45.0 ppm of CO. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppm or less and record the CO

concentration from the DAS. View the percent deviation calculation on the Carbon Monoxide Worksheet to verify that it is +/- 5%. Adjust the span if the percent deviation is outside +/- 5% (see section F.4.2 for Calibration Procedures).

6. Precision Check: Repeat step 5 above using 4.5 ppm CO for the concentration and 7 LPM for the calibrator flow.
7. Zero Check: Press GEN, and then press AUTO. Press the CO touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 5 liters per minute (LPM), and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppm or less and record the CO concentration from the DAS. Adjust the zero if the CO concentration is outside +/- 0.3 parts per million (ppm)[1] (see section H.4.2 for Calibration Procedures).
8. Press STBY on the dilution calibrator, this will stop all calibration procedures.
9. Take the instrument out of maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press O for Take Channel Out of Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters should display on the screen in green.
10. Record "End Time" on the CO Worksheet and make sure to save the document before shutting down the computer.
11. Print two copies of the CO worksheet at the office, one for the QA/QC logbook at the site and one for the data exception log in the office.
12. Record the Z/P/S results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
13. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the Z/P/S flag.

[1] EPA zero drift criteria is 0.4 ppm for 24 hours and 0.6 ppm for 14 days, 0.3 ppm reflects our in house action level.

Figure 2 Carbon Monoxide Worksheet

Air Quality Management Division

Carbon Monoxide Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Z / P / S ______ Multipoint ______ Calibration ______ Audit ______

Date ______ Operator ______ Site ______

Site Instrument (Indicated)		Gas Calibrator (Actual)		Zero Air	
Manufacturer		Manufacturer		Manufacturer	
Model		Model		Model	
Serial No.		Serial No.		Serial No.	
Sample Flow (cc/m)		Sample Flow (LPM)		PSI	
Ref. Voltage (mV)					
		Cal. Cylinder No.			
Slope		Concentration (ppm)			
Offset		Expiration Date			
		Cyl. Pressure (PSI)			

Date of Last Particulate Filter Change ______

Start Time ______ PST **End Time** ______ PST

Set Point	Indicated	Actual	Percent Dev.	*EPA Acceptance Criteria	Audit Acceptance Criteria
45.0 ppm			#DIV/0!	+/- 10% dev.	+/- 15% dev.
18.0 ppm			#DIV/0!	+/- 10% dev.	+/- 15% dev.
9.0 ppm			#DIV/0!	+/- 10% dev.	+/- 15% dev.
4.5 ppm			#DIV/0!	+/- 10% dev.	+/- 15% dev.
0.0 ppm			#DIV/0!	+/- 0.6 ppm	+/- 0.6 ppm

*AQMDs in house action level for adjustment is +/- 0.3 ppm for zero and +/- 5% for precision and/or span points

Average Percent Dev.	#DIV/0!	Slope	#DIV/0!
Std. Dev.	#DIV/0!	Intercept	#DIV/0!
		Correlation	#DIV/0!

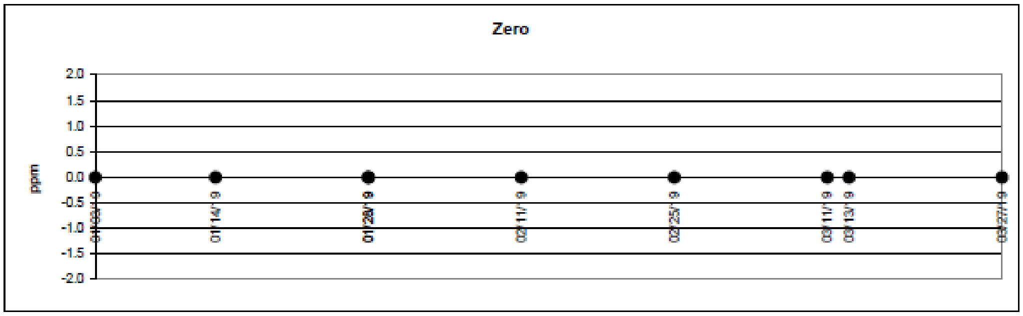
Comments ______

File Name: 20190924_CO_Sparksnewlogo
Last Revision: 09/12/19

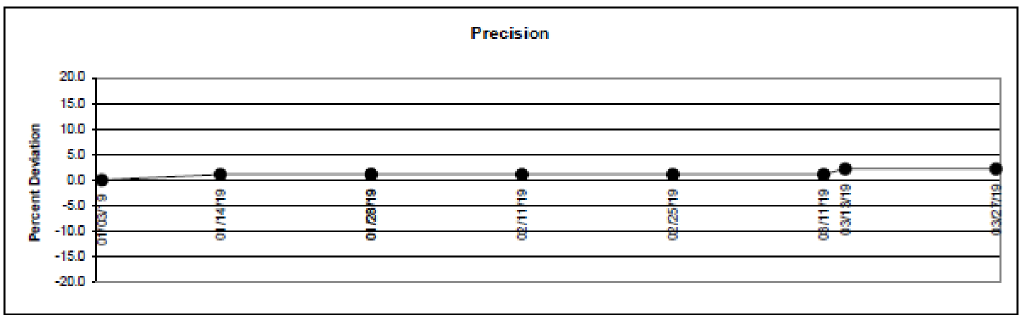
Figure 3 Carbon Monoxide Control Chart

Carbon Monoxide Control Chart

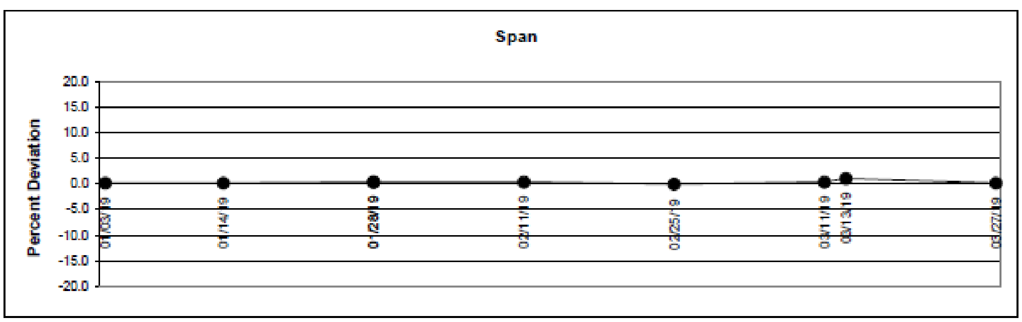
Site:	Sparks	**Instrument:**	TAPI
Year:	2019	**Model:**	300EU
Quarter:	1st	**Serial #:**	269



Zero Drift Limits: 0 - 0.3 ppm, no adjustment necessary
0.4 - 1.0 ppm, adjust analyzer
>1.0 ppm, invalidate data and recalibrate



EPA Acceptance Criteria: < +/-10% dev.



Span Drift Limits: 0 - 4.9% dev., no adjustment necessary
5 - 10% dev., adjust analyzer and run multipoint
>10% dev., invalidate data and recalibrate

Notes: 01/14/19 Multipoint
03/13/19 Qtrly audit

Figure 4 Data Exception Log

Site: Year: Quarter:

Date	Begin Time	End Time	Parameter	Error Code												
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a

Notes:

F.4.1.4 Monthly Checks

Perform monthly checks at the beginning of each month.

1. Check pressure in the CO calibration gas cylinder. Complete the Monthly Cylinder Pressure Log (Figure 5). Compare to last month pressure check to ensure there has been no excess loss of CO.
2. Replace the analyzer’s particulate filter (see section F.5.1 for Replacing the Particulate Filter).

Figure 5 Monthly Cylinder Pressure Log

Monthly Cylinder Pressure Log

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Year(s): ______ / ______
Site: ____________

Date	Cylinder ID #	Concentration (ppm)			Expiration Date	Pressure (PSI)	Initials
		CO	NO	SO_2			

Comments: ____________

F.4.1.5 Quarterly Audits

Equipment Needed:

- Certified audit ozone transfer standard/dilution calibrator (TAPI T750U)
- Audit zero air generator (TAPI 751H)
- Audit CO calibration cylinder

F.4.1.5.1 Audit Equipment Set-Up

1. Set-up, plug in, and power on the audit T750U calibrator. It may be set-up on top of the site calibrator. Prior to beginning any gaseous audit, the audit T750U must be powered on for at least 30 minutes, allowing the calibrator to come up to proper operating temperature.
2. Set-up and plug in the audit 751H zero air generator on the station floor near the T750U.
3. Using 1/4" Teflon FEP tubing with stainless steel (SS) fittings, connect the ZERO OUT port on the 751H to the DILUENT IN port on the T750U.
4. Power on the 751H, and ensure the pressure gauge on the front panel is reading 30 pounds per square inch (PSI). If it is not, adjust the regulator knob on the front panel until it is reading 30 PSI.
5. Set-up the audit CO calibration cylinder inside the station in close proximity to the T750U calibrator. Position the end of the cylinder line outside the station door. Open the second stage regulator valve. Turn the regulator pressure adjustment knob all the way counter-clockwise. Open and close the cylinder valve. Turn the regulator pressure adjustment knob clockwise to bleed all gas from the regulator until the cylinder pressure and regulator pressure read 0 PSI. Turn the regulator pressure adjustment knob all the way counter-clockwise. Repeat this process three times to ensure any contaminated gas is purged from the regulator and cylinder line. See Figure 6 for a diagram of the cylinder and regulator.
6. Connect the audit CO cylinder line to CYL IN port on the T750U, open cylinder valve, and use the regulator pressure adjustment knob to set the regulator pressure to 30 PSI.
7. Remove the calibration manifold line from the back of the station calibrator CAL OUT port and connect to the CAL OUT port on the T750U.

F.4.1.5.2 Audit Procedures

1. Follow steps 1 – 10 in Section F.4.2.3 using the audit standards instead of the site standards and ensuring that each point is within +/- 15%. If any point is out of range, complete a Corrective Action Request (Figure 7) and submit to instrument operator.
2. Print three copies of the CO worksheet at the office, one for the audit folder maintained by the senior air quality specialist, one for the QA/QC logbook at the site, and one for the data exception log in the office.
3. Record the audit results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
4. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the audit flag.

Figure 6 Calibration Cylinder/Regulator Diagram

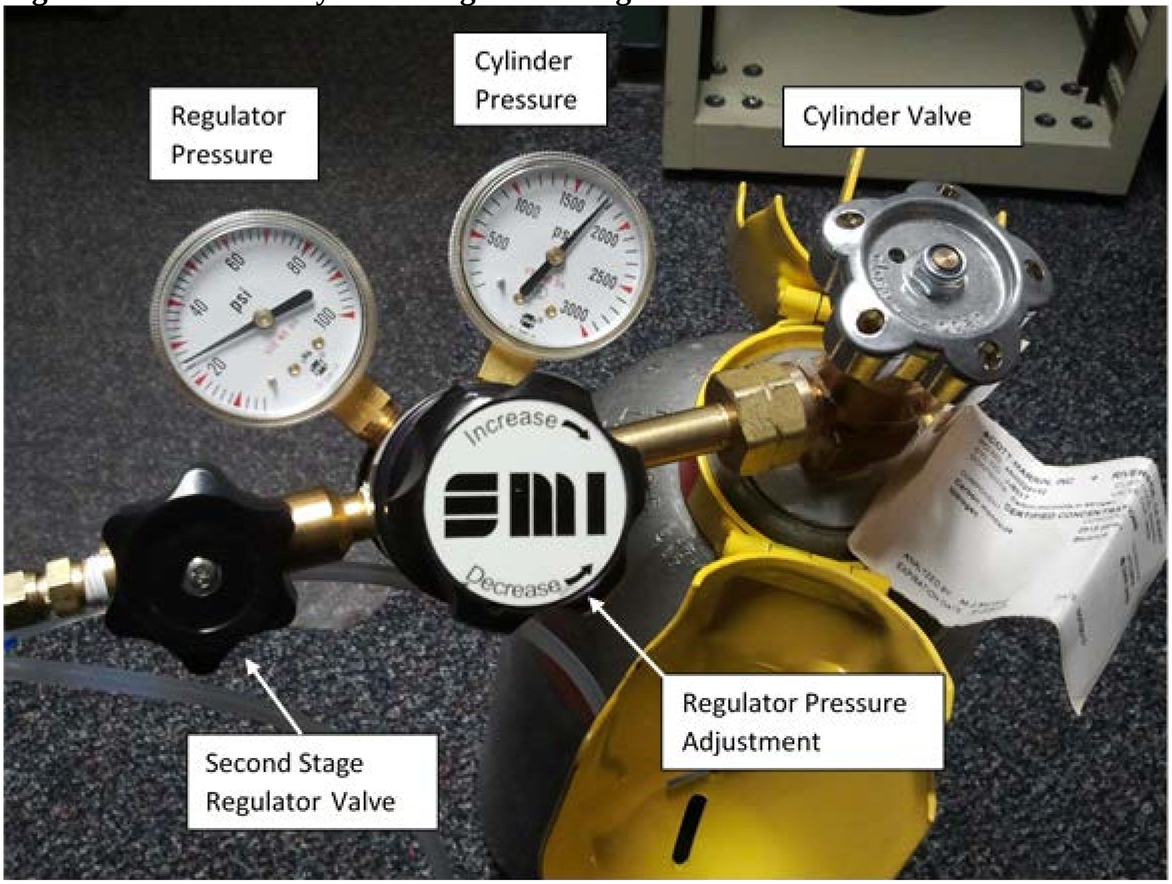


Figure 7 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ____________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ____________________________

Problem Identification:

Site: ____________________________
System: ____________________________
Date: ____________________________
Time: ____________________________
Nature of Problem: ____________________________
____
____

Recommended Action: ____________________________
____
____

Signature: ____________________________ Date: ________________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________________
Time corrective action taken: ____________________________
Corrective Action Summary: ____________________________
____
____
____

Signature: ____________________________ Date: ________________

QA Manager Signature: ____________________________ Date: ________________

Supervisor Signature: ____________________________ Date: ________________

Director Signature: ____________________________ Date: ________________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

F.4.2 Calibration Procedures

F.4.2.1 Zero Adjustment

Perform a zero adjustment when the zero point is outside +/- 0.3 ppm during the bi-weekly checks. The zero adjustment must be done after the completion of the bi-weekly Z/P/S check.

1. Upon completion of the bi-weekly Z/P/S, press GEN, and then press AUTO. Press the CO touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 5 LPM, and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppm or less.
2. Once the instrument is stabilized press the CAL button on the front panel of the instrument.
3. Press the ZERO button followed by ENTR. The instrument will adjust automatically to 0.0 ppm CO concentration. Log "zero adjustment" in the comments section of the original Z/P/S worksheet.
4. Allow the instrument to stabilize to 0.1 ppm and record the reading from the DAS on a new Z/P/S worksheet.
5. After a ZERO adjustment, a re-check of the span and precision points is recommended. If the span or precision points are outside the required acceptance criteria, continue with section F.4.2.2 for span adjustment and F.4.2.3 for multipoint calibration.

F.4.2.2 Span Adjustment

Perform a span adjustment when the percent deviation of the span point is outside +/- 5% during the bi-weekly checks. The span adjustment must be done after the completion of the bi-weekly Z/P/S check.

1. Upon completion of the weekly Z/P/S, press GEN, and then press AUTO. Update the touchscreen buttons to read 45.0 ppm CO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 5 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 45.0 ppm of CO. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.010 ppm or less.
2. Once the instrument is stable, press CAL on the front panel of the analyzer. Ensure the CONC button is programmed to 45.0 ppm. Press SPAN, and then press ENTR. The analyzer will adjust automatically to 45.0 ppm CO concentration.
3. Allow the instrument to stabilize and record the reading from the DAS. Complete a multipoint calibration as described in section F.4.2.3 after any span adjustment is made.

F.4.2.3 Multipoint Calibration

Perform a multipoint calibration after a span adjustment is made to the instrument. A multipoint calibration must be performed before any other adjustments are made to the instrument.

1. Put the site instrument in maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS, press L to Login, and enter the Password to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press I for Put Channel In Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, then L to return to displaying the parameters on the screen. The parameter chosen should appear on the screen in red indicating they are in maintenance mode. (See Appendix V for the SOP on this instrument).
2. Ensure the valve to the CO cylinder is open and the regulator pressure is at 30 PSI.
3. Ensure the pressure on the zero air generator is at 30 PSI.
4. Using an Ethernet cable, connect laptop to the firewall network router box. Locate the AQMonitoring drive on the computer. Open the Field Management Functions folder, QA/QC folder, then CO QA/QC folder. Open the respective site folder and current year folder. Find the latest form and open. Click file and SAVE AS, save the file with the current date, parameter, and site (ex 20190912_CO_Sparks). Clear the contents from the old data sheet and input all the new information on the CO worksheet. Ensure the instrument's reference voltage and sample flow is within the instrument's diagnostic range. Record "Start Time" on the CO worksheet from when you put the channel in maintenance on the DAS.
5. Span Check: From the standby screen on the Teledyne T700 Dilution Calibrator (see Appendix LL for the SOP on this instrument), press GEN, and then press AUTO. Update the touchscreen buttons to read 45.0 ppm CO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 5 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 45.0 ppm of CO. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppm or less and record the CO concentration from the DAS. View the percent deviation calculation on the Carbon Monoxide Worksheet to verify that it is +/- 5%.
6. Repeat step 5 above for the following points:
    - 18.0 ppm CO
    - 9.0 ppm CO
    - 4.5 ppm CO (Ensure flow delivered from calibrator is 7 LPM for this point)
7. Zero Check: Press GEN, and then press AUTO. Press the CO touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 5 liters per minute (LPM), and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppm or less and record the CO concentration from the DAS.
8. Press STBY on the dilution calibrator, this will stop all calibration procedures.
9. Take the instrument out of maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press O for Take Channel Out of Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters should display on the screen in green.

10. Record “End Time” on the CO Worksheet and make sure to save the document before shutting down the computer.
11. Print two copies of the CO worksheet at the office, one for the QA/QC logbook at the site and one for the data exception log in the office.
12. Record the multipoint results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
13. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the multipoint flag.

F.5 Routine Maintenance

F.5.1. Replacing the Particulate Filter

The particulate filter is located between the instrument and sample manifold in a particulate filter holder.

1. Unscrew the top Teflon fitting from the particulate filter holder with your fingers.
2. Use particulate filter holder wrenches to release the two parts of the particulate filter holder.
3. Examine old filter for unusual accumulation or tears and replace with new particulate filter. Note any abnormalities in the particulate filter in the site log and the instrument log.
4. Clean the two parts of the particulate holder using compressed air, Kim wipes, or cotton swabs.
5. Using forceps, insert the new particulate filter being careful not to touch the filter media with your fingers.
6. Use particulate filter holder wrenches to tighten the two parts of the particulate filter holder.
7. Using a Teflon cap, block the upper portion of the particulate filter holder to leak test the analyzer. It may take several minutes for the displayed sample flow and pressure to stabilize.
8. Record the Sample Flow and the Pressure in the instrument log book. The sample flow must be below 10 cc/min and the pressure must be below 10 inHg to pass the leak test. If the leak test does not pass, refer to the instrument manual for instructions on diagnosing a leak.

F.5.2. Replacing the Sample Manifold

Replace the sample manifold line once per year.

1. Flag all affected gas parameters on the data logger.
2. Log Start Date and Time on a Misc. Instrument Maintenance/Data Exception Worksheet (Figure 8).
3. Completely remove all ¼” FEP Teflon lines from the sample manifold.
4. Clean the bug screen at the top of the sample inlet and all Teflon tees in the sample manifold with alcohol and cotton swabs.

5. Replace with new, clean ¼" FEP Teflon lines, making sure to measure the length of tubing that is used. Record new manifold length on misc. data exception worksheet.
6. Condition new sample manifold lines with 500 ppb ozone for at least one hour.
7. Log End Date and Time on misc. data exception worksheet.

F.6 Troubleshooting

Refer to the Troubleshooting section in the operator's manual for troubleshooting options specific to each instrument.

Figure 8 Misc. Instrument Maintenance/Data Exception Worksheet

Air Quality Management Division

Misc. Instrument Maintenance / Data Exception Worksheet

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site ______________ Operator ______________ Parameter(s) ______________

Start Date ______________ **End Date** ______________

Start Time ______________ **End Time** ______________

Comments ____

File Name: Misc Data Exception Worksheet
Last Revision: 10/02/19

Appendix G: Ozone Analyzers

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ______________________________

Title of Author: ______________________________

Signature: ______________________________ Date: ______________

Name: ______________________________

Title: ______________________________

Signature: ______________________________ Date: ______________

Name: ______________________________

Title: ______________________________

Signature: ______________________________ Date: ______________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Acronyms and Abbreviations

AQMD	Washoe County Air Quality Management Division
CPU	Central Processing Unit
DAS	Data Acquisition System
LPM	Liters per Minute
nm	Nanometers
PCB	Printed Circuit Board
ppb	Parts per Billion
PSI	Pounds per Square Inch
QC	Quality Control
SCR	Strip Chart Recorder
SLAMS	State and Local Air Monitoring Stations
SOP	Standard Operating Procedures
TAPI	Teledyne Advanced Pollution Instrumentation
UV	Ultraviolet
V/F	Voltage to Frequency
z/p/s	Zero, precision, span

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G.1 Introduction

The Teledyne Advance Pollution Instrumentation (TAPI) Model 400 series analyzers measure ozone concentrations in ambient air. The detection of ozone is based on the absorption of ultraviolet light by molecular ozone. The amount of light absorbed is proportional to the concentration of ozone in the ambient air sample. For additional information, a detailed discussion of the analyzers principle of operation can be found in the TAPI manufacturers' manual. The purpose of this document is to supplement the manufacturers' manual with instructions for operating the analyzer.

G.2 Theory of Operation

The analyzer uses a mercury lamp that emits a majority of light at the 254 nanometer wavelength of ultraviolet (UV) light. Light from the lamp shines down a hollow quartz tube that is alternately filled with sample gas, and then filled with gas scrubbed of ozone. A ratio of the intensity of light passing through the scrubbed gas to that of the sample gas is formed. This ratio is the basis for the calculation of the ozone concentration based on the Beer-Lambert equation (Figure 1). The absorption coefficient is a number that reflects the ability of ozone to absorb 254 nm light. The absorption path length determines how many molecules are present in the column of gas in the absorption tube. The intensity of light is converted into a voltage by the detector/preamp module. The voltage is converted into a number by a voltage-to-frequency (V/F) converter. The digitized signal is used by the central processing unit (CPU) to compute the concentration using the Beer-Lambert equation. Every 6 seconds the analyzer completes a measurement cycle consisting of a 2 second wait period for the sample tube to flush, followed by a 1 second measurement of the UV light intensity to obtain I. The sample valve is switched to allow scrubbed sample gas through the tube for 2 seconds followed by a 1 second measurement of the UV light intensity to obtain I_o. The analyzer measures I_o every 6 seconds to minimize instrument drift due to changing intensity of the lamp due to aging and dirt.

Figure 1 Beer-Lambert equation

$A = \varepsilon bc$

Where:

A = absorbance
ε = molar absorptivity
b = path length
c = concentration
P = transmitted power
P_0 = initial incident power

G.3 Precautions

1. To avoid injury, always use two people to lift and carry the analyzer.
2. Connect the exhaust fitting on the rear panel to a vent outside the analyzer area.
3. Ensure analyzer is set up for proper voltage and frequency.
4. Ensure power plug has a ground lug.
5. Never disconnect CPU or other Printed Circuit Board (PCB) cards while under power.
6. Hazardous voltages exist within the instrument chassis.
7. Do not exceed 15 Pounds per Square Inch (PSI) of pressure within the instrument.
8. Remove power from the instrument before service is performed.

G.4 Instrument Operation

G.4.1 Quality Control

G.4.1.1 Site Checks

Perform Site Checks during each visit to the site. Check the instrument's front panel display for indication of analyzer malfunction or warning messages. Compare the instrument front panel concentration to the Data Acquisition System (DAS) concentrations to check for deviations. Check all analyzer diagnostics by pressing the <TST> button on the front of the analyzer to ensure all diagnostics are within range. Refer to the instrument diagnostics page located at the front of the instrument manual for diagnostics specific to each instrument. Shelter conditions are noted and logged on the Station Log Report (Figure 2). Warning messages, changes in diagnostics or work performed on the analyzer is also noted on the Station Log Report and Instrument Log Book.

Figure 2 Station Log Report

Washoe County Health District - Air Quality Management Division

Station Log Report

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site: ____________________

	Operator(s):												
	Date:												
	Time (PST):												
		Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
1	Outside Good Repair:												
2	Inside Good Repair:												
3	All Settings Correct:												
4	Heat/Air Working:												
5	A/C Clean Filter Light Off:												
6	Analyzer Fault Lights Off:												
7	Analyzer Date/Time +/- 1 min:												
8	Gas Analyzer Multipoint Current:												
9	Datalogger Date/Time +/- 1 min:												
10	UPS Battery Status Light Green:												
11	T° Sentry Status Light Green:												
12	Station Inside Temperature (°C):												
13	Instruments Adjusted:												

Additional Comments:

Station Log Report
Last Revision: 09/05/17

G.4.1.2 Daily Checks – NCore Site

Daily span/zero checks are performed at 0045 PST using automatic calibrations programmed into the Environmental Systems Corporation (ESC) 8832 data logger (see appendix V for the ESC SOP). If the span or zero point is outside the operating specifications a calibration must be performed. (See section G.4.2 for Calibration Procedures).

G.4.1.3 Weekly Checks

G.4.1.3.1 Diagnostic Checks – SLAMS and NCore Sites

The O_3 analyzer diagnostics are checked at the beginning of every week.

1. Note the date, time and operator in the instrument log book.
2. Record the Sample Flow and Reference Voltage off of the analyzer display by scrolling through the <TST> functions. The sample flow must be 800 cc/min +/- 20%. The O_3 reference voltage must be within 3000-4000 mv.
3. Record the concentration in parts per billion (ppb) of O_3 off of the analyzer display and the DAS. These must be within +/- 1 ppb.
4. Ensure there are no major changes in these diagnostics from last week's readings.

G.4.1.3.2 Calibration Checks – NCore Site

At the NCore site, perform a zero, precision, span (Z/P/S) check of the analyzer once a week. Record all readings on the Ozone Worksheet (Figure 3).

1. Put the site instrument in maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS, press L to Login, and enter the Password to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press I for Put Channel In Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters chosen should appear on the screen in red indicating they are in maintenance mode. (See Appendix V for the SOP on this instrument).
2. Ensure the pressure on the zero air generator is at 30 PSI.
3. Using an Ethernet cable, connect laptop to the firewall network router box. Locate the AQMonitoring drive on the computer. Open the Field Management Functions folder, QA/QC folder, then O3 QA/QC folder. Open the respective site folder and current year folder. Find the latest form and open. Click file and SAVE AS, save the file with the current date, site, and parameter (ex 20190916_Reno 3_O3). Clear the contents from the old data sheet and input all the new information on the ozone worksheet. Ensure the instrument's reference voltage and sample flow is within the instrument's diagnostic range. Record "Start Time" on the ozone worksheet from when you put the channel in maintenance on the DAS.
4. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press GEN, and then press AUTO. Update the touchscreen buttons to read 180 ppb O3, then press ENTER. Ensure the flow

delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 180 ppb of O3. Allow the instrument to stabilize. Press the TEST button on the O3 analyzer until STABIL is displayed. Wait until STABIL is reading 1.0 ppb or less and record the next 10 O3 readings from the DAS every time the photometer updates (every 6 seconds). View the percent deviation calculation on the Ozone Worksheet to verify that it is +/- 5%. Adjust the span if the percent deviation is +/- 5% (see section G.4.2 for Calibration Procedures).

5. Precision Check: Repeat Step 4 above using 55 ppb O3 for the concentration.
6. Zero Check: Press GEN, and then press AUTO. Press the O3 touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the O3 analyzer until STABIL is displayed. Wait until STABIL is reading 1.0 ppb or less and record the next 10 O3 readings from the DAS every time the photometer updates (every 6 seconds). Adjust the zero if the O3 concentration is outside +/- 1.5 parts per billion (ppb)[1] (see section G.4.2 for Calibration Procedures).
7. Press STBY on the dilution calibrator, this will stop all calibration procedures.
8. Take the instrument out of maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press O for Take Channel Out of Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters should display on the screen in green.
9. Record “End Time” on the Ozone Worksheet and make sure to save the document before shutting down the computer.
10. Print two copies of the ozone worksheet at the office, one for the QA/QC logbook at the site and one for the data exception log in the office.
11. Enter the results from the field form onto the respective control chart (Figure 4). Control charts are maintained on the AQMD data management drives.
12. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 5) and circle the Z/P/S flag.

G.4.1.4 Bi-weekly Checks – SLAMS Sites

At all SLAMS sites, perform a zero/precision/span (z/p/s) check of the analyzer every other week. Record all readings on the Ozone Worksheet (Figure 3).

1. Follow steps 1 – 12 in section G.4.1.3.2, using 5 LPM for calibrator flow rate.

[1] EPA zero drift criteria is 3 ppb for 24 hours and 5 ppb for 14 days, 1.5 ppb reflects our in house action level.

Figure 3 Ozone Worksheet

Air Quality Management Division

Ozone Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Z / P / S ______ Multipoint ______ Calibration ______ Audit ______

Date ______ Operator ______ Site ______

Site Instrument (Indicated)		Transfer Standard (Actual)		Zero Air	
Manufacturer		Manufacturer		Manufacturer	
Model		Model		Model	
Serial No.		Serial No.		Serial No.	
Sample Flow (cc/m)		Sample Flow (LPM)		PSI	
Ref. Voltage (mV)		Photometer Ref. (mV)			
		Photometer Flow (LPM)			
Slope				Audit Correction	
Offset (ppb)		Date of Last Particulate Filter Change		Slope	1.0000
				Intercept (ppb)	0.00

Start Time ______ PST End Time ______ PST

Set Point	180 ppb		130 ppb		80 ppb		55 ppb		0 ppb	
	Indicated	Actual	Indicated	Actual	Indicated	Actual	Indicated	Actual	Indicated	Actual
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
Average	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Std. Dev.	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Corrected		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		
Percent Dev.	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!			
*EPA Accp. Criteria	+/- 7% dev.		+/- 7% dev.		+/- 7% dev.		+/- 7% dev.		+/- 3.0 ppb	
Audit Accp. Criteria	+/- 15% dev.		+/- 15% dev.		+/- 15% dev.		+/- 15% dev.		+/- 3.0 ppb	

*AQMDs in house action level for adjustment is +/- 1.5 ppb for zero and +/- 3.5% for precision and/or span points

Average Percent Dev.	#DIV/0!	Slope	#DIV/0!
Std. Dev.	#DIV/0!	Intercept	#DIV/0!
		Correlation	#DIV/0!

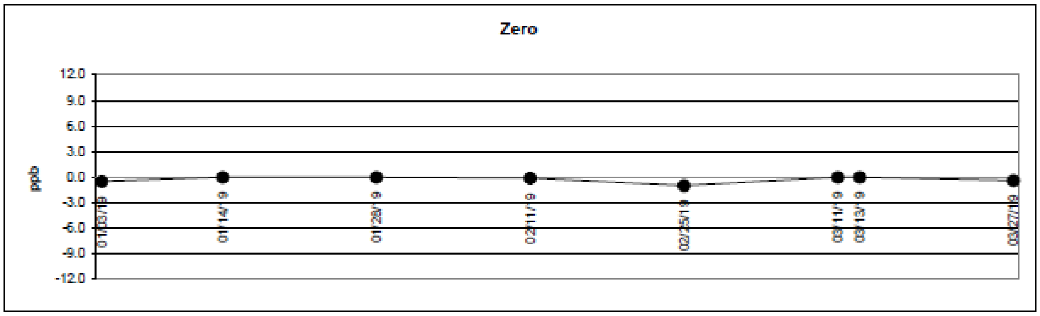
Comments ______

File Name: Master_Template_ozone
Last Revision: 09/12/19

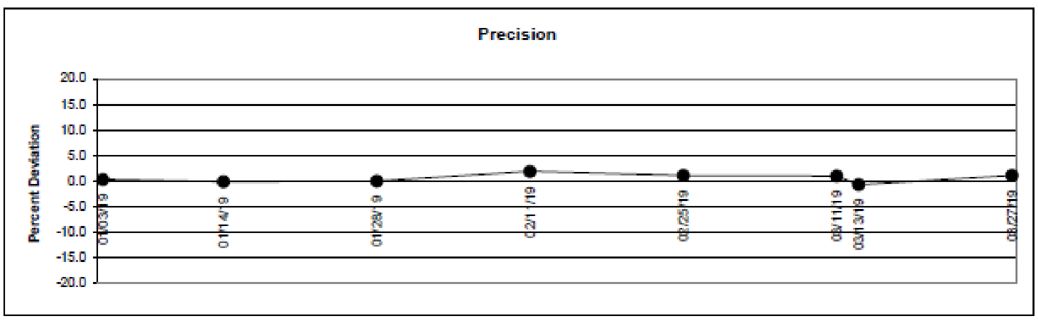
Figure 4 Ozone Control Chart

Ozone Control Chart

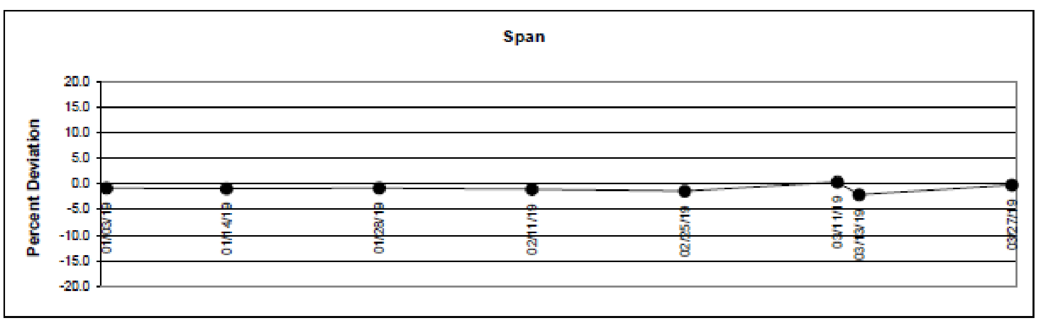
Site:	Spanish Springs	**Instrument:**	TAPI
Year:	2019	**Model:**	T400
Quarter:	1st	**Serial #:**	2789



Zero Drift Limits: 0 - 3 ppb, no adjustment necessary
4 - 10 ppb, adjust analyzer
>10 ppb, invalidate data and recalibrate



EPA Acceptance Criteria: <7% dev.



Span Drift Limits: 0 - 3.4% dev., no adjustment necessary
3.5 - 7% dev., adjust analyzer and run multipoint
>7% dev., invalidate data and recalibrate

Notes: 01/14/19 Multipoint
03/13/19 Qtrly audit

Figure 5 Data Exception Log

Site: Year: Quarter:

Date	Begin Time	End Time	Parameter	Error Code												
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	
				g	P	s	i	+or-	x	m	C	e	f	o	a	

Notes:

G.4.1.5 Monthly Checks – SLAMS and NCore Sites

Perform monthly checks at the beginning of each month.

1. Replace the analyzer's particulate filter (see section G.5.1 for Replacing the Particulate Filter).

G.4.1.6 Quarterly Audits

Equipment Needed:

- Certified audit ozone transfer standard/dilution calibrator (TAPI T750U)
- Audit zero air generator (TAPI 751H)

G.4.1.6.1 Audit Equipment Set-Up

1. Set-up, plug in, and power on the audit T750U calibrator. It may be set-up on top of the site calibrator. Prior to beginning any gaseous audit, the audit T750U must be powered on for at least 30 minutes, allowing the calibrator to come up to proper operating temperature.
2. Set-up and plug in the audit 751H zero air generator on the station floor near the T750U.
3. Using 1/4" Teflon FEP tubing with stainless steel (SS) fittings, connect the ZERO OUT port on the 751H to the DILUENT IN port on the T751U.
4. Power on the 751H, and ensure the pressure gauge on the front panel is reading 30 pounds per square inch (PSI). If it is not, adjust the regulator knob on the front panel until it is reading 30 PSI.
5. Remove the calibration manifold line from the back of the station calibrator CAL OUT port and connect to the CAL OUT port on the T750U.

G.4.1.6.2 Audit Procedures

1. Follow steps 1 – 8 in Section G.4.2.3 using the audit standards instead of the site standards and ensuring that each point is within +/- 15%. If any point is out of range, complete a Corrective Action Request (Figure 6) and submit to instrument operator.
2. Print three copies of the O3 worksheet at the office, one for the audit folder maintained by the senior air quality specialist, one for the QA/QC logbook at the site, and one for the data exception log in the office.
3. Record the audit results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
4. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the audit flag.

Figure 6 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ______________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ______________________________

Problem Identification:

Site: ____________________
System: ____________________
Date: ____________________
Time: ____________________
Nature of Problem: ____
____
____
____
Recommended Action: ____
____

Signature: ______________________________ Date: ______________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________
Time corrective action taken: ____________________
Corrective Action Summary: ____
____
____
____

Signature: ______________________________ Date: ______________

QA Manager Signature: ______________________________ Date: ______________

Supervisor Signature: ______________________________ Date: ______________

Director Signature: ______________________________ Date: ______________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

G.4.2 Calibration Procedures – SLAMS and NCore Sites

G.4.2.1 Zero Adjustment

Perform a zero adjustment when the zero point is outside +/- 1.5 ppb during the weekly checks for NCore and bi-weekly checks for SLAMS. The zero adjustment must be done after the completion of the weekly/bi-weekly z/p/s checks.

1. Upon completion of the weekly/bi-weekly Z/P/S, press GEN, and then press AUTO. Press the O3 touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 5 LPM for SLAMS sites or 6 LPM for NCore site, and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the O3 analyzer until STABIL is displayed. Wait until STABIL is reading 1.0 ppb or less.
2. Once the instrument is stabilized press the CAL button on the front panel of the instrument.
3. Press the ZERO button followed by ENTR. The instrument will adjust automatically to 0.0 ppb O3 concentration. Log “zero adjustment” in the comments section of the original z/p/s worksheet.
4. Allow the instrument to stabilize and record the nest 10 readings from the DAS every time the photometer updates (every 6 seconds) on a new Z/P/S worksheet.
5. After a ZERO adjustment, a re-check of the span and precision points is recommended. Label in the comments section the indicated ppm values of CO during the re-check. If the span or precision points are outside the required acceptance criteria, continue with section G.4.2.2 for span adjustment and G.4.2.3 for multipoint calibration.

G.4.2.2 Span Adjustment

Perform a span adjustment when the percent deviation of the span point is outside +/- 5% during the weekly/bi-weekly checks. The span adjustment must be done after the completion of the weekly/bi-weekly check.

1. Upon completion of the weekly/bi-weekly Z/P/S, press GEN, and then press AUTO. Press the O3 touchscreen buttons to read 180 ppb O3, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 5 LPM for SLAMS sites or 6 LPM for NCore site, and then press ENTER. The instrument will begin to 180 ppb O3. Allow the instrument to stabilize. Press the TEST button on the O3 analyzer until STABIL is displayed. Wait until STABIL is reading 1.0 ppb or less.
2. Once the instrument is stabilized press the CAL button on the front panel of the instrument. Ensure the CONC button is programmed to 180 ppb.
3. Press the SPAN button followed by ENTR. The instrument will adjust automatically to 180 ppb O3 concentration. Log “span adjustment” in the comments section of the original z/p/s worksheet.
4. Allow the instrument to stabilize and record the next 10 readings every time the photometer updates (every 6 seconds) on a new ozone worksheet. Complete a multipoint calibration as described in sections G.4.2.3.

G.4.2.3 Multipoint Calibration –SLAMS and NCore Sites

Perform a multipoint calibration after a span adjustment made to the instrument. A multipoint calibration must be performed before any other adjustments are made to the instrument.

1. Put the site instrument in maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS, press L to Login, and enter the Password to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press I for Put Channel In Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, then L to return to displaying the parameters on the screen. The parameter chosen should appear on the screen in red indicating they are in maintenance mode. (See Appendix V for the SOP on this instrument).
2. Ensure the pressure on the zero air generator is at 30 PSI.
3. Using an Ethernet cable, connect laptop to the firewall network router box. Locate the AQMonitoring drive on the computer. Open the Field Management Functions folder, QA/QC folder, then O3 QA/QC folder. Open the respective site folder and current year folder. Find the latest form and open. Click file and SAVE AS, save the file with the current date, site, and parameter (ex 20190916_Reno 3_O3). Clear the contents from the old data sheet and input all the new information on the ozone worksheet. Ensure the instrument's reference voltage and sample flow is within the instrument's diagnostic range. Record "Start Time" on the ozone worksheet from when you put the channel in maintenance on the DAS.
4. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press GEN, and then press AUTO. Update the touchscreen buttons to read 180 ppb O3, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 5 liters per minute (LPM) for SLAMS sites and 6 LPM for the NCore site, and then press ENTER. The instrument will begin to sample 180 ppb O3. Allow the instrument to stabilize. Press the TEST button on the O3 analyzer until STABIL is displayed. Wait until STABIL is reading 1.0 ppb or less and record the next 10 O3 readings from the DAS every time the photometer updates (every 6 seconds). View the percent deviation calculation on the Ozone Worksheet to verify that it is +/- 5%. Repeat step 4 above for the following points:
    - 130 ppb O3
    - 80 ppb O3
    - 55 ppb O3
5. Zero Check: Press GEN, and then press AUTO. Press the O3 touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 5 liters per minute (LPM) for SLAMS sites and 6 LPM for the NCore site, and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the O3 analyzer until STABIL is displayed. Wait until STABIL is reading 1.0 ppb or less and record the next 10 O3 concentrations from the DAS every time the photometer updates (every 6 seconds).
6. Press STBY on the dilution calibrator, this will stop all calibration procedures.
7. Take the instrument out of maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS to get to the Main Menu. From the Main Menu press C for the

Configuration Menu, press D for Configure (Data) Channels, press O for Take Channel Out of Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters should display on the screen in green.

8. Record "End Time" on the Ozone Worksheet and make sure to save the document before shutting down the computer.
9. Print two copies of the ozone worksheet at the office, one for the QA/QC logbook at the site and one for the data exception log in the office.
10. Record the multipoint results from the field form onto the respective control chart (Figure 4). Control charts are maintained on the AQMonitoring drive.
11. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 5) and circle the multipoint flag.

G.5 Routine Maintenance

G.5.1 Replacing the Particulate Filter

The particulate filter is located between the instrument and sample manifold in a particulate filter holder.

1. Unscrew the top Teflon fitting from the particulate filter holder with your fingers.
2. Use particulate filter holder wrenches to release the two parts of the particulate filter holder.
3. Examine old filter for unusual accumulation or tears and replace with new particulate filter. Note any abnormalities in the particulate filter in the site log and the instrument log.
4. Clean the two parts of the particulate holder using compressed air, Kim wipes, or cotton swabs.
5. Using forceps, insert the new particulate filter being careful not to touch the filter media with your fingers.
6. Use particulate filter holder wrenches to tighten the two parts of the particulate filter holder.
7. Using a Teflon cap, block the upper portion of the particulate filter holder to leak test the analyzer. It may take several minutes for the displayed sample flow and pressure to stabilize.
8. Record the Sample Flow and the Pressure in the instrument log book. The sample flow must be below 10 cc/min and the pressure must be below 10 inHg to pass the leak test. If the leak test does not pass, refer to the instrument manual for instructions on diagnosing a leak.

G.5.2 Replacing the Sample Manifold

1. Flag all affected gas parameters on the data logger.
2. Log Start Date and Time on a Misc. Instrument Maintenance/Data Exception Worksheet (Figure 7).
3. Completely remove all ¼" FEP Teflon lines from the sample manifold.

4. Clean the bug screen at the top of the sample inlet and all Teflon tees in the sample manifold with alcohol and cotton swabs.
5. Replace with new, clean ¼" FEP Teflon lines, making sure to measure the length of tubing that is used. Record new manifold length on misc. data exception worksheet.
6. Condition new sample manifold lines with 500 ppb ozone for at least one hour.
7. Log End Date and Time on misc. data exception worksheet.

G.6 Troubleshooting

Refer to the instruments operation's manual for a troubleshooting guide specific to the instrument.

Figure 7 Misc. Instrument Maintenance/Data Exception Worksheet

Air Quality Management Division

Misc. Instrument Maintenance / Data Exception Worksheet

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site ________________ Operator ________________ Parameter(s) ________________

Start Date ________________ **End Date** ________________

Start Time ________________ **End Time** ________________

Comments ____

File Name: Misc Data Exception Worksheet
Last Revision: 10/02/19

Appendix H: Trace Carbon Monoxide Analyzers

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ______________________________

Title of Author: ______________________________

Signature: ______________________ Date: __________

Name: ______________________________

Title: ______________________________

Signature: ______________________ Date: __________

Name: ______________________________

Title: ______________________________

Signature: ______________________ Date: __________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:___________________________Date:____________

Name: ____

Title: ____

Signature:___________________________Date:____________

Name: ____

Title: ____

Signature:___________________________Date:____________

Name: ____

Title: ____

Signature:___________________________Date:____________

Name: ____

Title: ____

Signature:___________________________Date:____________

Acronyms and Abbreviations

AREF	Auto Reference
AQMD	Washoe County Air Quality Management Division
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO MEAS	measurement pulse
CO REF	reference pulse
DAS	Data Acquisition System
EPA	U.S. Environmental Protection Agency
ESC	Environmental Systems Corporation
GFC	Gas Filter Correlation
H_2O	Water
iDAS	Internal Data Acquisition System
IR	Infrared
LPM	Liters per Minute
N_2	Nitrogen
PSI	Pounds per Square Inch
ppm	Parts per Million
QC	Quality Control
SOP	Standard Operating Procedures
TAPI	Teledyne Advanced Pollution Instrumentation
Z/P/S	Zero, Precision, Span

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H.1 Introduction

The Teledyne Advanced Pollution Instrumentation (TAPI) M300EU Gas Filter Correlation Carbon monoxide Analyzer is a microprocessor-controlled analyzer that determines the concentration of carbon monoxide (CO) in a sample gas drawn through the instrument. It requires that the sample and calibration gases be supplied at ambient atmospheric pressure in order to establish a stable gas flow through the sample chamber where the gases ability to absorb infrared radiation (IR) is measured. Calibration of the instrument is performed in software and does not require physical adjustments to the instrument. During calibration, the microprocessor measures the current state of the IR Sensor output and various other physical parameters of the instrument and stores them in memory. The microprocessor uses these calibration values, the IR absorption measurements made on the sample gas along with data regarding the current temperature and pressure of the gas to calculate a final CO concentration. This concentration value and the original information from which it was calculated are stored in one of the unit's internal data acquisition system (iDAS) as well as reported to the user via a vacuum florescent display or a variety of digital and analog signal outputs.

H.2 Theory of Operation

The basic principle by which the analyzer works is called the Beer-Lambert Law or Beer's Law. It defines how light of a specific wavelength is absorbed by a particular gas molecule over a certain distance. The mathematical relationship between these three parameters is:

$I = Io\ e\text{-}\alpha Lc$

Where:
Io is the intensity of the light if there was no absorption.
I is the intensity with absorption.
L is the absorption path, or the distance the light travels as it is being absorbed.
C is the concentration of the absorbing gas, Carbon Monoxide (CO).
α is the absorption coefficient that tells how well CO absorbs light at the specific wavelength of interest.

In the most basic terms, the M300EU uses a high-energy heated element to generate a beam of broad-band IR light with a known intensity (measured during instrument calibration). This beam is directed through multi-pass cell filled with sample gas. The sample cell uses mirrors at each end to reflect the IR beam back and forth through the sample gas a number of times). The total length that the reflected light travels is directly related to the intended sensitivity of the instrument. The lower the concentrations the instrument is designed to detect, the longer the light path must be in order to create detectable levels of attenuation. Lengthening the absorption path is accomplished partly by making the physical dimension of the reaction cell longer, but primarily by adding extra passes back and forth along the length of the chamber.

Upon exiting the sample cell, the beam shines through a band-pass filter that allows only light at a wavelength of 4.7 µm to pass. Finally, the beam strikes a solid-state photo-detector that converts the light signal into a modulated voltage signal representing the attenuated intensity of the beam. Unfortunately, water vapor absorbs light at 4.7 µm too. To overcome the interfering effects of water vapor the M300EU adds another component to the IR light path called a Gas Filter Correlation (GFC) Wheel. A GFC Wheel is a metallic wheel into which two chambers are carved. The chambers are sealed on both sides with material transparent to 4.7 µm IR radiation creating two airtight cavities. Each cavity is mainly filled with composed gases. One cell is filled with pure N_2 (the measurement cell). The other is filled with a combination of N_2 and a high concentration of CO (the reference cell). As the GFC Wheel spins, the IR light alternately passes through the two cavities. When the beam is exposed to the reference cell, the CO in the gas filter wheel strips the beam of most of the IR at 4.7µm. When the light beam is exposed to the measurement cell, the N_2 in the filter wheel does not absorb IR light. This causes a fluctuation in the intensity of the IR light striking the photo-detector which results in the output of the detector resembling a square wave.

The M300EU determines the amount of CO in the sample chamber by computing the ratio between the peak of the measurement pulse (CO MEAS) and the peak of the reference pulse (CO REF). If no gases exist in the sample chamber that absorb light at 4.7µm, the high concentration of CO in the gas mixture of the reference cell will attenuate the intensity of the IR beam by 60% giving a M/R ratio of approximately 2.4:1. Adding CO to the sample chamber causes the peaks corresponding to both cells to be attenuated by a further percentage. Since the intensity of the light passing through the measurement cell is greater, the effect of this additional attenuation is greater. This causes CO MEAS to be more sensitive to the presence of CO in the sample chamber than CO REF and the ratio between them (M/R) to move closer to 1:1 as the concentration of CO in the sample chamber increases.

Once the M300EU has computed this ratio, a look-up table is used, with interpolation, to linearize the response of the instrument. This linearized concentration value is combined with calibration SLOPE and OFFSET values to produce the CO concentration which is then normalized for changes in sample pressure. If an interfering gas, such as H2O vapor is introduced into the sample chamber, the spectrum of the IR beam is changed in a way that is identical for both the reference and the measurement cells, but without changing the ratio between the peak heights of CO MEAS and CO REF. In effect, the difference between the peak heights remains the same. Thus, the difference in the peak heights and the resulting M/R ratio is only due to CO and not to interfering gases. In this case, GFC rejects the effects of interfering gases and so that the analyzer responds only to the presence of CO.

To improve the signal-to-noise performance of the IR photo-detector, the GFC Wheel also incorporates an optical mask that chops the IR beam into alternating pulses of light and dark at six times the frequency of the measure/reference signal. This limits the detection bandwidth helping to reject interfering signals from outside this bandwidth improving the signal to noise ratio. The basic design of the M300EU rejects most of this interference at a 300:1 ratio. The two primary methods used to accomplish this are:

1. The 4.7µm band pass filter just before the IR sensor which allows the instrument to only react to IR absorption in the wavelength affected by CO.
2. Comparison of the measure and reference signals and extraction of the ratio between them.

The higher resolution of the M300EU makes it more susceptible then the M300E/EM to the effects of a variety of environmental conditions such as:

- Drift related to the age of the optical bench components (e.g. the IR lamp, the IR detector, etc.)
- Variations in the temperature of the sample gas (affecting it density).
- Interferents, specifically carbon dioxide (CO_2) and water (H_2O).

The M300EU accounts for these issues by adding an additional component to the CO concentration calculation call the Auto-reference ratio (AREF). This ratio is arrived at in the same manner as the measure/reference ratio described above with the difference being that during the measurements that are to calculate the AREF ratio, the gas stream is switched to pass through a scrubber that completely removes all CO from the sample gas. Therefore the measured difference between CO MEAS and CO REF represents the exact state of the sample gas and the optical bench's sensors without CO present.

The analyzer averages the last five AREF ratios and multiplies this average by a constant and the result is included in the final CO calculation as a positive or negative offset.
Whenever an AREF is manually initiated either by using the AREF submenu via the front panel or by activating pin-7 of the instrument's digital control input connector, all previously stored AREF ratios are erased and the new ratio inserted. This allows the user to correct for a bad AREF reading (e.g. the oven temperature during the AREF cycle was too high/low). The auto-reference measurement takes approximately 15 minutes. To ensure that the sample chamber of the optical bench is properly purged when switching between the sample and auto-reference measurements and vice-versa, each auto-reference cycle includes a 3 minute dwell period before and after the actual measurements are made. This cycle is restarted every 4 hours by an ACAL sequence, programmed at the factory.

H.3. Precautions

1. To avoid injury, always use two people to lift and carry the analyzer.
2. Connect the exhaust fitting on the rear panel to a vent outside the analyzer area.
3. Ensure analyzer is set up for proper voltage and frequency.
4. Ensure power plug has a ground lug.
5. Hazardous voltages exist within the instrument chassis.
6. Do not exceed 15 Pounds per Square Inch (PSI) of pressure within the instrument.
7. Remove power from the instrument before service is performed.
8. Follow all warning signs within the manual during setup, operation and maintenance.

H.4 Instrument Operation

H.4.1 Quality Control

H.4.1.1. Site Checks

Perform Site Checks during each visit to the site. Check the instrument's front panel display for indication of analyzer malfunction or warning messages. Compare the instrument front panel concentration to the Data Acquisition System (DAS) concentrations to check for deviations. Check all analyzer diagnostics by pressing the <TST> button on the front of the analyzer to ensure all diagnostics are within range. Refer to the instrument diagnostics page located at the front of the instrument manual for diagnostics specific to each instrument. Shelter conditions are noted and logged on the Station Log Report (Figure 1). Warning messages, changes in diagnostics or work performed on the analyzer is also noted on the Station Log Report and Instrument Log Book.

Figure 1 Station Log Report

Washoe County Health District - Air Quality Management Division

Station Log Report

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site: ____________________

	Operator(s):												
	Date:												
	Time (PST):												
		Y	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**
1	Outside Good Repair:												
2	Inside Good Repair:												
3	All Settings Correct:												
4	Heat/Air Working:												
5	A/C Clean Filter Light Off:												
6	Analyzer Fault Lights Off:												
7	Analyzer Date/Time +/- 1 min:												
8	Gas Analyzer Multipoint Current:												
9	Datalogger Date/Time +/- 1 min:												
10	UPS Battery Status Light Green:												
11	T° Sentry Status Light Green:												
12	Station Inside Temperature (°C):												
13	Instruments Adjusted:												

Additional Comments:

Station Log Report
Last Revision: 09/05/17

H.4.1.2 Daily Checks

Daily span/zero checks are performed at 0145 PST using automatic calibrations programmed into the Environmental Systems Corporation (ESC) 8832 data logger (see appendix V for the ESC SOP). If the span or zero point is outside the operating specifications a calibration must be performed. (See section H.4.2 for Calibration Procedures).

H.4.1.3 Weekly Checks

H.4.1.3.1 Diagnostic Checks

The Trace CO analyzer diagnostics are checked at the beginning of every week.

1. Note the date, time and operator in the instrument log book.
2. Record the Sample Flow and Reference Voltage off of the analyzer display by scrolling through the <TST> functions. The sample flow must be 1800 cc/min +/- 20%. The CO reference voltage must be within 3000-4000 mv.
3. Record the concentration in parts per million (ppm) of CO off of the analyzer display and the DAS. These must be within +/- 0.010 ppm.
4. Ensure there are no major changes in these diagnostics from last week's readings.

H.4.1.3.2 Calibration Checks

Perform a zero, precision, span (Z/P/S) check of the analyzer once a week. Record all readings on the Trace Level Carbon Monoxide Worksheet (Figure 2).

1. Put the site instrument in maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS, press L to Login, and enter the Password to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press I for Put Channel In Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters chosen should appear on the screen in red indicating they are in maintenance mode. (See Appendix V for the SOP on this instrument).
2. Ensure the valve to the CO cylinder is open and the regulator pressure is at 30 PSI.
3. Ensure the pressure on the zero air generator is at 30 PSI.
4. Using an Ethernet cable, connect laptop to the firewall network router box. Locate the AQMonitoring drive on the computer. Open the Field Management Functions folder, QA/QC folder, then CO QA/QC folder. Open the respective site folder and current year folder. Find the latest form and open. Click file and SAVE AS, save the file with the current date, site, and parameter (ex 20190916_Reno 3_CO). Clear the contents from the old data sheet and input all the new information on the CO worksheet. Ensure the instrument's reference voltage and sample flow is within the instrument's diagnostic range. Record "Start Time" on the CO worksheet from when you put the channel in maintenance on the DAS.
5. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press GEN, and then press AUTO. Update

the touchscreen buttons to read 9.0 ppm CO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 9.0 ppm of CO. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.010 ppm or less and record the CO concentration from the DAS. View the percent deviation calculation on the Trace Level Carbon Monoxide Worksheet to verify that it is +/- 5%. Adjust the span if the percent deviation is outside +/- 5% (see section H.4.2 for Calibration Procedures).

6. Precision Check: Repeat step 5 above using 0.5 ppm CO for the concentration.
7. Zero Check: Press GEN, and then press AUTO. Press the CO touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.010 ppm or less and record the CO concentration from the DAS. Adjust the zero if the CO concentration is outside +/- 0.030 parts per million (ppm)[1] (see section H.4.2 for Calibration Procedures).
8. Press STBY on the dilution calibrator, this will stop all calibration procedures.
9. Take the instrument out of maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press O for Take Channel Out of Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters should display on the screen in green.
10. Record “End Time” on the Trace Level CO Worksheet and make sure to save the document before shutting down the computer.
11. Print two copies of the CO worksheet at the office, one for the QA/QC logbook at the site and one for the data exception log in the office.
12. Enter the results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMD data management drives.
13. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the Z/P/S flag.

[1] EPA zero drift criteria is 0.4 ppm for 24 hours and 0.6 ppm for 14 days, 0.3 ppm reflects our in house action level.

Figure 2 Trace Level Carbon Monoxide Worksheet

Air Quality Management Division
Trace Level Carbon Monoxide Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Z / P / S ____ Multipoint ____ Calibration ____ Audit ____

Date ____ Operator ____ Site ____

Site Instrument (Indicated)		Gas Calibrator (Actual)		Zero Air	
Manufacturer		Manufacturer		Manufacturer	
Model		Model		Model	
Serial No.		Serial No.		Serial No.	
Sample Flow (cc/m)		Sample Flow (LPM)		PSI	
Ref. Voltage (mV)					
		Cal. Cylinder No.			
Slope		Concentration (ppm)			
Offset		Expiration Date			
		Cyl. Pressure (PSI)			

Date of Last Particulate Filter Change ____

Start Time ____ PST End Time ____ PST

Set Point	Indicated	Actual	Percent Dev.	*EPA Acceptance Criteria	Audit Acceptance Criteria
9.0 ppm			#DIV/0!	+/- 10% dev.	+/- 15% dev.
5.0 ppm			#DIV/0!	+/- 10% dev.	+/- 15% dev.
3.5 ppm			#DIV/0!	+/- 10% dev.	+/- 15% dev.
0.5 ppm			#DIV/0!	+/- 10% dev.	+/- 15% dev.
0.0 ppm			#DIV/0!	+/- 0.4 ppm	+/- 0.4 ppm

*AQMDs in house action level for adjustment is +/- 0.030 ppm for zero and +/- 5% for precision and/or span points

Average Percent Dev.	#DIV/0!	Slope	#DIV/0!
Std. Dev.	#DIV/0!	Intercept	#DIV/0!
		Correlation	#DIV/0!

Comments ____

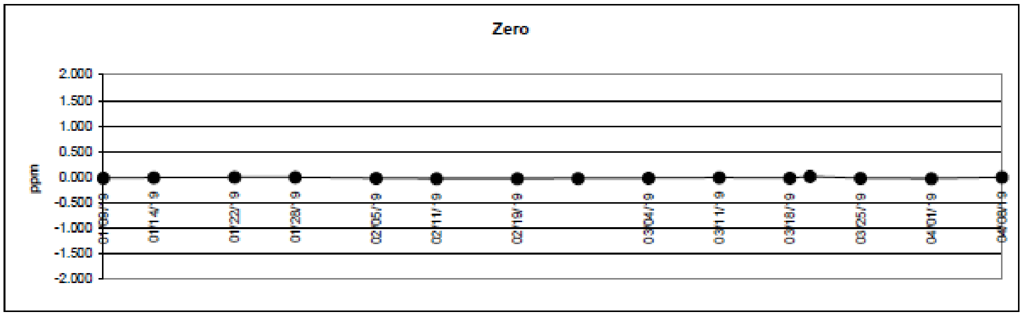
File Name: Master_Template_CO_Trace_NCore
Last Revision: 09/12/19

Figure 3 CO Control Chart

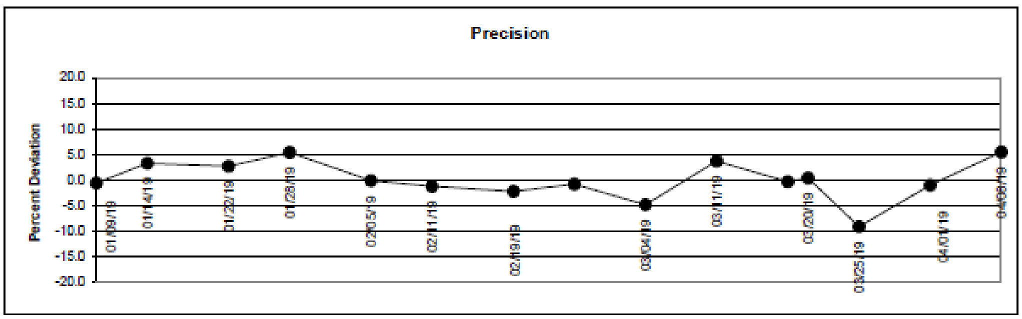
Carbon Monoxide Control Chart

Site: Reno 3
Year: 2019
Quarter: 1st

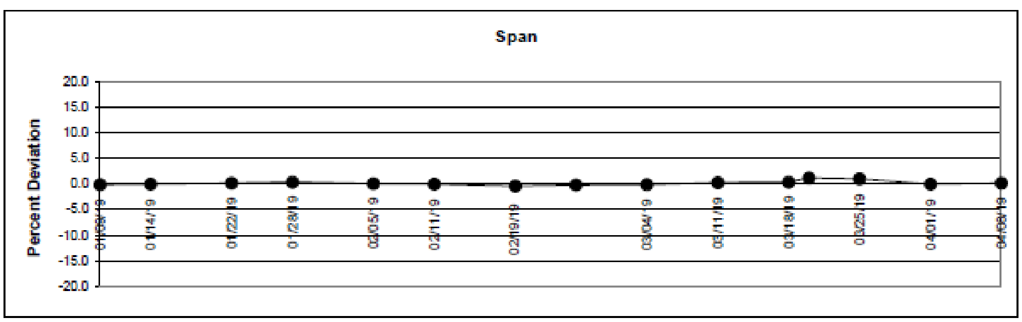
Instrument: TAPI
Model: 300EU
Serial #: 261



Zero Drift Limits: 0 - 0.03 ppm, no adjustment necessary
0.03 - 0.4 ppm, adjust analyzer
> +/-0.4 ppm, invalidate data and recalibrate



EPA Acceptance Criteria: < +/-10% dev. (< +/- 15% dev. for audits)



Span Drift Limits: 0 - 4.9% dev., no adjustment necessary
5 - 10% dev., adjust analyzer and run multipoint
> +/-10% dev., invalidate data and recalibrate

Notes: 03/20/19 Qrtly Audit

Figure 4 Data Exception Log

Site: Year: Quarter:

Date	Begin Time	End Time	Parameter	Error Code											
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a

Notes:

H.4.1.4. Monthly Checks

Perform monthly checks at the beginning of each month.

1. Check pressure in the CO calibration gas cylinder. Complete the Monthly Cylinder Pressure Log (Figure 5). Compare to last month pressure check to ensure there has been no excess loss of CO.
2. Replace the analyzer's particulate filter (see section H.5.1. for Replacing the Particulate Filter).

Figure 5 Monthly Cylinder Pressure Log

Monthly Cylinder Pressure Log

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Year(s): _____ / _____
Site: __________

Date	Cylinder ID #	Concentration (ppm)			Expiration Date	Pressure (PSI)	Initials
		CO	NO	SO_2			

Comments: __________

H.4.1.5 Quarterly Audits

Equipment Needed:

- Certified audit ozone transfer standard/dilution calibrator (TAPI T750U)
- Audit zero air generator (TAPI 751H)
- Audit CO/SO2 calibration cylinder

H.4.1.5.1 Audit Equipment Set-Up

1. Set-up, plug in, and power on the audit T750U calibrator. It may be set-up on top of the site calibrator. Prior to beginning any gaseous audit, the audit T750U must be powered on for at least 30 minutes, allowing the calibrator to come up to proper operating temperature.
2. Set-up and plug in the audit 751H zero air generator on the station floor near the T750U.
3. Using 1/4" Teflon FEP tubing with stainless steel (SS) fittings, connect the ZERO OUT port on the 751H to the DILUENT IN port on the T750U.
4. Power on the 751H, and ensure the pressure gauge on the front panel is reading 30 pounds per square inch (PSI). If it is not, adjust the regulator knob on the front panel until it is reading 30 PSI.
5. Set-up the audit CO/SO2 calibration cylinder inside the station in close proximity to the T750U calibrator. Position the end of the cylinder line outside the station door. Open the second stage regulator valve. Turn the regulator pressure adjustment knob all the way counter-clockwise. Open and close the cylinder valve. Turn the regulator pressure adjustment knob clockwise to bleed all gas from the regulator until the cylinder pressure and regulator pressure read 0 PSI. Turn the regulator pressure adjustment knob all the way counter-clockwise. Repeat this process three times to ensure any contaminated gas is purged from the regulator and cylinder line. See Figure 6 for a diagram of the cylinder and regulator.
6. Connect the audit CO/SO2 cylinder line to CYL IN port on the T750U, open cylinder valve, and use the regulator pressure adjustment knob to set the regulator pressure to 30 PSI.
7. Remove the calibration manifold line from the back of the station calibrator CAL OUT port and connect to the CAL OUT port on the T750U.

H.4.1.5.2 Audit Procedures

1. Follow steps 1 – 10 in Section H.4.2.3 using the audit standards instead of the site standards and ensuring that each point is within +/- 15%. If any point is out of range, complete a Corrective Action Request (Figure 7) and submit to instrument operator.
2. Print three copies of the Trace CO worksheet at the office, one for the audit folder maintained by the senior air quality specialist, one for the QA/QC logbook at the site, and one for the data exception log in the office.
3. Record the audit results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
4. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the audit flag.

Figure 6 Calibration Cylinder/Regulator Diagram

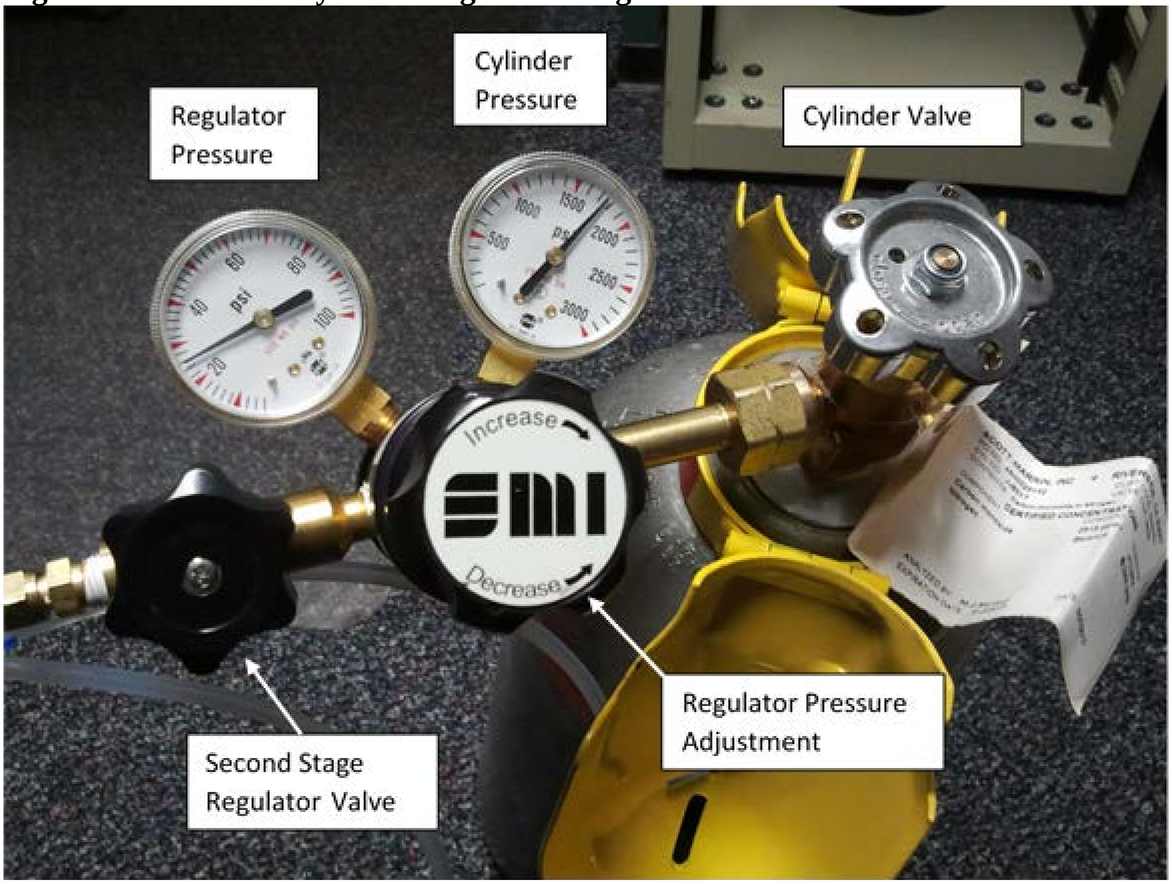


Figure 7 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ____________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ____________________________

Problem Identification:

Site: ____________________________
System: ____________________________
Date: ____________________________
Time: ____________________________
Nature of Problem: ____________________________

Recommended Action: ____________________________

Signature: ____________________________ Date: ________________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________________
Time corrective action taken: ____________________________
Corrective Action Summary: ____________________________

Signature: ____________________________ Date: ________________

QA Manager Signature: ____________________________ Date: ________________

Supervisor Signature: ____________________________ Date: ________________

Director Signature: ____________________________ Date: ________________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

H.4.2 Calibration Procedures

H.4.2.1 Zero Adjustment

Perform a zero adjustment when the zero point is outside +/- 0.03 ppm during the daily or weekly checks (see section H.4.1.3 for weekly check instructions). The zero adjustment must be done after the completion of the weekly z/p/s check or when a daily zero check is outside +/- 0.03 ppm.

1. Upon completion of the weekly Z/P/S, press GEN, and then press AUTO. Press the CO touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 LPM, and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppm or less.
2. Once the instrument is stabilized press the CAL button on the front panel of the instrument.
3. Press the ZERO button followed by ENTR. The instrument will adjust automatically to 0.0 ppm CO concentration. Log “zero adjustment” in the comments section of the original Z/P/S worksheet.
4. Allow the instrument to stabilize to 0.1 ppm and record the reading from the DAS on a new Z/P/S worksheet.
5. After a ZERO adjustment, a re-check of the span and precision points is recommended. If the span or precision points are outside the required acceptance criteria, continue with section H.4.2.2 for span adjustment and H.4.2.3 for multipoint calibration.

H.4.2.2 Span Adjustment

Perform a span adjustment when the percent deviation of the span point is outside +/- 5% during the weekly checks or daily span check (see section H.4.1.2 for weekly check instructions). The span adjustment must be done after the completion of the weekly Z/P/S check.

1. Upon completion of the weekly Z/P/S, press GEN, and then press AUTO. Update the touchscreen buttons to read 9.0 ppm CO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 9.0 ppm of CO. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.010 ppm or less.
2. Once the instrument is stable, press CAL on the front panel of the analyzer. Ensure the CONC button is programmed to 9.0 ppm. Press SPAN, and then press ENTR. The analyzer will adjust automatically to 9.0 ppm CO concentration.
3. Allow the instrument to stabilize and record the reading from the DAS on a new CO worksheet. Complete a multipoint calibration as described in section H.4.2.3 after any span adjustment is made.

H.4.2.3 Multipoint Calibration

Perform a multipoint calibration after a span adjustment is made to the instrument. A multipoint calibration must be performed before any other adjustments are made to the instrument.

1. Put the site instrument in maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS, press L to Login, and enter the Password to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press I for Put Channel In Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, then L to return to displaying the parameters on the screen. The parameter chosen should appear on the screen in red indicating they are in maintenance mode. (See Appendix V for the SOP on this instrument).
2. Ensure the valve to the CO cylinder is open and the regulator pressure is at 30 PSI.
3. Ensure the pressure on the zero air generator is at 30 PSI.
4. Using an Ethernet cable, connect laptop to the firewall network router box. Locate the AQMonitoring drive on the computer. Open the Field Management Functions folder, QA/QC folder, then CO QA/QC folder. Open the respective site folder and current year folder. Find the latest form and open. Click file and SAVE AS, save the file with the current date, site, and parameter (ex 20190916_Reno 3_CO). Clear the contents from the old data sheet and input all the new information on the CO worksheet. Ensure the instrument's reference voltage and sample flow is within the instrument's diagnostic range. Record "Start Time" on the CO worksheet from when you put the channel in maintenance on the DAS.
5. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press GEN, and then press AUTO. Update the touchscreen buttons to read 9.0 ppm CO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 9.0 ppm of CO. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.010 ppm or less and record the CO concentration from the DAS. View the percent deviation calculation on the Trace Level Carbon Monoxide Worksheet to verify that it is +/- 5%.
6. Repeat step 5 above for the following points:
   - 5.0 ppm CO
   - 3.5 ppm CO
   - 0.5 ppm CO
7. Zero Check: Press GEN, and then press AUTO. Press the CO touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.010 ppm or less and record the CO concentration from the DAS.
8. Press STBY on the dilution calibrator, this will stop all calibration procedures.
9. Take the instrument out of maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press O for Take Channel Out of Maint., choose the parameter and press Enter. ESC back to the Main Menu and

press D, the L to return to displaying the parameters on the screen. The parameters should display on the screen in green.

10. Record "End Time" on the Trace CO Worksheet and make sure to save the document before shutting down the computer.
11. Print two copies of the Trace CO worksheet at the office, one for the QA/QC logbook at the site and one for the data exception log in the office.
12. Record the multipoint results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
13. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the multipoint flag.

H.5 Routine Maintenance

H.5.1 Replacing the Particulate Filter

The particulate filter is located between the instrument and sample manifold in a particulate filter holder.

1. Unscrew the top Teflon fitting from the particulate filter holder with your fingers.
2. Use particulate filter holder wrenches to release the two parts of the particulate filter holder.
3. Examine old filter for unusual accumulation or tears and replace with new particulate filter. Note any abnormalities in the particulate filter in the site log and the instrument log.
4. Clean the two parts of the particulate holder using compressed air, Kim wipes, or cotton swabs.
5. Using forceps, insert the new particulate filter being careful not to touch the filter media with your fingers.
6. Use particulate filter holder wrenches to tighten the two parts of the particulate filter holder.
7. Using a Teflon cap, block the upper portion of the particulate filter holder to leak test the analyzer. It may take several minutes for the displayed sample flow and pressure to stabilize.
8. Record the Sample Flow and the Pressure in the instrument log book. The sample flow must be below 10 cc/min and the pressure must be below 10 inHg to pass the leak test. If the leak test does not pass, refer to the instrument manual for instructions on diagnosing a leak.

H.5.2 Replacing the Sample Manifold

1. Flag all affected gas parameters on the data logger.
2. Log Start Date and Time on a Misc. Instrument Maintenance/Data Exception Worksheet (Figure 8).
3. Completely remove all ¼" FEP Teflon lines from the sample manifold.
4. Clean the bug screen at the top of the sample inlet and all Teflon tees in the sample manifold with alcohol and cotton swabs.

5. Replace with new, clean ¼” FEP Teflon lines, making sure to measure the length of tubing that is used. Record new manifold length on misc. data exception worksheet.
6. Condition new sample manifold lines with 500 ppb ozone for at least one hour.
7. Log End Date and Time on misc. data exception worksheet.

H.6 Troubleshooting

Refer to the Troubleshooting section in the operator’s manual for troubleshooting options specific to each instrument.

Figure 8 Misc. Instrument Maintenance/Data Exception Worksheet

Air Quality Management Division

Misc. Instrument Maintenance / Data Exception Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site ________________ Operator ________________ Parameter(s) ________________

Start Date ________________ **End Date** ________________

Start Time ________________ **End Time** ________________

Comments ____

File Name: Misc Data Exception Worksheet
Last Revision: 10/02/19

Appendix I: Trace Level NOx/NOy Analyzers

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ______________________________

Title of Author: ______________________________

Signature: ______________________________ Date: ______________

Name: ______________________________

Title: ______________________________

Signature: ______________________________ Date: ______________

Name: ______________________________

Title: ______________________________

Signature: ______________________________ Date: ______________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Acronyms and Abbreviations

CPU	Central Processing Unit
DAS	Data Acquisition System
ESC	Environmental Systems Corporation
DFU	Disposable Filter Unit
GDS	Gas Dilution System
GPT	Gas Phase Titration
HVPS	High Voltage Power Supply
inHg	Inches of Mercury
IR	Infrared
LPM	Liters per Minute
Mo	Molybdenum
Moly	Molybdenum
nm	nanometers
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
NOy	Reactive Oxides of Nitrogen
NOz	Unstable Compounds, Difference between NOy and NOx
O_2	Oxygen
O_3	Ozone
PCB	Printed Circuit Board
PMT	Photo-Multiplier Tube
Ppb	Parts per Billion
ppm	Parts per Million
RCel	Reaction Cell
PSI	Pounds per Square Inch
SOP	Standard Operating Procedures
TAPI	Teledyne-Advanced Pollution Instrumentation

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I.1 Introduction

The Teledyne-Advanced Pollution Instrumentation (TAPI) Nitrogen Oxides Analyzer is a microprocessor controlled instrument that determines the concentration of nitric oxide (NO), total nitrogen oxides (NOx, the sum of NO and NO_2) and nitrogen dioxide (NO_2) in a sample gas drawn through the instrument. It requires that sample and calibration gases be supplied at ambient atmospheric pressure in order to establish a constant gas flow through the reaction cell where the sample gas is exposed to ozone (O_3), initiating a chemical reaction that gives off light (hv). The instrument measures the amount of chemiluminescence to determine the amount of NO in the sample gas. A catalytic-reactive converter converts NO_2 in the sample gas to NO which, along with the NO present in the sample is reported as NOx. NO_2 is calculated as the difference between NOx and NO.

Calibration of the instrument is performed in software and usually does not require physical adjustments to the instrument. During calibration, the microprocessor measures the sensor output signal when gases with known amounts of NO or NO_2 are supplied and stores these results in memory. The microprocessor uses these calibration values along with the signal from the sample gas and data of the current temperature and pressure of the gas to calculate a final NO_X concentration. The concentration values and the original information from which it was calculated are stored in the unit's internal data acquisition system and are reported to the user through a vacuum fluorescence display or several output ports.

The TAPI Model 200EU with NOy Option is designed to measure the concentration of NO, NO_2, and other compounds that are too unstable to be measured when taken in through the normal ambient air sample inlet system. The suite of compounds known collectively as NOy is composed of roughly 30 compounds. There is some disagreement over whether certain compounds should be on the list. The NOy measurement is generally done in conjunction with a standard NOx measurement, with the difference between the two being the concentration of the unstable compounds, sometimes referred to as NOz.

The NOy system is composed of 3 modules:

1. The M200EU, without a moly converter
2. A Bypass pump chassis containing:
    a. Bypass pump
    b. Flow control
    c. Sample filtration
    d. Moly temperature control
    e. Pneumatic provisions for calibration
3. An externally mounted molybdenum converter

The M200EU w/NOy Option system allows the converter to be mounted at the sample inlet point. This configuration provides minimal time delay between the sample inlet port and the remotely mounted molybdenum converter. Minimizing the transit time between the sample inlet and converter enables the conversion of labile components of NOy.

I.2 Theory of Operation

The M200E's measures the amount of NO present in a gas by detecting the chemiluminescence which occurs when NO is exposed to O_3. This reaction is a two-step process. In the first step, one molecule of NO and one molecule of O_3 collide and chemically react to produce one molecule of oxygen (O_2) and one molecule of NO_2. Some of the NO_2 molecules created by this reaction retain excess energy from the collision and exist in an excited state, where one of the electrons of the NO_2 molecule resides in a higher energy state than normal (denoted by an asterisk in the following equation).

$$NO_2 + O_3 > NO_2^* + O_2$$

The second step occurs because the laws of thermodynamics require that systems seek the lowest stable energy state available, therefore the excited NO_2 molecule quickly returns to its ground state, releasing the excess energy. This release takes the form of a quantum of light (*hv*). The distribution of wavelengths for these quanta range between 600 and 3000 nanometers (nm), with a peak at about 1200 nm.

$$NO_2^* > NO_2 + hv_{1200nm}$$

All things being constant (temperature, pressure, amount of ozone present, etc.), the relationship between the amount of NO present in the reaction cell and the amount of light emitted from the reaction is very linear. If more NO is present, more infrared (IR) light is produced. By measuring the amount of IR light produced with a sensor sensitive in the near-infrared spectrum the amount of NO present can be determined. In addition, sometimes the excited NO_2 collides with other gaseous molecules in the reaction cell chamber or even the molecules of the reaction cell walls and transfers its excess energy to this collision partner (represented by *M* in the equation below) without emitting any light at all. In fact, by far the largest portion of the excited NO_2 returns to the ground state this way, leaving only a few percent yield of usable chemiluminescence.

$$NO_2^* + M > NO_2 + M$$

The probability of a collision between the NO_2^* molecule and a collision partner *M* increases proportionally with the reaction cell pressure. This non-radiating collision with the NO_2^* molecules is usually referred to as *third body quenching*, an unwanted process further described in the TAPI 200E operations manual. Even under the best conditions only about 20% of the NO_2 that is formed by the reaction described in the above equation is in the excited state. In order to maximize chemiluminescence, the reaction cell is maintained at reduced pressure (thereby reducing the amount of available collision partners) and is supplied with a large, constant excess of ozone (about 3000-5000 parts per million (ppm)) from the internal ozone generator.

The M200E uses a special kind of vacuum tube, called a photo-multiplier tube (PMT), to detect the amount of light created by the NO and O_3 reaction in the reaction cell. Photons enter the PMT and strike a negatively charged photo cathode causing it to emit electrons. These electrons

are accelerated by an applied high voltage and multiplied through a sequence of similar acceleration steps (dynodes) until a useable current signal is generated.
The more light present (in this case photons given off by the chemiluminescent reaction described above), the more current is produced. Therefore the more NO present in the reaction cell the more current is produced by the PMT. The current produced by the PMT is converted to a voltage and amplified by the preamplifier board and then communicated to the M200Es central processing unit (CPU) via the A>D converter circuitry on the analyzer.

A high pass optical filter, only transparent to wavelengths of light above 645nm, placed between the reaction cell and the PMT in conjunction with the response characteristics of the PMT creates a very narrow window of wavelengths of light to which the M200E will respond. The narrowness of this band of sensitivity allows the M200E to ignore extraneous light and radiation that might interfere with the M200Es measurement. For instance, some oxides of sulfur can also be chemiluminescent emitters when in contact with O_3 but give off light at much shorter wavelengths (usually around 260nm to 480nm).

The only gas that is actually measured by the M200E is NO. NO_2, and therefore NOx (which is defined here as the sum of NO and NO_2 in the sample gas), contained in the gas is not detected because NO_2 does not react with O_3 to create chemiluminescence. In order to measure the concentration of NO_2, and therefore the concentration of NOx, the M200E periodically switches the sample gas stream so that the pump pulls it through a special converter cartridge filled with molybdenum (Mo, “moly”) chips that are heated to a temperature of 315°C. The heated molybdenum reacts with NO_2 in the sample gas and produces a NO gas and a variety of molybdenum.

$$\mathbf{xNO_2 + yMo > xNO + MyOz}$$

Once the NO_2 in the sample gas has been converted to NO, it is routed to the reaction cell where it undergoes the chemiluminescence reactions described above. By converting the NO_2 in the sample gas into NO, the analyzer can measure the total NOx content of the sample gas (i.e. the NO present + the converted NO_2 present). By switching the sample gas stream in and out of the “moly” converter every 6 - 10 seconds, the M200E analyzer is able to quasi-continuously measure both the NO and the total NOx content. Finally, the NO_2 concentration is not directly measured but calculated by subtracting the known NO content of the sample gas from the known NOx content.

I.3 Precautions

1. To avoid injury, always use two people to lift and carry the analyzer.
2. Connect the exhaust fitting on the rear panel to a vent outside the analyzer area.
3. Ensure analyzer is set up for proper voltage and frequency.
4. Ensure power plug has a ground lug.
5. Never disconnect CPU or other printed circuit boards (PCB) cards while under power.
6. Hazardous voltages exist within the instrument chassis.
7. Do not exceed 15 Pounds per Square Inch (PSI) of pressure within the instrument.
8. Remove power from the instrument before service is performed

I.4 Instrument Operation

I.4.1 Quality Control

I.4.1.1 Site Checks

Perform Site Checks during each visit to the site. Check the instruments front panel display for indication of analyzer malfunction or warning messages. Compare the instrument front panel concentration to the Data Acquisition System (DAS) concentration to check for deviations. Check all analyzer diagnostics by pressing the Test <TST> button to ensure all diagnostics are within range. Refer to the operator's manual for a list of diagnostics specific to the individual instruments. Shelter conditions are noted and logged on the Station Log Report (Figure 1). Warning messages, changes in diagnostics or work performed on the analyzer is noted in the Station Log.

Figure 1 Station Log Report

Washoe County Health District - Air Quality Management Division

Station Log Report

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site: ____________________

	Operator(s):												
	Date:												
	Time (PST):												
		Y	N	Y	N	Y	N	Y	N	Y	N	Y	N
1	Outside Good Repair:												
2	Inside Good Repair:												
3	All Settings Correct:												
4	Heat/Air Working:												
5	A/C Clean Filter Light Off:												
6	Analyzer Fault Lights Off:												
7	Analyzer Date/Time +/- 1 min:												
8	Gas Analyzer Multipoint Current:												
9	Datalogger Date/Time +/- 1 min:												
10	UPS Battery Status Light Green:												
11	T° Sentry Status Light Green:												
12	Station Inside Temperature (°C):												
13	Instruments Adjusted:												

Additional Comments:

Station Log Report
Last Revision: 09/05/17

I.4.1.2 Every Third Day Checks

Every third day span/zero checks are performed at 2300 PST using automatic calibrations programmed into the Environmental Systems Corporation (ESC) 8832 data logger (see appendix V for the ESC SOP). If the span or zero point is outside the operating specifications a calibration must be performed. (See section I.4.2 for Calibration Procedures).

I.4.1.3 Weekly Checks

I.4.1.3.1 Weekly Diagnostic Checks

The Trace NOx/NOy analyzer diagnostics are checked at the beginning of every week.

1. Note the date, time and operator in the instrument log book.
2. Record the Sample Flow, O3 Flow, and Reaction Cell (RCel) Pressure off of the analyzer display by scrolling through the <TST> functions. The sample flow must be 1000 cc/min +/- 20%. The O3 flow must be 800 cc/min +/- 15 cc/min. The RCel pressure must be <4 inches of mercury (inHg).
3. Record the concentration in parts per billion (ppb) of NO2 off of the analyzer display and the DAS. These must be within +/- 0.1 ppb.
4. Ensure there are no major changes in these diagnostics from last week's readings.

I.4.1.3.2 Weekly Multipoint with Gas Phase Titration (GPT) Checks

Perform a multipoint with GPT check of the analyzer once every week. Record all readings on the Trace Level NOx/NOy Worksheet (Figure 2).

1. Put the site instrument in maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS, press L to Login, and enter the Password to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press I for Put Channel In Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters chosen should appear on the screen in red indicating they are in maintenance mode. (See Appendix V for the SOP on this instrument).
2. Ensure the valve to the NO cylinder is open and the regulator pressure is at 30 PSI.
3. Ensure the pressure on the zero air generator is at 30 PSI.
4. Using an Ethernet cable, connect laptop to the firewall network router box. Locate the AQMonitoring drive on the computer. Open the Field Management Functions folder, QA/QC folder, then CO QA/QC folder. Open the respective site folder and current year folder. Find the latest form and open. Click file and SAVE AS, save the file with the current date, site, and parameter (ex 20190916_Reno 3_NOx). Clear the contents from the old data sheet and input all the new information on the Trace Level NOx/NOy Worksheet. Ensure the sample flow, O3 flow, high voltage power supply (HVPS) voltage, and RCel pressure are within the instruments diagnostic range.
5. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press GEN, and then press AUTO. Update

the touchscreen buttons to read 450 ppb NO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 8 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 450 ppb of NO. Allow the instrument to stabilize. Press the TEST button on the NOx and/or NOy analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less and record the NO, NO2, and NOx (or NOT, NO2y, NOy) concentrations from the DAS in the Multipoint section of the NOx/NOy worksheet. View the percent deviation calculation on the Trace Level NOx/NOy Worksheet to verify that it is +/- 5%. Adjust the span if the percent deviation is outside +/- 5% (see section I.4.2 for Calibration Procedures).

6. Repeat step 5 above for the following points:
   - 250 ppb NO
   - 100 ppb NO
   - 25 ppb NO
7. GPT Check: Press GEN, and then press GPT. Update the touchscreen buttons to read 450 ppb NO, then press ENTER. Update the touchscreen buttons to read 400 ppb O3, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 8 LPM, and then press ENTER. The instrument will begin to sample 450 ppb NO mixed with 400 ppb O3, creating approximately 400 ppb NO2. Allow the instrument to stabilize. Press the TEST button on the NOX and/or NOy analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less and record the NO, NO2, and NOx (or NOT, NO2y, NOy) concentrations from the DAS in the GPT section of the NOx/NOy worksheet. View the percent deviation calculation on the NOx/NOy worksheet to verify that it is +/-5%.
8. Repeat step 7 above for the following points:
   - 450 ppb NO, 180 ppb O3
   - 450 ppb NO, 55 ppb O3
9. Zero Check: Press GEN, and then press AUTO. Press the NO touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 8 liters per minute (LPM), and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the NOx and/or NOy analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less and record the NO, NO2, and NOx (or NOT, NO2y, NOy) concentrations from the DAS. Adjust the zero if the NO, NO2, or NOx (or NOT, NO2y, NOy) concentrations are outside +/- 1.5 ppb[1] (see section I.4.2 for Calibration Procedures).
10. Press STBY on the dilution calibrator, this will stop all calibration procedures.
11. Take the instrument out of maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press O for Take Channel Out of Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters should display on the screen in green.
12. Record “End Time” on the Trace Level NOx/NOy Worksheet and make sure to save the document before shutting down the computer.

[1] EPA zero drift criteria is 3.0 ppb for 24 hours and 5.0 ppb for 14 days, 1.5 ppb reflects our in-house action level.

13. Print two copies of the NOx/NOy worksheet at the office, one for the QA/QC logbook at the site and one for the data exception log in the office.
14. Enter the results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMD data management drives.
15. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the Z/P/S flag.

Figure 2 Trace Level NOx/NOy Worksheet

Air Quality Management Division
Trace Level NO_X Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Multipoint ____ GPT ____ Calibration ____ Audit ____

Date ____ Operator ____ Site ____

Site Instrument (Indicated)		**Gas Calibrator / Transfer Standard (Actual)**		**Zero Air**	
Manufacturer		Manufacturer		Manufacturer	
Model		Model		Model	
Serial No.		Serial No.		Serial No.	
Sample Flow (cc/min)		Sample Flow (LPM)		PSI	
Ozone Flow (cc/min)		Ozone Gen. Flow (LPM)			
HVPS Voltage (V)					
RCel Pressure (inHg)		Cal. Cylinder No.			
		Concentration (ppm)			
Calibration Factors		Expiration Date			
NO_X Slope		Cyl. Pressure (PSI)			
NO_X Offset					
NO Slope					
NO Offset					

Date of Last Particulate Filter Change ____

Start Time (PST) ____ **End Time (PST)** ____

Multipoint

NO Set Point	NO (ppb) Indicated	NO (ppb) Actual	Percent Deviation	NO_2 (ppb) Indicated	NO_2 (ppb) Actual	Percent Deviation	NO_X (ppb) Indicated	NO_X (ppb) Actual	Percent Deviation	*EPA NO/NO_Y Acceptance Criteria	Audit Acceptance Criteria
0 ppb		0.0			0.0			0.0		+/- 3.0 ppb	+/- 3.0 ppb
450 ppb		450.0	-100.0		0.0			450.0	-100.0	+/- 10% dev.	+/- 15% dev.
250 ppb		250.0	-100.0		0.0			250.0	-100.0	+/- 10% dev.	+/- 15% dev.
100 ppb		100.0	-100.0		0.0			100.0	-100.0	+/- 10% dev.	+/- 15% dev.
25 ppb		25.0	-100.0		0.0			25.0	-100.0	+/- 10% dev.	+/- 15% dev.
		Avg. Percent Dev.	-100.0					Avg. Percent Dev.	-100.0		
		Std. Dev.	0.0					Std. Dev.	0.0		

GPT

Ozone Set Point	NO Set Point	Remaining NO (ppb) Indicated		NO_2 (ppb) Indicated	NO_2 (ppb) Calculated	Percent Deviation	Remaining NO_X (ppb) Indicated	Remaining NO_X (ppb) Actual	Percent Deviation	*EPA NO_2 Acceptance Criteria	Audit Acceptance Criteria
400 ppb	450 ppb				#DIV/0!	#DIV/0!		450.0	-100.0	+/- 10% dev.	+/- 15% dev.
180 ppb	450 ppb				#DIV/0!	#DIV/0!		450.0	-100.0	+/- 10% dev.	+/- 15% dev.
55 ppb	450 ppb				#DIV/0!	#DIV/0!		450.0	-100.0	+/- 10% dev.	+/- 15% dev.
					Avg. Percent Dev.	#DIV/0!					
					Std. Dev.	#DIV/0!					

***AQMDs in house action level for adjustment is +/- 1.5 ppb for zero and +/- 5% for precision and/or span points**

Comments ____

File Name: Master_Template_NOx
Last Revision: 09/12/19

Figure 2a NO_2/Convertor Efficiency Calculation Worksheet

Washoe County Health District - Air Quality Management Division

NO_2 / Convertor Efficiency Calculation Worksheet

Linear Regression

	NO		NO_X		NO_2
m	#DIV/0!	*m*	#DIV/0!	*m*	#DIV/0!
b	#DIV/0!	*b*	#DIV/0!	*b*	#DIV/0!
r	#DIV/0!	*r*	#DIV/0!	*r*	#DIV/0!

NO_2 Calculated = $[m(NO\ Original)+b]-[m(NO\ Remaining)+b]$

NO_2 Calculated =	#DIV/0!	-	#DIV/0!
=	#DIV/0!		
NO_2 Calculated =	#DIV/0!	-	#DIV/0!
=	#DIV/0!		
NO_2 Calculated =	#DIV/0!	-	#DIV/0!
=	#DIV/0!		

Converter Efficiency = $\left(\frac{[NO_2\ Calculated-([m(NO_x\ Original)+b]-[m(NO_x\ Remaining)+b])]}{NO_2\ Calculated}\right)\times 100$

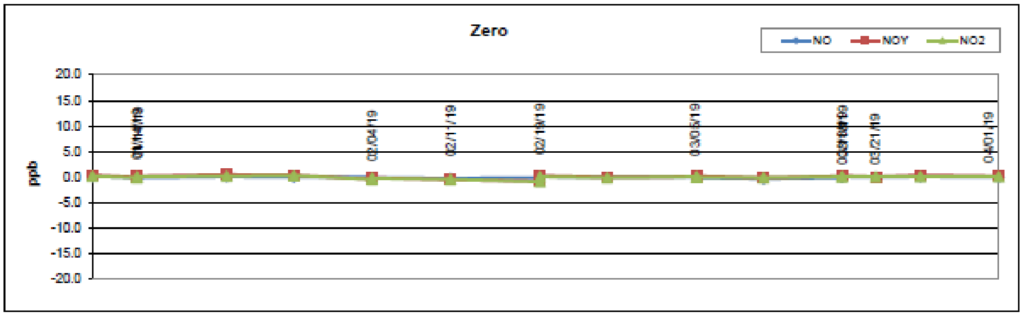
Converter Efficiency =	#DIV/0!	#DIV/0!	#DIV/0!
Converter Efficiency =	#DIV/0!	#DIV/0!	#DIV/0!
Converter Efficiency =	#DIV/0!	#DIV/0!	#DIV/0!
		Average Converter Efficiency =	#DIV/0! %

File Name: Master_Template_NOx
Last Revision: 03/10/14

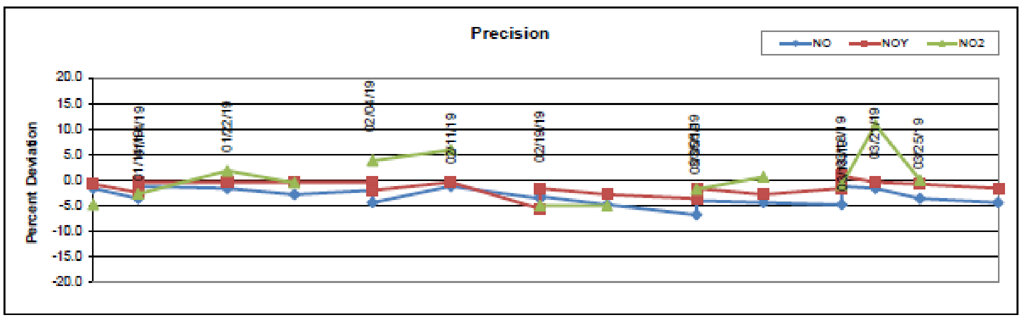
Figure 3 Trace Level NOx/NOy Control Chart

NOy Control Chart

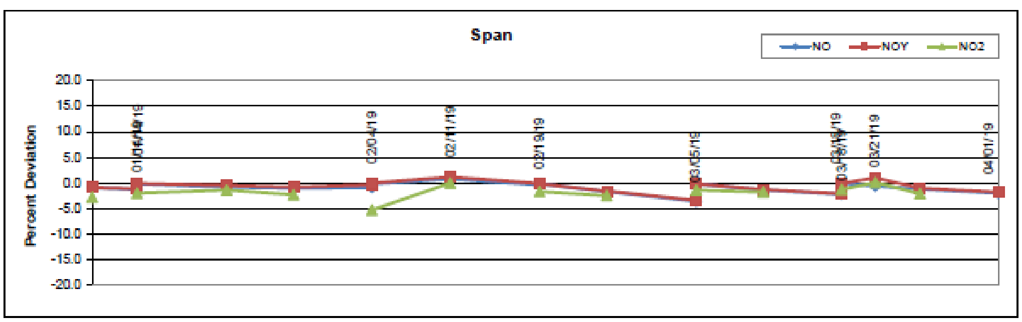
Site:	Reno 3	**Instrument:**	TAPI
Year:	2019	**Model:**	200EU
Quarter:	1st	**Serial #:**	109



Zero Drift Limits: 0 - 1.5 ppb, no adjustment necessary
1.5 - 3 ppb, adjust analyzer
> +/-3 ppb, invalidate data and recalibrate



Acceptance Criteria: < +/-10% dev.



Span Drift Limits: 0 - 4.9% dev., no adjustment necessary
5 - 10% dev., adjust analyzer and run multipoint
> +/-10% dev., invalidate data and recalibrate

Notes: 01/14/19 z/p/s; span adj — 03/21/19 Qtrly audit
02/04/19 z/p/s; maint; zero/span adj
02/19/19 z/p/s; zero/span adj
03/05/19 z/p/s; span adj
03/18/19 z/p/s; span adj

Figure 4 Data Exception Log

Site: Year: Quarter:

Date	Begin Time	End Time	Parameter	Error Code											
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a

Notes:

I.4.1.4 Monthly Checks

Perform monthly checks at the beginning of each month.

1. Check pressure in the NO calibration gas cylinder. Complete the Monthly Cylinder Pressure Log (Figure 5). Compare to last month pressure check to ensure there has been no excess loss of NO.
2. Replace the analyzer's particulate filter (see sections I.6.1 and I.6.2 for Replacing the Particulate Filter).

Figure 5 Monthly Cylinder Pressure Log

Monthly Cylinder Pressure Log

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Year(s): ____________/____________
Site: ________________________

Date	Cylinder ID #	Concentration (ppm)			Expiration Date	Pressure (PSI)	Initials
		CO	NO	SO_2			

Comments: ____

I.4.1.5 Quarterly Audits

Equipment Needed:

- Certified audit ozone transfer standard/dilution calibrator (TAPI T750U)
- Audit zero air generator (TAPI 751H)
- Audit NO calibration cylinder

I.4.1.5.1 Audit Equipment Set-Up

1. Set-up, plug in, and power on the audit T750U calibrator. It may be set-up on top of the site calibrator. Prior to beginning any gaseous audit, the audit T750U must be powered on for at least 30 minutes, allowing the calibrator to come up to proper operating temperature.
2. Set-up and plug in the audit 751H zero air generator on the station floor near the T750U.
3. Using 1/4" Teflon FEP tubing with stainless steel (SS) fittings, connect the ZERO OUT port on the 751H to the DILUENT IN port on the T750U.
4. Power on the 751H, and ensure the pressure gauge on the front panel is reading 30 pounds per square inch (PSI). If it is not, adjust the regulator knob on the front panel until it is reading 30 PSI.
5. Set-up the audit NO calibration cylinder inside the station in close proximity to the T750U calibrator. Position the end of the cylinder line outside the station door. Open the second stage regulator valve. Turn the regulator pressure adjustment knob all the way counter-clockwise. Open and close the cylinder valve. Turn the regulator pressure adjustment knob clockwise to bleed all gas from the regulator until the cylinder pressure and regulator pressure read 0 PSI. Turn the regulator pressure adjustment knob all the way counter-clockwise. Repeat this process three times to ensure any contaminated gas is purged from the regulator and cylinder line. See Figure 6 for a diagram of the cylinder and regulator.
6. Connect the audit NO cylinder line to CYL IN port on the T750U, open cylinder valve, and use the regulator pressure adjustment knob to set the regulator pressure to 30 PSI.
7. Remove the calibration manifold line from the back of the station calibrator NOy CAL OUT port and connect to the CAL OUT port on the T750U.

I.4.1.5.2 Audit Procedures

1. Follow steps 1 – 12 in Section I.4.1.3.2 using the audit standards instead of the site standards and ensuring that each point is within +/- 15%. If any point is out of range, complete a Corrective Action Request (Figure 7) and submit to instrument operator.
2. Print three copies of the NOx/NOy worksheet at the office, one for the audit folder maintained by the senior air quality specialist, one for the QA/QC logbook at the site, and one for the data exception log in the office.
3. Record the audit results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
4. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the audit flag.

Figure 6 Calibration Cylinder/Regulator Diagram

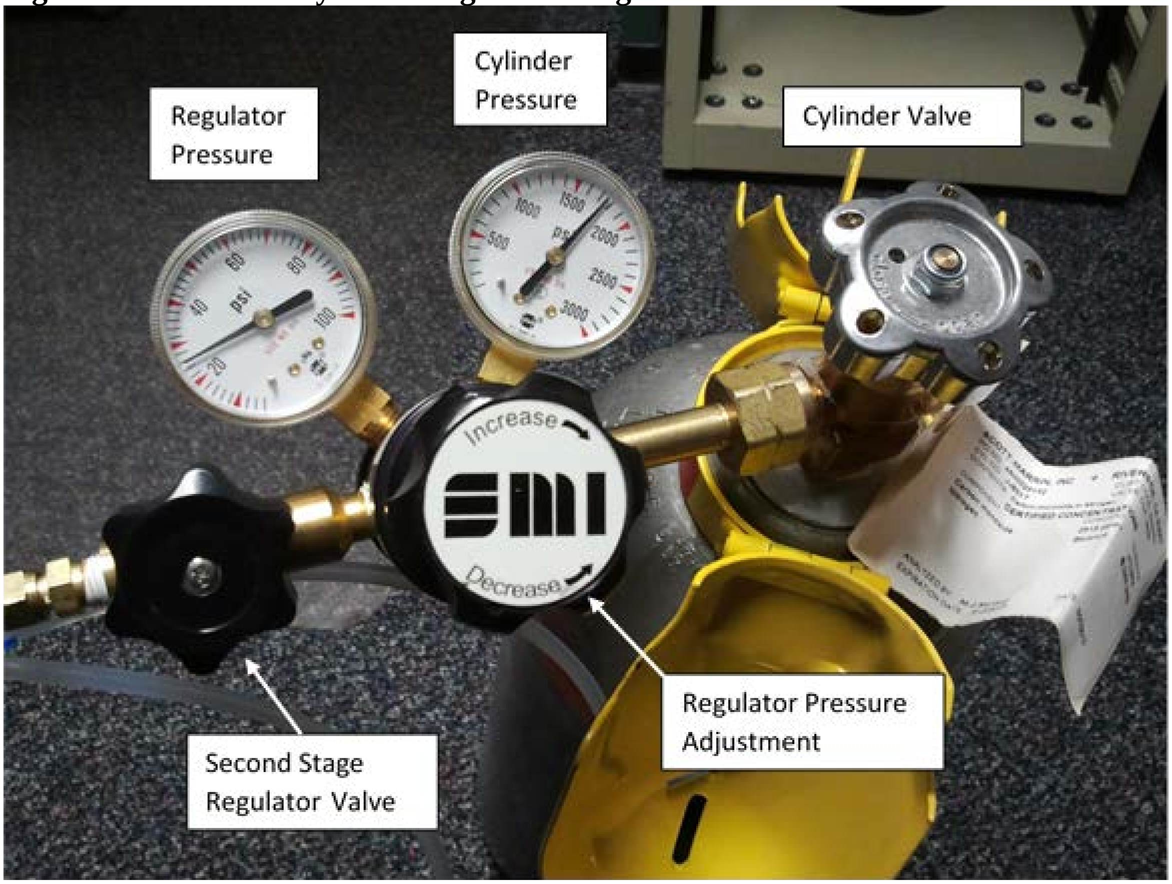


Figure 7 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ____________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ____________________________

Problem Identification:

Site: ____________________________
System: ____________________________
Date: ____________________________
Time: ____________________________
Nature of Problem: ____________________________

Recommended Action: ____________________________

Signature: ____________________________ Date: ______________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________________
Time corrective action taken: ____________________________
Corrective Action Summary: ____________________________

Signature: ____________________________ Date: ______________

QA Manager Signature: ____________________________ Date: ______________

Supervisor Signature: ____________________________ Date: ______________

Director Signature: ____________________________ Date: ______________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

I.4.1.6 Annual Checks

See Section 11 (Instrument Maintenance) in the manufacturer's manual for instructions on how to complete the following items:

1. Replace the sample pump charcoal exhaust filter.
2. Replace the ozone dryer disposable filter unit (DFU).
3. Replace the ozone cleaner chemical.
4. Clean the reaction cell and optical glass (annually or as needed).

I.4.2 Calibration Procedures

I.4.2.1 Zero Adjustment

Perform a zero adjustment when the zero point is outside+/- 1.5 ppb during the every third day or weekly checks (see section I.4.1.3 for weekly check instructions). The zero adjustment must be done after the completion of the weekly multipoint with GPT check or when an every third day check is outside +/- 1.5 ppb.

1. Upon completion of the weekly multipoint with GPT, press GEN, and then press AUTO. Press the NO touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 8 LPM, and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the NOx and/or NOy analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less.
2. Once the instrument is stabilized press the CAL button on the front panel of the instrument.
3. Press the ZERO button followed by ENTR. The instrument will adjust automatically to 0.0 ppb NO, NO2, and NOx (or NOT, NO2y, NOy) concentration. Log "zero adjustment" in the comments section of the original Z/P/S worksheet.
4. Allow the instrument to stabilize to 0.1 ppb and record the reading from the DAS on a new NOx/NOy worksheet.
5. After a ZERO adjustment, a re-check of the span and precision points is recommended. If the span or precision points are outside the required acceptance criteria, continue with section I.4.2.2 for span adjustment and I.4.2.3 for multipoint calibration.

I.4.2.2 Span Adjustment

Perform a span adjustment when the percent deviation of the span point is outside+/- 5% during the every third day or weekly checks (see section I.4.1.3 for weekly check instructions). The span adjustment must be done after the completion of the weekly multipoint with GPT check or when an every third day check is outside +/- 5% deviation.

1. Upon completion of the weekly multipoint with GPT, press GEN, and then press AUTO. Update the touchscreen buttons to read 450 ppb NO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 8 liters per minute (LPM), and then

press ENTER. The instrument will begin to sample 450 ppb of NO. Allow the instrument to stabilize. Press the TEST button on the NOx and/or NOy analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less.

2. Once the instrument is stable, press CAL on the front panel of the analyzer. Ensure the CONC button is programmed to 450 ppb. Press SPAN, and then press ENTR. The analyzer will adjust automatically to 450 ppb NO and NOx (or NOT and NOy) concentration, and will "zero out" NO2 (or NO2y).
3. Allow the instrument to stabilize and record the reading from the DAS on a new NOx/NOy worksheet. Complete a multipoint calibration as described in section I.4.1.3.2 after any span adjustment is made.

I.6 Routine Maintenance

I.6.1 Replacing the Particulate Filter on NOx Analyzer

On the NOx analyzer, the particulate filter is located between the instrument and sample manifold in a particulate filter holder.

1. Unscrew the top Teflon fitting from the particulate filter holder with your fingers.
2. Use particulate filter holder wrenches to release the two parts of the particulate filter holder.
3. Examine old filter for unusual accumulation or tears and replace with new particulate filter. Note any abnormalities in the particulate filter in the site log and the instrument log.
4. Clean the two parts of the particulate holder using compressed air, Kim wipes, or cotton swabs.
5. Using forceps, insert the new particulate filter being careful not to touch the filter media with your fingers.
6. Use particulate filter holder wrenches to tighten the two parts of the particulate filter holder.
7. Using a Teflon cap, block the upper portion of the particulate filter holder to leak test the analyzer. It may take several minutes for the displayed sample flow and pressure to stabilize.
8. Record the Sample Flow and the Sample Pressure in the instrument log book. The sample flow must be below 10 cc/min and the sample pressure must be below 10 inHg to pass the leak test. If the leak test does not pass, refer to the instrument manual for instructions on diagnosing a leak.

I.6.2 Replacing the Particulate Filter on NOy Analyzer

One the NOy analyzer, the particulate filters are located inside the front panel of the 501 bypass pump box.

1. Pull the two black knobs located on the top left and right of the front panel. The front panel will release and can be folded down.
2. Unscrew the hold-down ring, remove the glass window, the Teflon O-ring, and the particulate filter.
3. Examine old filter for unusual accumulation or tears and replace with new particulate filter. Note any abnormalities in the particulate filter in the site log and the instrument log.
4. Clean the glass window and Teflon O-ring using compressed air and/or Kim wipes.
5. Using forceps, insert the new particulate filter, being careful not to touch the filter media with your fingers. Make sure that the element is fully seated in the bottom of the holder.
6. Replace the Teflon O-ring, making sure the cut outs in the O-ring face upward.
7. Replace the glass window, then screw on the hold-down ring and hand tighten. Do not overtighten; this can cause the glass window to crack!

8. Remove the “NO in” and “NOy in” lines from the back panel of the analyzer, and block both ports using ¼” caps to leak test the analyzer. It may take several minutes for the displayed sample flow and sample pressure to stabilize.
9. Record the Sample Flow and the Sample Pressure in the instrument log book. The sample flow must be below 10 cc/min and the sample pressure must be below 10 inHg to pass the leak test. If the leak test does not pass, refer to the instrument manual for instructions on diagnosing a leak.

I.6.3 Replacing the Sample Manifold

1. Flag all affected gas parameters on the data logger.
2. Log Start Date and Time on a Misc. Instrument Maintenance/Data Exception Worksheet (Figure 8).
3. Completely remove all ¼” FEP Teflon lines from the sample manifold.
4. Clean the bug screen at the top of the sample inlet and all Teflon tees in the sample manifold with alcohol and cotton swabs.
5. Replace with new, clean ¼” FEP Teflon lines, making sure to measure the length of tubing that is used. Record new manifold length on misc. data exception worksheet.
6. Condition new sample manifold lines with 500 ppb ozone for at least one hour.
7. Log End Date and Time on misc. data exception worksheet.

I.7 Troubleshooting

Refer to the Troubleshooting section in the operator’s manual for troubleshooting options specific to each instrument.

Figure 8 Misc. Instrument Maintenance/Data Exception Worksheet

Air Quality Management Division

Misc. Instrument Maintenance / Data Exception Worksheet

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site ________________ Operator ________________ Parameter(s) ________________

Start Date ________________ **End Date** ________________

Start Time ________________ **End Time** ________________

Comments ____

File Name: Misc Data Exception Worksheet
Last Revision: 10/02/19

Appendix J: Trace Sulfur Dioxide Analyzers

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ____

Title of Author: ____

Signature: ______________________________ Date: ______________

Name: ____

Title: ____

Signature: ______________________________ Date: ______________

Name: ____

Title: ____

Signature: ______________________________ Date: ______________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:___________________________Date:______________

Name: ____

Title: ____

Signature:___________________________Date:______________

Name: ____

Title: ____

Signature:___________________________Date:______________

Name: ____

Title: ____

Signature:___________________________Date:______________

Name: ____

Title: ____

Signature:___________________________Date:______________

Acronyms and Abbreviations

cc/min	Cubic Centimeters per Minute
DAS	Data Acquisition System
EPA	U.S. Environmental Protection Agency
ESC	Environmental Systems Corporation
LPM	Liters per Minute
mV	Millivolts
nm	nanometers
PMT	Photo Multiplier Tube
PSI	Pounds per Square Inch
PST	Pacific Standard Time
ppb	Parts per Billion
ppm	Parts per Million
QC	Quality Control
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedures
TAPI	Teledyne Advanced Pollution Instrumentation
UV	Ultraviolet Radiation
Z/P/S	Zero, Precision, Span

Figures and Tables

Figure 1: Station Log Report J-4
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Figure 3: SO_2 Control Chart J-8
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Figure 8: Misc. Instrument Maintenance/Data Exception Worksheet....................J-19

J.1 Introduction

The M100EU UV Fluorescence SO_2 Analyzer is a microprocessor controlled analyzer that determines the concentration of sulfur dioxide (SO2), in a sample gas drawn through the instrument. It requires that sample and calibration gases be supplied at ambient atmospheric pressure in order to establish a constant gas flow through the sample chamber where the sample gas is exposed to ultraviolet light causing the SO_2 to become excited (SO_2*). As these SO_2* molecules decay into SO_2 they fluoresce. The instrument measures the amount of fluorescence to determine the amount of SO_2 present in the sample gas. Calibration of the instrument is performed in software and usually does not require physical adjustments to the instrument. During calibration, the microprocessor measures the sensor output signal when gases with known amounts of SO_2 at various concentrations are supplied and stores these measurements in memory. The microprocessor uses these calibration values along with other performance parameters such as the PMT dark offset, UV lamp ratio and the amount of stray light present and measurements of the temperature and pressure of the sample gas to compute the final SO_2 concentration. This concentration value and the original information from which it was calculated are stored in the unit's internal data acquisition system and reported to the user through a vacuum fluorescent display or as electronic data via several communication ports. This concentration value and the original information from which it was calculated are stored in the unit's internal data acquisition system and reported to the user through a vacuum fluorescent display or several communication ports.

J.2 Theory of Operation

The physical principle upon which the M100EU's measurement method is based is the fluorescence that occurs when sulfur dioxide (SO_2) is excited by ultraviolet light with wavelengths in the range of 190 nm-230 nm. This reaction is a two-step process.
The first stage occurs when SO_2 molecules are struck by photons of the appropriate ultraviolet wavelength. A band pass filter between the source of the UV light and the affected gas limits the wavelength of the light to approximately 214 nm. The SO_2 molecules absorbs some of energy from the UV light causing one of the electrons of each of the affected molecules to move to a higher energy orbital state.

$$SO_2 + hv_{214nm} \longrightarrow SO_2^*$$

The amount SO_2 converted to excited SO_2* in the sample chamber is dependent on the average intensity of the UV light and not its peak intensity because the intensity of UV light is not constant in every part of the sample chamber. Some of the photons are absorbed by the SO_2 as the light travels through the sample gas.

The second stage of this reaction occurs after the SO_2 reaches its excited state (SO2*). Because the system will seek the lowest available stable energy state, the SO_2* molecule quickly returns to its ground state by giving off the excess energy in the form of a photon (*hv*). The wavelength of this fluoresced light is also in the ultraviolet band but at a longer (lower energy) wavelength centered at 330nm.

$SO_2^* \longrightarrow SO_2 + hv_{330nm}$

The amount of detectable UV given off by the decay of the SO_2^* is affected the rate at which this reaction occurs (*k*).

$F = k (SO_2^*)$

Where:
F = the amount of fluorescent light given off.
k = the rate at which the SO_2^* decays into SO_2.
SO_2^* = Amount of excited SO_2 in the sample chamber.

So:

$k(SO_2^*) \longrightarrow SO_2 + hv_{330nm}$

Finally, the function (***k***) is affected by the temperature of the gas. The warmer the gas, the faster the individual molecules decay back into their ground state and the more photons of UV light are given off per unit of time. The net result is that any variation in UV fluorescence can be directly attributed to changes in the concentration of SO_2 in the sample gas.

J.3. Precautions

1. To avoid injury, always use two people to lift and carry the analyzer.
2. Connect the exhaust fitting on the rear panel to a vent outside the analyzer area.
3. Ensure analyzer is set up for proper voltage and frequency.
4. Ensure power plug has a ground lug.
5. Hazardous voltages exist within the instrument chassis.
6. Do not exceed 15 Pounds per Square Inch (PSI) of pressure within the instrument.
7. Remove power from the instrument before service is performed.
8. Follow all warning signs within the manual during setup, operation and maintenance.

J.4 Instrument Operation

J.4.1 Quality Control

J.4.1.1. Site Checks

Perform Site Checks during each visit to the site. Check the instruments front panel display for indication of analyzer malfunction or warning messages. Compare the instrument front panel concentration to the Data Acquisition System (DAS) concentrations to check for deviations. Check all analyzer diagnostics by pressing the Test <TST> button on the front of the analyzer to ensure all diagnostics are within range. Refer to the instrument diagnostics page located at the front of the instrument manual for diagnostics specific to each instrument. Shelter conditions are noted and logged on the Station Log Report (Figure 1). Warning messages, changes in diagnostics or work performed on the analyzer is also noted on the Station Log Report and Instrument Log Book.

Figure 1 Station Log Report

Washoe County Health District - Air Quality Management Division

Station Log Report

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site: ____________________

	Operator(s):												
	Date:												
	Time (PST):												
		Y	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**	**Y**	**N**
1	Outside Good Repair:												
2	Inside Good Repair:												
3	All Settings Correct:												
4	Heat/Air Working:												
5	A/C Clean Filter Light Off:												
6	Analyzer Fault Lights Off:												
7	Analyzer Date/Time +/- 1 min:												
8	Gas Analyzer Multipoint Current:												
9	Datalogger Date/Time +/- 1 min:												
10	UPS Battery Status Light Green:												
11	T° Sentry Status Light Green:												
12	Station Inside Temperature (°C):												
13	Instruments Adjusted:												

Additional Comments:

Station Log Report
Last Revision: 09/05/17

J.4.1.2 Daily Checks

Daily span/zero checks are performed at 0145 PST using automatic calibrations programmed into the Environmental Systems Corporation (ESC) 8832 data logger (see appendix V for the ESC SOP). If the span or zero point is outside the operating specifications a calibration must be performed. (See section J.4.2 for Calibration Procedures).

J.4.1.3 Weekly Checks

J.4.1.3.1 Diagnostic Checks

The Trace SO2 analyzer diagnostics are checked at the beginning of every week.

1. Note the date, time and operator in the instrument log book.
2. Record the Sample Flow and Reference Voltage off of the analyzer display by scrolling through the <TST> functions. The sample flow must be 650 cc/min +/- 10%. The UV lamp voltage must be within 3000-4000 mv.
3. Record the concentration in parts per million (ppb) of SO2 off of the analyzer display and the DAS. These must be within +/- 0.1 ppb.
4. Ensure there are no major changes in these diagnostics from last week's readings.

J.4.1.3.2 Calibration Checks

Perform a zero, precision, span (Z/P/S) check of the analyzer once a week. Record all readings on the Trace Level Sulfur Dioxide Worksheet (Figure 2).

1. Put the site instrument in maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS and enter the Password to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press I for Put Channel In Maintenance, choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters chosen should appear on the screen in red indicating they are in maintenance mode. (See Appendix V for the SOP on this instrument).
2. Ensure the valve to the SO_2 cylinder is open and the pressure is at 30 PSI.
3. Ensure the pressure on the zero air generator is at 30 PSI.
4. Using an Ethernet cable, connect laptop to the firewall network router box. Locate the AQMonitoring drive on the computer. Open the Field Management Functions folder, QA/QC folder, then CO QA/QC folder. Open the respective site folder and current year folder. Find the latest form and open. Click file and SAVE AS, save the file with the current date, site, and parameter (ex 20190916_Reno 3_SO2). Clear the contents from the old data sheet and input all the new information on the SO2 worksheet. Ensure the instrument's UV lamp voltage and sample flow is within the instrument's diagnostic range. Record "Start Time" on the SO2 worksheet from when you put the channel in maintenance on the DAS.
5. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press GEN, and then press AUTO. Update

the touchscreen buttons to read 90.0 ppb SO2, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 90.0 ppb of SO2. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less and record the SO2 concentration from the DAS. View the percent deviation calculation on the Trace Level Sulfur Dioxide Worksheet to verify that it is +/- 5%. Adjust the span if the percent deviation is outside +/- 5% (see section J.4.2 for Calibration Procedures).

6. Precision Check: Repeat step 5 above using 5.0 ppb SO2 for the concentration.
7. Zero Check: Press GEN, and then press AUTO. Press the SO2 touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the SO2 analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less and record the SO2 concentration from the DAS. Adjust the zero if the SO2 concentration is outside +/- 0.2 parts per billion (ppb)[1] (see section J.4.2 for Calibration Procedures).
8. Press STBY on the dilution calibrator, this will stop all calibration procedures.
9. Take the instrument out of maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press O for Take Channel Out of Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, the L to return to displaying the parameters on the screen. The parameters should display on the screen in green.
10. Record “End Time” on the Trace Level SO2 Worksheet and make sure to save the document before shutting down the computer.
11. Print two copies of the SO2 worksheet at the office, one for the QA/QC logbook at the site and one for the data exception log in the office.
12. Enter the results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMD data management drives.
13. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the Z/P/S flag.

[1] EPA zero drift criteria is 3.0 ppb for 24 hours and 5 ppb for 14 days, 0.2 ppb reflects our in house action level.

Figure 2 Trace Level Sulfur Dioxide Worksheet

Air Quality Management Division
Trace Level Sulfur Dioxide Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Z / P / S ______ Multipoint ______ Calibration ______ Audit ______

Date ______ Operator ______ Site ______

Site Instrument (Indicated)		Gas Calibrator (Actual)		Zero Air	
Manufacturer		Manufacturer		Manufacturer	
Model		Model		Model	
Serial No.		Serial No.		Serial No.	
Sample Flow (cc/m)		Sample Flow (LPM)		PSI	
PMT Signal (mV)					
UV Lamp (mV)		Cal. Cylinder No.			
Str. Light (ppb)		Concentration (ppm)			
		Expiration Date			
Slope		Cyl. Pressure (PSI)			
Offset (mV)					

Date of Last Particulate Filter Change ______

Start Time ______ PST **End Time** ______ PST

Set Point	Indicated	Actual	Percent Dev.	*EPA Acceptance Criteria	Audit Acceptance Criteria
90 ppb			#DIV/0!	+/- 10% dev.	+/- 15% dev.
50 ppb			#DIV/0!	+/- 10% dev.	+/- 15% dev.
35 ppb			#DIV/0!	+/- 10% dev.	+/- 15% dev.
5 ppb			#DIV/0!	+/- 10% dev.	+/- 15% dev.
0 ppb			#DIV/0!	+/- 3.0 ppb	+/- 3.0 ppb

*AQMDs in house action level for adjustment is +/- 0.20 ppb for zero and +/- 5% for precision and/or span points

Average Percent Dev.	#DIV/0!	Slope	#DIV/0!
Std. Dev.	#DIV/0!	Intercept	#DIV/0!
		Correlation	#DIV/0!

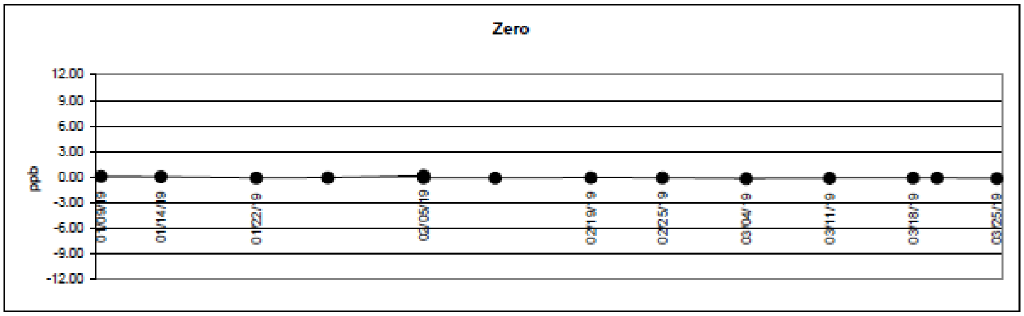
Comments ______________________________

File Name: Master_Template_SO2_Trace_NCore
Last Revision: 09/12/19

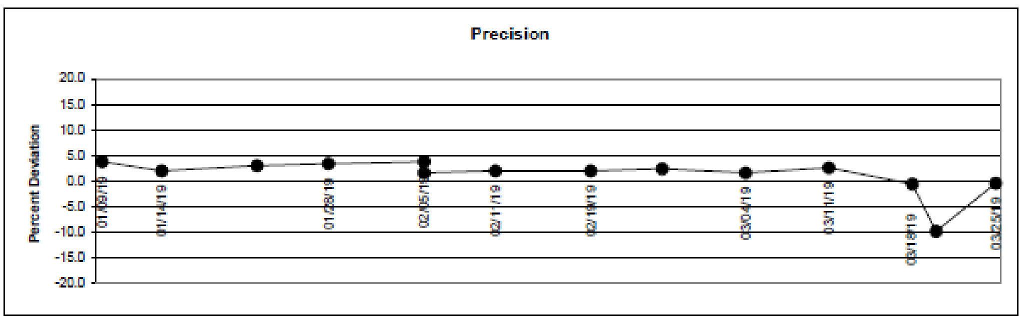
Figure 3 SO_2 Control Chart

SO2 Control Chart

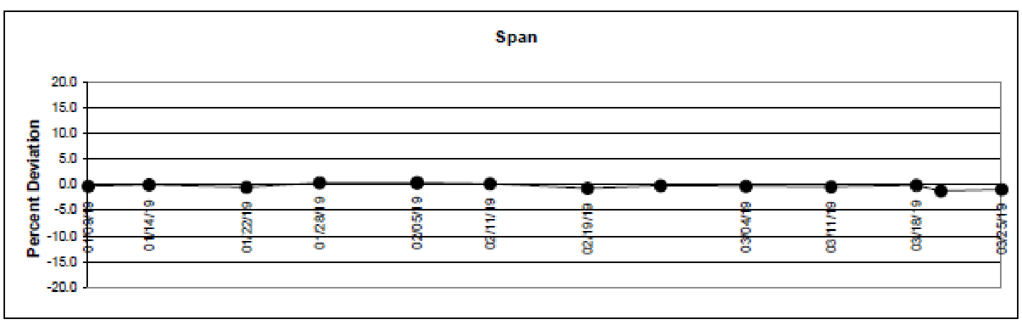
Site:	Reno 3	**Instrument:**	TAPI
Year:	2019	**Model:**	100EU
Quarter:	1st	**Serial #:**	157 / 085



Zero Drift Limits: 0.0 - 0.2 ppb, no adjustment necessary
0.2 - 3.0 ppb, adjust analyzer
> +/-3.0 ppb, invalidate data and recalibrate



EPA Acceptance Criteria: < +/- 10% dev. (< +/- 15% dev. for audits)



Span Drift Limits: 0 - 4.9% dev., no adjustment necessary
5 - 10% dev., adjust analyzer and run multipoint
> +/-10% dev., invalidate data and recalibrate

Notes: 02/05/19 zero adj
03/20/19 Qrtly Audit

Figure 4 Data Exception Log

Site: Year: Quarter:

Date	Begin Time	End Time	Parameter	Error Code											
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a

Notes:

J.4.1.3. Monthly Checks

Perform monthly checks at the beginning of each month.

1. Check pressure in the SO2 calibration gas cylinder. Complete the Monthly Cylinder Pressure Log (Figure 5). Compare to last month pressure check to ensure there has been no excess loss of SO2.
2. Replace the analyzer's particulate filter (see section J.5.1. for Replacing the Particulate Filter).

Figure 5 Monthly Cylinder Pressure Log

Monthly Cylinder Pressure Log

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Year(s): ______________ / ______________
Site: ____________________________

Date	Cylinder ID #	Concentration (ppm)			Expiration Date	Pressure (PSI)	Initials
		CO	NO	SO_2			

Comments: ____
____
____
____
____
____

J.4.1.4 Quarterly Audits

Equipment Needed:

- Certified audit ozone transfer standard/dilution calibrator (TAPI T750U)
- Audit zero air generator (TAPI 751H)
- Audit CO/SO2 calibration cylinder

J.4.1.4.1 Audit Equipment Set-Up

1. Set-up, plug in, and power on the audit T750U calibrator. It may be set-up on top of the site calibrator. Prior to beginning any gaseous audit, the audit T750U must be powered on for at least 30 minutes, allowing the calibrator to come up to proper operating temperature.
2. Set-up and plug in the audit 751H zero air generator on the station floor near the T750U.
3. Using 1/4" Teflon FEP tubing with stainless steel (SS) fittings, connect the ZERO OUT port on the 751H to the DILUENT IN port on the T750U.
4. Power on the 751H, and ensure the pressure gauge on the front panel is reading 30 pounds per square inch (PSI). If it is not, adjust the regulator knob on the front panel until it is reading 30 PSI.
5. Set-up the audit CO/SO2 calibration cylinder inside the station in close proximity to the T750U calibrator. Position the end of the cylinder line outside the station door. Open the second stage regulator valve. Turn the regulator pressure adjustment knob all the way counter-clockwise. Open and close the cylinder valve. Turn the regulator pressure adjustment knob clockwise to bleed all gas from the regulator until the cylinder pressure and regulator pressure read 0 PSI. Turn the regulator pressure adjustment knob all the way counter-clockwise. Repeat this process three times to ensure any contaminated gas is purged from the regulator and cylinder line. See Figure 6 for a diagram of the cylinder and regulator.
6. Connect the audit CO/SO2 cylinder line to CYL IN port on the T750U, open cylinder valve, and use the regulator pressure adjustment knob to set the regulator pressure to 30 PSI.
7. Remove the calibration manifold line from the back of the station calibrator CAL OUT port and connect to the CAL OUT port on the T750U.

J.4.1.4.2 Audit Procedures

1. Follow steps 1 – 10 in Section J.4.2.3 using the audit standards instead of the site standards and ensuring that each point is within +/- 15%. If any point is out of range, complete a Corrective Action Request (Figure 7) and submit to instrument operator.
2. Print three copies of the SO2 worksheet at the office, one for the audit folder maintained by the senior air quality specialist, one for the QA/QC logbook at the site, and one for the data exception log in the office.
3. Record the audit results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
4. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the audit flag.

Figure 6 Calibration Cylinder/Regulator Diagram

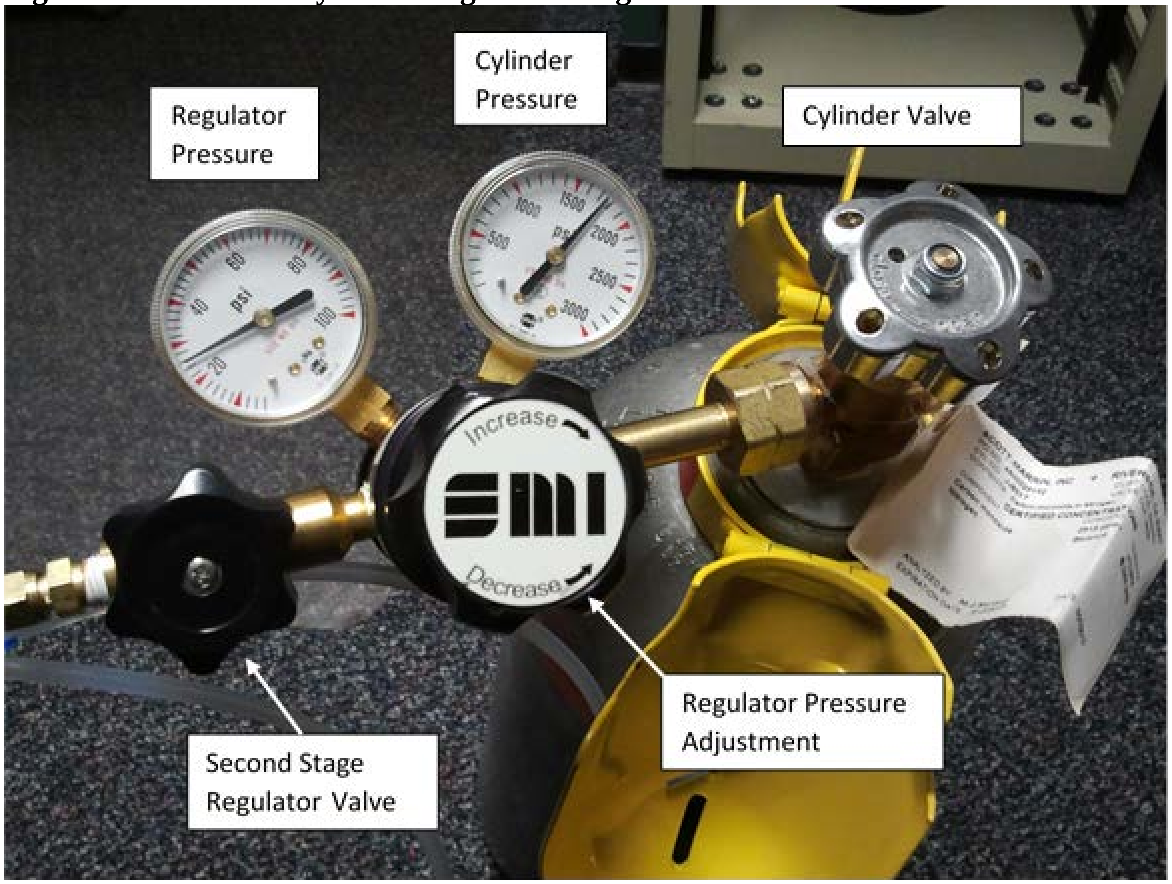


Figure 7 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ____________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ____________________________

Problem Identification:

Site: ____________________
System: ____________________
Date: ____________________
Time: ____________________
Nature of Problem: ____

Recommended Action: ____

Signature: ____________________ Date: ____________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________
Time corrective action taken: ____________________
Corrective Action Summary: ____

Signature: ____________________ Date: ____________

QA Manager Signature: ____________________ Date: ____________

Supervisor Signature: ____________________ Date: ____________

Director Signature: ____________________ Date: ____________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

J.4.2. Calibration Procedures

J.4.2.1. Zero Adjustment

Perform a zero adjustment when the zero point is +/- 0.2 ppb during the daily or weekly checks (see section J.4.1.2 for weekly check instructions). The zero adjustment must be done after the completion of the weekly z/p/s check or when a daily zero check is outside +/- 0.2 ppb.

1. Upon completion of the weekly Z/P/S, press GEN, and then press AUTO. Press the SO2 touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 LPM, and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the CO analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less.
2. Once the instrument is stabilized press the CAL button on the front panel of the instrument.
3. Press the ZERO button followed by ENTR. The instrument will adjust automatically to 0.0 ppm SO2 concentration. Log "zero adjustment" in the comments section of the original Z/P/S worksheet.
4. Allow the instrument to stabilize to 0.1 ppb and record the reading from the DAS on a new Z/P/S worksheet.
5. After a ZERO adjustment, a re-check of the span and precision points is recommended. If the span or precision points are outside the required acceptance criteria, continue with section J.4.2.2 for span adjustment and J.4.2.3 for multipoint calibration.

J.4.2.2. Span Adjustment

Perform a span adjustment when the percent deviation of the span point is outside +/- 5% during the weekly checks or daily span check (see section J.4.1.2 for weekly check instructions). The span adjustment must be done after the completion of the weekly Z/P/S check.

1. Upon completion of the weekly Z/P/S, press GEN, and then press AUTO. Update the touchscreen buttons to read 90.0 ppb SO2, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 90.0 ppb of SO2. Allow the instrument to stabilize. Press the TEST button on the SO2 analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less.
2. Once the instrument is stable, press CAL on the front panel of the analyzer. Ensure the CONC button is programmed to 90.0 ppb. Press SPAN, and then press ENTR. The analyzer will adjust automatically to 90.0 ppb SO2 concentration.
3. Allow the instrument to stabilize and record the reading from the DAS on a new SO2 worksheet. Complete a multipoint calibration as described in section J.4.2.3 after any span adjustment is made.

J.4.2.3. Multipoint Calibration

Perform a multipoint calibration after a span adjustment is made to the instrument. A multipoint calibration must be performed before any other adjustments are made to the instrument.

1. Put the site instrument in maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS, press L to Login, and enter the Password to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press I for Put Channel In Maint., choose the parameter and press Enter. ESC back to the Main Menu and press D, then L to return to displaying the parameters on the screen. The parameter chosen should appear on the screen in red indicating they are in maintenance mode. (See Appendix V for the SOP on this instrument).
2. Ensure the valve to the SO2 cylinder is open and the regulator pressure is at 30 PSI.
3. Ensure the pressure on the zero air generator is at 30 PSI.
4. Using an Ethernet cable, connect laptop to the firewall network router box. Locate the AQMonitoring drive on the computer. Open the Field Management Functions folder, QA/QC folder, then SO2 QA/QC folder. Open the respective site folder and current year folder. Find the latest form and open. Click file and SAVE AS, save the file with the current date, site, and parameter (ex 20190916_Reno 3_SO2). Clear the contents from the old data sheet and input all the new information on the SO2 worksheet. Ensure the instrument's reference voltage and sample flow is within the instrument's diagnostic range. Record "Start Time" on the SO2 worksheet from when you put the channel in maintenance on the DAS.
5. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press GEN, and then press AUTO. Update the touchscreen buttons to read 90.0 ppb SO2, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 90.0 ppb of SO2. Allow the instrument to stabilize. Press the TEST button on the SO2 analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less and record the SO2 concentration from the DAS. View the percent deviation calculation on the Trace Level Sulfur Dioxide Worksheet to verify that it is +/- 5%.
6. Repeat step 5 above for the following points:
   - 50.0 ppb SO2
   - 35.0 ppb SO2
   - 5.0 ppb SO2
7. Zero Check: Press GEN, and then press AUTO. Press the SO2 touchscreen button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample zero air. Allow the instrument to stabilize. Press the TEST button on the SO2 analyzer until STABIL is displayed. Wait until STABIL is reading 0.1 ppb or less and record the SO2 concentration from the DAS.
8. Press STBY on the dilution calibrator, this will stop all calibration procedures.
9. Take the instrument out of maintenance mode on the DAS. Press the ESC key on the keyboard of the DAS to get to the Main Menu. From the Main Menu press C for the Configuration Menu, press D for Configure (Data) Channels, press O for Take Channel Out of Maint., choose the parameter and press Enter. ESC back to the Main Menu and

press D, the L to return to displaying the parameters on the screen. The parameters should display on the screen in green.

10. Record "End Time" on the Trace SO2 Worksheet and make sure to save the document before shutting down the computer.
11. Print two copies of the Trace SO2 worksheet at the office, one for the QA/QC logbook at the site and one for the data exception log in the office.
12. Record the multipoint results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
13. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 4) and circle the multipoint flag.

J.5 Routine Maintenance

J.5.1. Replacing the Particulate Filter

The particulate filter is located between the instrument and sample manifold in a particulate filter holder.

1. Unscrew the top Teflon fitting from the particulate filter holder with your fingers.
2. Use particulate filter holder wrenches to release the two parts of the particulate filter holder.
3. Examine old filter for unusual accumulation or tears and replace with new particulate filter. Note any abnormalities in the particulate filter in the site log and the instrument log.
4. Clean the two parts of the particulate holder using compressed air, Kim wipes, or cotton swabs.
5. Using forceps, insert the new particulate filter being careful not to touch the filter media with your fingers.
6. Use particulate filter holder wrenches to tighten the two parts of the particulate filter holder.
7. Using a Teflon cap, block the upper portion of the particulate filter holder to leak test the analyzer. It may take several minutes for the displayed sample flow and pressure to stabilize.
8. Record the Sample Flow and the Pressure in the instrument log book. The sample flow must be below 10 cc/min and the pressure must be below 10 inHg to pass the leak test. If the leak test does not pass, refer to the instrument manual for instructions on diagnosing a leak.

J.5.2. Replacing the Sample Manifold

1. Flag all affected gas parameters on the data logger.
2. Log Start Date and Time on a Misc. Instrument Maintenance/Data Exception Worksheet (Figure 8).
3. Completely remove all ¼" FEP Teflon lines from the sample manifold.
4. Clean the bug screen at the top of the sample inlet and all Teflon tees in the sample manifold with alcohol and cotton swabs.

5. Replace with new, clean ¼” FEP Teflon lines, making sure to measure the length of tubing that is used. Record new manifold length on misc. data exception worksheet.
6. Condition new sample manifold lines with 500 ppb ozone for at least one hour.
7. Log End Date and Time on misc. data exception worksheet.

J.6 Troubleshooting

Refer to the Troubleshooting section in the operator’s manual for troubleshooting options specific to each instrument.

Figure 8 Misc. Instrument Maintenance/Data Exception Worksheet

Air Quality Management Division

Misc. Instrument Maintenance / Data Exception Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Site ________________ Operator ________________ Parameter(s) ________________

Start Date ________________ **End Date** ________________

Start Time ________________ **End Time** ________________

Comments ____

File Name: Misc Data Exception Worksheet
Last Revision: 10/02/19

Appendix K: Zero Air Generator

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ____

Title of Author: ______________________________________

Signature: ___________________________ Date: ____________

Name: ____

Title: ____

Signature: ___________________________ Date: ____________

Name: ____

Title: ____

Signature: ___________________________ Date: ____________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:__________________________Date:____________

Name: ____

Title: ____

Signature:__________________________Date:____________

Name: ____

Title: ____

Signature:__________________________Date:____________

Name: ____

Title: ____

Signature:__________________________Date:____________

Name: ____

Title: ____

Signature:__________________________Date:____________

Acronyms and Abbreviations

°C	Degrees Celsius
PSI	Pounds per Square Inch
SOP	Standard Operating Procedures
TAPI	Teledyne Advanced Pollution Instrumentation

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K.1 Introduction

The Teledyne Advance Pollution Instrumentation (TAPI) Model 701/701H generators dry and scrub ambient air to produce zero air. For additional information, a detailed discussion of the instrument's principle of operation can be found in the TAPI manufacturers' manual. The purpose of this document is to supplement the manufacturers' manual with instructions for operating the analyzer.

K.2 Theory of Operation

The generator draws in air from the rear panel bulkhead union and inlet filter. Air is under pressure and hot from the compression at the outlet. The relative humidity is high due to the high pressure. The air is conducted through the cooling coil where heat is removed by transfer to the cooling fan air. The temperature is reduced to ambient and the pressure remains high, at this point the relative humidity is highest and the air is supersaturated. From the coil, wet air passes through a coalescing filter where excess water is separated and settles in the filter. The controller opens periodically to expel the water through a rear panel bulkhead union. The partially dried air passes a pressure relief valve and enters the regenerative scrubber which removes almost all the remaining water and some of the other contaminants. The dry air then passes through a check-valve to the storage tank. A pressure switch turns off the compressor when the pressure reaches a set high value and turns on the compressor when the pressure reaches a set low value. As air leaves the tank the pressure is controlled by a pressure regulator mounted on the front panel. This maintains a constant pressure at the calibrator inlet and is displayed by the pressure gauge on the front panel. After the dry regulated air enters through specific pollutant scrubbers the clean air passes through a particulate filter and leaves the generator through the rear panel bulkhead union.

K.3 Precautions

1. To avoid injury, always use two people to lift and carry the analyzer.
2. Be sure the power cord is properly grounded.
3. Do not operate the generator unrestricted for more than a few minutes.
4. Be sure you remove the shipping screws before starting the generator.
5. The spray leaving the rear panel is in high velocity spurts and should be pointed away from sensitive components.
6. Do not adjust the relief valve.
7. Never set the delivery pressure higher than 55 pounds per square inch (PSI). This may cause damage to the generator and injury to the operator.
8. Air coming out of the scrubber is 300°C, the copper coil and casing can be very hot.
9. Dangerous voltages exist on the controller board even when the power switch is turned off.
10. There are high voltages present while the generator is plugged in.
11. Do not loosen any tubing connection while the generator is running.
12. Before working on the instrument, turn it off and wait for the pressure gauge to read zero.
13. There is line voltage present at the power terminals and control board when power is switched off. For added safety, remove the power cord from the rear panel receptacle.
14. The scrubber is hot.

K.4 Instrument Operation

Turn the zero air generator on 15 minutes prior to use. Ensure the pressure gauge is reading 30 PSI throughout zero/precision/span checks and calibrations.

K.4.1 Quality Control

K.4.1.1 Quarterly Audits – SLAMS and NCore Sites

Every quarter, zero air audits are completed immediately following the final zero point in the gaseous audits. For more details on gaseous audits, see each respective gas SOP.

Equipment Needed:
- Certified audit ozone transfer standard/dilution calibrator (TAPI T750U)
- Audit zero air generator (TAPI 751H)
- Site zero air generator (TAPI 701 or 701H)

K.4.1.1.1 Audit Equipment Set-up

1. Power off the audit 751H zero air generator. Remove the zero air line from the DILUENT IN port on the audit T750U calibrator. Air may purge from the line.
2. Power off the station 701 zero air generator. Remove the station 701 zero air line from DILIENT IN port on the back of the station T700 calibrator. Air may purge from the line.
3. Connect the station 701 zero air line to the DILUENT IN port on the audit T750U.
4. Power on the station 701 and wait for the pressure on the front panel gauge to reach 30 PSI.

K.4.1.1.2 Audit Procedures

1. If they are not already, put the affected parameters in maintenance mode on the data acquisition system (DAS). Press the ESC key on the keyboard of the DAS and press L to log in. Enter the Password to get to the Home Menu. From the Home Menu, press C for the Configuration Menu, press D for Configure (Data) Channels, and press I for Put Channel In Maintenance. Choose the parameter(s) by highlighting them with the arrow keys and pressing the spacebar. Press enter when all the parameters to be flagged are chosen. ESC back to the Home Menu and press D for Real-Time Display and L for Large Text Display. Highlight “Show Large Text Display” and press enter. The flagged parameters should appear on the screen in red indicating they are in maintenance mode.
2. Log the “Start Time” on the Zero Air Generator Audit Worksheet (see Figure 1).
3. Transfer the final zero readings from the gaseous audit worksheets on to the Zero Air Generator Audit Worksheet in the “Audit Zero Air Generator” column for the applicable parameters.
4. On the audit T750U, press GEN>AUTO. Toggle the gas parameter button until it reads ZERO, then press ENTER. Ensure the flow delivered to the instrument from the

calibrator is 5 liters per minute (LPM) at SLAMS sites, 6 LPM for CO, O3, and SO2 at NCore, or 8 LPM for NOx/NOy at NCore, and then press ENTER. The instrument will begin to sample zero air.

5. While waiting for the analyzers to stabilize, fill out the "Date", "Operator", "Site", "Site Zero Air Generator", and "Audit Zero Air Generator" sections on the Zero Air Generator Audit Worksheet.
6. After the analyzer(s) has reached stability (approximately 15 minutes), record the applicable parameter concentrations from the DAS in the "Audit Zero Air Generator" column of the audit worksheet.
7. Ensure that each point is within acceptance criteria outlined on the Zero Air Generator Audit Worksheet. If any point is out of range, complete a Corrective Action Request (Figure 2) and submit to instrument operator.
8. Press STBY on the dilution calibrator, this will stop all calibration procedures.
9. Take the affected parameters out maintenance mode on the data acquisition system (DAS). Press the ESC key on the keyboard of the DAS to get to the Home Menu. From the Home Menu, press C for the Configuration Menu, press D for Configure (Data) Channels, and press O for Take Channel Out of Maintenance. Choose the parameter(s) by highlighting them with the arrow keys and pressing the spacebar. Press enter when all the parameters to be de-flagged are chosen. ESC back to the Home Menu and press D for Real-Time Display and L for Large Text Display. Highlight "Show Large Text Display" and press enter. The parameters should appear on the screen in green indicating they are out of maintenance mode.
10. Log the "End Time" on the Zero Air Generator Audit Worksheet.
11. Print at least three copies of the worksheet at the office, one for the audit folder maintained by the senior air quality specialist, one for each of the QA/QC logbooks at the site, and one for each affected parameter for the data exception log in the office.
12. Record the Date, Start Time, End Time, and Parameter on the Data Exception Log (Figure 3) and circle the audit flag.

K.4.1.2 Annual Checks – NCore Site

An annual recertification of the audit zero air generator against an ultra pure zero air cylinder is conducted once per year. This recertification is conducted at the NCore site because it monitors all four gaseous criteria pollutants.

Equipment Needed:

- Certified audit ozone transfer standard/dilution calibrator (TAPI T750U)
- Audit zero air generator (TAPI 751H)
- Ultrapure zero air cylinder

K.4.1.2.1 Annual Recertification Equipment Set-up

1. Power off the audit 751H zero air generator. Remove the zero air line from the DILUENT IN port on the audit T750U calibrator. Air may purge from the line.

2. Connect the ultrapure zero air cylinder line to the DILUENT IN port on the audit T750U, open cylinder valve, and use the regulator pressure adjustment knob to set the regulator pressure to 30 PSI.

K.4.1.2.2 Recertification Procedure

1. Follow steps 1 – 12 in Section K.4.1.1.2 using the ultrapure zero air cylinder instead of the audit 751H.

Figure 1 Zero Air Generator Audit Worksheet

Air Quality Management Division
Zero Air Generator Audit Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Date ________ Operator ________ Site ________

Start Time ________ **End Time** ________

Site Zero Air Generator		**Audit Zero Air Generator**		**Ultra Pure Cylinder**	
Manufacturer	________	Manufacturer	________	Manufacturer	________
Model	________	Model	________	Cyl. No.	________
Serial No.	________	Serial No.	________	Cert. Date	________
PSI	________	PSI	________	Cyl. Press.	________ PSI

Instrument Response

CO	Site Zero Air Generator (ppm)	Audit Zero Air Generator (ppm)	Ultra Pure Cylinder (ppm)	Difference (ppm)	
					<0.1 ppm? Yes / No / NA

Ozone	Site Zero Air Generator (ppb)	Audit Zero Air Generator (ppb)	Ultra Pure Cylinder (ppb)	Difference (ppb)	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
Average					<10 ppb? Yes / No / NA

SO2	Site Zero Air Generator (ppb)	Audit Zero Air Generator (ppb)	Ultra Pure Cylinder (ppb)	Difference (ppb)	
					<1 ppb? Yes / No / NA

NO2	Site Zero Air Generator (ppb)	Audit Zero Air Generator (ppb)	Ultra Pure Cylinder (ppb)	Difference (ppb)	
					<10 ppb? Yes / No / NA

NOY-NO	Site Zero Air Generator (ppb)	Audit Zero Air Generator (ppb)	Ultra Pure Cylinder (ppb)	Difference (ppb)	
					<10 ppb? Yes / No / NA

Comments ____

____

____

____

File Name: Zero Air Audit Worksheet2
Last Revision: 10/02/2019

Figure 2 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY
HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ____________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ____________________________

Problem Identification:

Site: ____________________________
System: ____________________________
Date: ____________________________
Time: ____________________________
Nature of Problem: ____________________________

Recommended Action: ____________________________

Signature: ____________________________ Date: ________________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________________
Time corrective action taken: ____________________________
Corrective Action Summary: ____________________________

Signature: ____________________________ Date: ________________

QA Manager Signature: ____________________________ Date: ________________

Supervisor Signature: ____________________________ Date: ________________

Director Signature: ____________________________ Date: ________________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

Figure 3 Data Exception Log

Site: Year: Quarter:

Date	Begin Time	End Time	Parameter	Error Code											
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a

Notes:

K.5 Routine Maintenance

K.5.1 Scrubber Maintenance

Replace the charcoal, Purafil, and particulate filter annually. Replace the CO scrubber if it is suspected to have become contaminated or poisoned.

K.5.1.1 Replacing the Charcoal Scrubber

1. Turn off the 701X and wait for the pressure to go to zero.
2. Open the front panel, or remove the top cover.
3. Remove the 1/4" tubing connected to the top of the scrubber canister.
4. Release the fastening strap to free the canister.
5. Remove the 1/4" tubing connected to the bottom of the canister.
6. Unscrew the cap of the canister.
7. Remove the pad from the top of the canister.
8. Pour out the charcoal and dispose of it properly.
9. Refill the canister with fresh charcoal, up to 3/8" to 1/4" from the top. Rap the sides of the canister gently to settle the charcoal and add more as necessary.
10. Replace the pad on top of the charcoal.
11. Wipe any charcoal dust from the top edge of the canister. This is the surface which seals against the gasket.
12. Check that the gasket is in place in the cap.
13. Replace the cap and tighten it "hand-tight".
14. Reconnect the lower 1/4" tube connection.
15. Reattach the canister with the fastening strap.
16. Reconnect the upper 1/4" tube.
17. Enable "maintenance mode" (See Section 6.6 in instrument manual) which will bypass the dew point warnings during scrubber drying.
18. After the compressor is turned on, it may be wise to check the scrubber for leaks using a commercial soap solution leak finder.
19. Place the instrument in Maintenance Mode to dry out scrubber (See Section 6.6 in instrument manual).

NOTE: After replacing the material in these scrubbers it can take up to 48 hours for the material to dry out before the 701X is functioning optimally.

K.5.1.2 Replacing the NO-NO_2 (Purafil) Scrubber

This procedure is identical to the charcoal scrubber replacement procedure (above) except that the canister should be refilled with Purafil.

NOTE: After replacing the material in these scrubbers it can take up to 48 hours for the material to dry out before the 701X is functioning optimally.

K.5.1.3 Replacing the CO Scrubber

The CO scrubber is attached to the HC scrubber housing. This is not a heated scrubber. It is secured with four screws through the body of the scrubber into the bracket.

1. Turn off power and unplug the 701X.
   CAUTION: THE SCRUBBER WILL BE HOT.
2. With a wrench, remove the inlet and outlet tubing and the two unions from the top of the scrubber cartridge.
3. Remove the four screws to remove the scrubber.
4. Pick out the retaining screens.
5. Shake out the catalyst beads and dispose. No special disposal methods required.
6. Pour in new catalyst to 1/2" from the top of the bores. Tap the cartridge sides gently to settle the beads and top up to the 1/2" level.
7. Replace the retainer screens.
8. Replace the TFE tape on the two unions and replace the unions in the cartridge.
9. Reassemble the scrubber, replace it in the chassis and reconnect the tubing and receptacle.
20. Turn on the 701X and leak check using soap solution.

K.5.2 Replacing the Particulate Filter Element

Replace the particulate filter located at the "Air In" inlet on the rear panel (refer to Figure 4) as follows:

1. Remove the particulate filter cap by turning it counter-clockwise.
2. Remove the old filter element and replace with a new filter element (Teledyne API P/N FL16).
3. Replace the particulate filter cap and turn it clockwise to secure in place.

K.5.3 Solenoid Valve Maintenance

Annual cleaning and greasing for Parker air solenoid valve (Part # P2E-KV31F) (Figure 5).

1. Disconnect power from unit.
2. Remove power wiring from circuit board.
3. Remove valve from Zero Air generator.
4. Dismantle valve and use Kim wipes and cotton swabs to clean old Parker lube grease from piston and cylinder walls.
5. Apply a small amount of Parker O-Lube to the piston O-rings and reassemble.
6. Install valve back into Zero Air and test for operation.
7. Perform a leak test by using a metal cap and plugging the output on the back of the generator. Generator should hold air once it reaches the set value on the front gauge.

Figure 4 Rear Panel with Particulate Filter Location

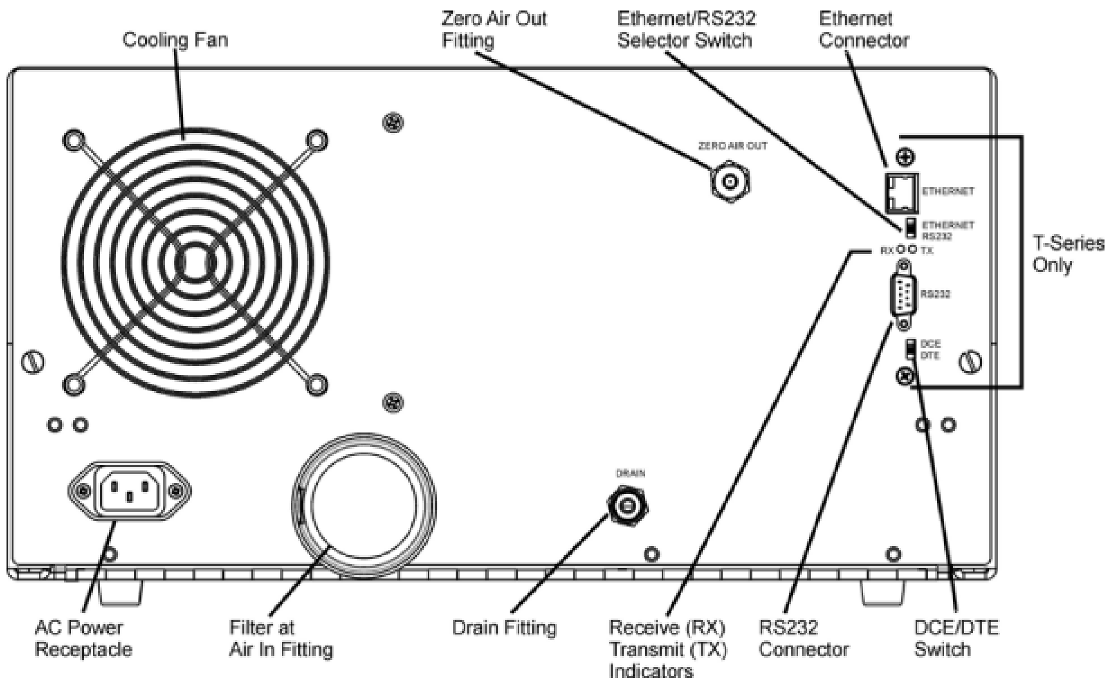

Figure 5 Solenoid Valve

K.6 Troubleshooting

See the TAPI Model 701/701H Zero Air Generator Instruction Manual for troubleshooting guides.

Appendix LL: Teledyne Dilution Calibrators

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ____

Title of Author: ____

Signature: ______________________________ Date: ______________

Name: ____

Title: ____

Signature: ______________________________ Date: ______________

Name: ____

Title: ____

Signature: ______________________________ Date: ______________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:___________________________Date:____________

Name: ____

Title: ____

Signature:___________________________Date:____________

Name: ____

Title: ____

Signature:___________________________Date:____________

Name: ____

Title: ____

Signature:___________________________Date:____________

Name: ____

Title: ____

Signature:___________________________Date:____________

Acronyms and Abbreviations

AC	Alternating Current
b	Intercept
ccm	Cubic Centimeters per Minute
CO	Carbon Monoxide
CPU	Central Processing Unit
EPA	Environmental Protection Agency
GPT	Gas Phase Titration
LPM	Liters per Minute
m	Slope
MFC	Mass Flow Controller
NIST	National Institute of Standards and Technology
NO	Nitric Oxide
NO2	Nitrogen Dioxide
O2	Oxygen
O3	Ozone
ppb	Parts per Billion
ppm	Parts per Million
ppt	Parts per Thousand
PSI	Pounds per Square Inch
RSD	Relative Standard Deviation
sccm	Standard Cubic Centimeters per Minute
SD	Standard Deviation
SLPM	Standard Liters per Minute
SO2	Sulfur Dioxide
SRM	Standard Reference Materials
UV	Ultra-violet

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LL.1 Introduction

The Model T700, T700U, and T750U are microprocessor-controlled calibrators for precision gas calibration. Using a combination of highly accurate mass flow controllers and compressed sources of standard gases, calibration standards are provided for multipoint, span, and zero checks. Up to four gas sources may be used.

The calibrator can be equipped with an optional built-in, programmable ozone generator for accurate, dependable ozone calibrations. The calibrator also produces NO2 when blended with NO gas in the internal GPT chamber. A multi-point linearization curve is used to control the generator to assure repeatable ozone concentrations. An optional photometer allows precise control of the ozone generator, both during calibrations and during Gas Phase Titrations (GPT). To ensure accurate NO2 output, the calibrator with photometer option measures the ozone concentration prior to doing a GPT.

As many as 50 independent calibration sequences may be programmed into the calibrator, covering time periods of up to one year. The setup of sequences is simple and intuitive. These sequences may be actuated manually, automatically, or by a remote signal. The sequences may be uploaded remotely, including remote editing. All programs are maintained in non-volatile memory.

The calibrator design emphasizes fast response, repeatability, overall accuracy and ease of operation. It may be combined with the Model 701 Zero Air Generator to provide the ultimate in easy-to-use, precise calibration for your gas calibrators.

LL.2 Principles of Operation

LL.2.1 Dynamic Dilution Calibration

The calibrator generates calibration gas mixtures by mixing bottled source gases of known concentrations with a diluent gas (zero air). Using several Mass Flow Controllers (MFCs) the calibrator creates exact ratios of diluent and source gas by controlling the relative rates of flow of the various gases, under conditions where the temperature and pressure of the gases being mixed is known (and therefore the density of the gases). The CPU calculates both the required source gas and diluent gas flow rates and controls the corresponding mass flow controllers by the following equation:

$$C_f = C_i * (Gas_{flow} / Total_{flow})$$

WHERE:
C_f = final concentration of diluted gas
C_i = source gas concentration
GAS_{flow} = source gas flow rate
$Total_{flow}$ = the total gas flow through the calibrator

$Total_{flow}$ is determined as:

$Total_{flow} = GAS_{flow} + Diluent_{flow}$
WHERE:
GAS_{flow} = source gas flow rate
$Diluent_{flow}$ = zero air flow rate

This dilution process is dynamic. The calibrator's CPU not only keeps track of the temperature and pressure of the various gases, but also receives data on actual flow rates of the various MFCs in real time so the flow rate control can be constantly adjusted to maintain a stable output concentration. The calibrator's level of control is so precise that bottles of mixed gases can be used as source gas. Once the exact concentrations of all of the gases in the bottle are programmed into the calibrator, it will create an exact output concentration of any of the gases in the bottle.

LL.2.2 Ozone Generator Operation

Ozone is a naturally occurring substance that is sometimes called "activated oxygen". It contains three atoms of oxygen (O3) instead of the usual two found in normal oxygen (O2) that is essential for life. Because of its relatively short half-life, ozone cannot be bottled and stored for later use and therefore must always be generated on-site by an ozone generator. The UV-light method is most feasible in calibration applications where production of low, accurate concentrations of ozone desired. This method mimics the radiation method that occurs naturally from the sun in the upper atmosphere producing the ozone layer. An ultra-violet lamp inside the generator emits a precise wavelength of UV Light (185 nm). Ambient air is passed over an ultraviolet lamp, which splits some of the molecular oxygen (O2) in the gas into individual oxygen atoms that attach to other existing oxygen molecules (O2), forming ozone (O3).

LL.2.3 Photometer Operation

The calibrator's optional photometer determines the concentration of Ozone (O3) in a sample gas drawn through it. Sample and calibration gases must be supplied at ambient atmospheric pressure in order to establish a stable gas flow through the absorption tube where the gas' ability to absorb ultraviolet (UV) radiation of a certain wavelength (in this case 254 nm) is measured. Gas bearing O3 and zero air are alternately routed through the photometer's absorption tube. Measurements of the UV light passing through the sample gas with and without O3 present are made and recorded. Calibration of the photometer is performed in software and does not require physical adjustment. During calibration, the CPU's microprocessor measures the current state of the UV Sensor output and various other physical parameters of the calibrator and stores them in memory. The CPU uses these calibration values, the UV absorption measurements made on the sample gas in the absorption tube along with data regarding the current temperature and pressure of the gas to calculate a final O3 concentration.

LL.3. Precautions

1. Operating the instrument at an incorrect line voltage will damage the instrument and void the manufacturer's warranty. Check the line voltage before you plug the instrument into any power source.
2. The standard supplied 115 volt power cord should be plugged into the rear panel power entry module of the instrument; the other end should then be plugged into a properly grounded outlet.
3. Before connecting or disconnecting any cables, wiring harnesses or other sources of potential electrical impulse, be sure the unit is powered OFF.
4. The main power disconnect for the unit shall be the power cord that is plugged into the rear of the unit. The instrument is totally enclosed at all times with a top and bottom cover for safety.

LL.4. Instrument Installation

LL.4.1 Electrical Connections

Attach the power cord to the calibrator and plug it into a power outlet capable of carrying at least 10A current at your AC voltage and that it is equipped with a functioning earth ground.

LL.4.2 Pneumatic Connections

Note that each time the pneumatic configuration is changed for any purpose, a backpressure compensation calibration must be performed (see Section LL.6.4).

LL.4.2.1 About Diluent Gas (Zero Air)

Zero Air is similar in chemical composition to the Earth's atmosphere but scrubbed of all components that might affect the calibrator's readings.

- Diluent Air should be dry (approximately -20ºC of Dew Point).
- Diluent Air should be supplied at a gas pressure of between 25 PSI and 35 PSI with a flow greater than the flow rate for the calibrator. For the standard unit this means greater than 10 SLPM.
- For calibrators with the 20 LPM diluent flow option (OPT) the diluent air should be supplied at a gas pressure of between 30 PSI and 35 PSI.
- Calibrators with optional O3 generators installed require that the zero air source supply gas flowing at a continuous rate of at least 100 ccm.
- If the calibrator is also equipped with an internal photometer, the zero air source supply gas must be capable of a continuous rate of flow of at least 1.1 LPM.

Zero Air can be purchased in pressurized cylinders or created using a Teledyne API's Model 701 Zero Air Generator (See Appendix K).

LL.4.2.1.1 Connecting Diluent Gas to the Calibrator

1. Attach the zero air source line to the port labeled Diluent In (See Figure 1).
2. Use the fittings provided with the calibrator to connect the zero air source line.

- First, finger tighten.
- Then using the properly sized wrench, make an additional 1 and 1/4 turn.

LL.4.2.2 Calibration Gas

Calibration gas is a gas specifically mixed to match the chemical composition of the type of gas being measured at near full scale of the desired measurement range. Usually it is a single gas type mixed with N2 although bottles containing multiple mixtures of compatible gases are also available.

- Calibration gas should be supplied at a pressure of between 25 PSI and 35 PSI with a flow greater than the flow rate for the calibrator.
- All calibration gases should be verified against standards of the National Institute for Standards and Technology (NIST). To ensure NIST traceability, we recommend acquiring cylinders of working gas that are certified to be traceable to NIST Standard Reference Materials (SRM). These are available from a variety of commercial sources.

LL.4.2.2.1 Connecting Calibration Source Gas to the Calibrator

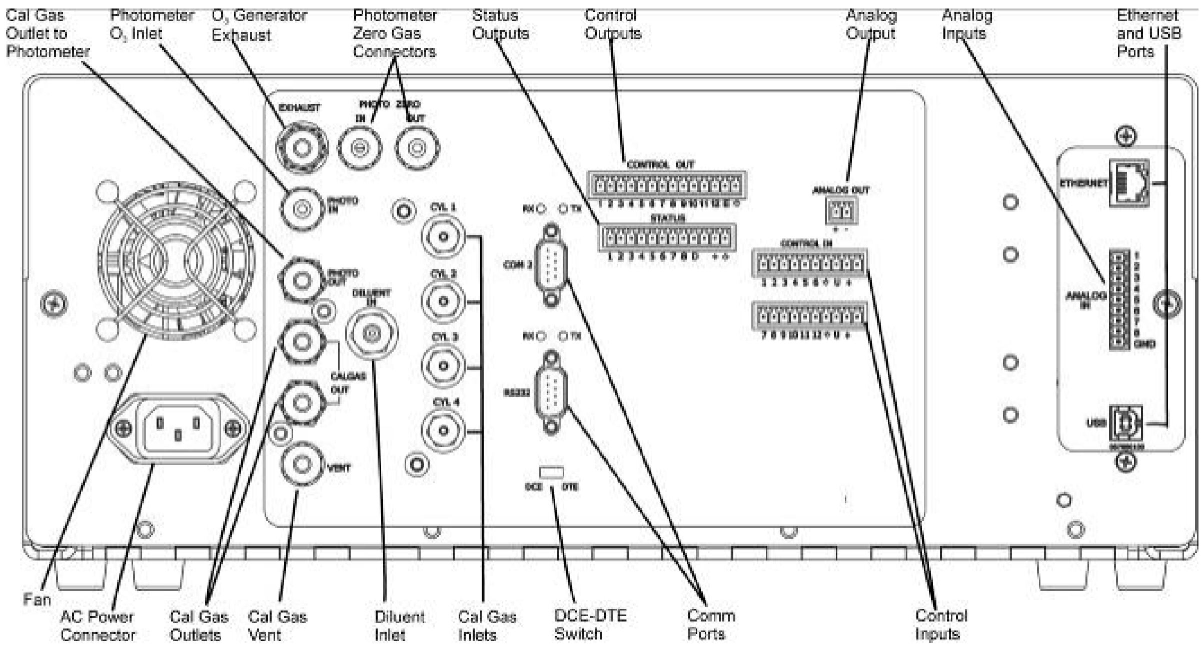
Connect the source gas line(s) to the ports labeled CYL 1 through CYL 4 on the back of the calibrator (see Figure 1).

- Source gas delivery pressure should be regulated between 25 PSI to 30 PSI.
- Use FEP tubing with a 1/4 inch outer diameter.

LL.4.2.3 Connecting Gas Outputs from the Calibrator

1. Attach the 1/4 inch FEP station calibration manifold line to one of the ports labeled CALGAS OUT using a stainless steel compression fitting (see Figure 1).
2. The other CALGAS OUT port and the VENT port should be plugged with a 1/4 inch brass cap. The excess gas will be vented through the sample inlet at the top of the sample manifold, outside the shelter.
3. The PHOTO IN and PHOTO OUT ports should be connected to themselves, using a short piece of 1/4 inch FEP tubing.
4. The PHOTO ZERO IN and OUT ports should be connected to themselves, using a short piece of 1/4 inch FEP tubing.
5. The EXHAUST port should be vented outside the shelter, to atmospheric pressure using a maximum of 10 meters of 1/4 inch tubing.

Figure 1 T700 Rear Panel Layout



LL.4.3 Start Up

After the electrical and pneumatic connections are made, an initial functional check is in order. Turn on the instrument. The exhaust fan (and pump if photometer option installed) should start immediately. The front panel display will show a splash screen and other information during the initialization process while the CPU loads the operating system, the firmware and the configuration data.

The calibrator should automatically switch to STANDBY mode after completing the brief boot-up sequence. However, the calibrator requires a minimum of 30 minutes for all of its internal components to reach a stable operating temperature. During the warm-up period, the front panel display may show messages in the Parameters field.

LL.4.3.1 Functional Checks

After the calibrator's components have warmed up for at least 30 minutes, verify that the software properly supports any hardware options that are installed.

Check to ensure that the calibrator is functioning within allowable operating parameters. Figure 2 includes a list of test functions viewable from the calibrator's front panel as well as their expected values. These functions are also useful tools for diagnosing problems with your calibrator. To view the current values of these parameters, press the <TST TST> buttons on the calibrator's front panel. Remember that until the unit has completed its warm-up, these parameters may not have stabilized.

Figure 2 T700 Final Calibrated Test and Validation Data

TELEDYNE
ADVANCED POLLUTION INSTRUMENTATION
A Teledyne Technologies Company

T700 Final Calibrated Test and Validation Data

@ 6/27

Model:	**T700**				
Firmware:	T700 1.1.0 bld 84	**Serial Number:**	744	**Sales Order:**	065778
Date:	6/27/2013	**Technician:**	DNG	**SP#:**	

Parameter	Displayed As	Observed Value	Units	Final Test Process Control Limits at Factory**	Acceptable Limits in Use
Act Cal Gas [3]	ACT CAL	0.0162	LPM	± 1% of TARG CAL	± 1% of TARG CAL
Target Cal Gas [3]	TARG CAL	0.0162	LPM		
Act Dilution [3]	ACT DIL	1.9901	LPM	± 1% of TARG DIL	± 1% of TARG DIL
Target Dilution [3]	TARG DIL	1.9838	LPM		
O3 Gen Ref [1,3]	O3 GEN REF	93	mVDC	25 - 600 mV	25 - 600 mV
O3 Flow [1,3]	O3 FLOW	0.115	LPM	0.100 - 0.200 LPM	0.100 - 0.200 LPM
O3 Gen Drive [1,3]	O3 GEN DRIVE	800	mVDC	800 mV	800 mV
Ozone Lamp Temp	O3 LAMP TEMP	48	°C	48 ± 0.5 °C	48 ± 0.5 °C
Cal Pressure	CAL PRESSURE	30	PSIG	25 - 35 PSIG	25 - 35 PSIG
Dilution Pressure	DIL PRESSURE	30	PSIG	25 - 35 PSIG	25 - 35 PSIG
Regulator Pressure	REG PRESSURE	20	PSIG	20 ± 1.0 PSIG	20 ± 1.0 PSIG
ACT NO Conc [3]	ACT=	798	PPB	± 1% of TARG=	± 1% of TARG=
Target NO Conc [3]	TARG=	800	PPB		
Box Temp	BOX TEMP	32.9	°C	20 - 35 °C	8 - 48 °C
Photo Measure [1,3]	PHOTO MEASURE	4465	mVDC	4400 - 4600 mV	2500 - 4800 mV
Photo Reference [1,3]	PHOTO REFERENCE	4465	mVDC	4400 - 4600 mV	
Photo Flow [2]	PHOTO FLOW	0.777	LPM	0.720 - 0.880 LPM	
Photo Lamp Temp	PHOTO LAMP TEMP	58	°C	58 ± 0.5 °C	58 ± 0.5 °C
Photo Sam Press [1,3]	PHOTO SPRESS	29.6	In-Hg-A	27 - 29.9 In-Hg-A	24 - 30 In-Hg-A
Photo Sample Temp	PHOTO STEMP	42.5	°C	28 - 45 °C	28 - 45 °C
Photo Slope	PHOTO SLOPE	1.008	-	1 ± 0.03	1 ± 0.03
Photo Offset	PHOTO OFFSET	0.5	PPB	0 ± 3 PPB	0 ± 3 PPB
Dark Offset	DARK OFFSET	1	mVDC	0 ±20mV	0 ±20mV
Perm Tube Flow	PERM FLOW		LPM	0.100 - 0.200 LPM	0.100 - 0.200 LPM
Perm Tube Temp	PERM TEMP		°C	50 ± 0.3 °C	50 ± 0.3 °C

** For good instrument performance, the steadiness of this signal is more important than its absolute value (within the operating range)*
*** These are process control limits, and not specification limits. Items out of range do not imply the unit is out of specification.*

Statement of Calibration
The unit identified above has been tested with NIST measuring and test equipment using lot traceable materials. The testing is performed in accordance with ISO 9001-2008 and is traceable to NIST and industry recognized standards.

[1] Recorded in Standby Mode, [2] Recorded in Generate O3 mode, [3] Recorded in Generate NO mode

05731H (DCN 5940) 12/20/2010 1 of 2

LL.4.3.2 Setting up the Calibration Gas Inlet Ports

The calibrator generates calibration gases of various concentrations by precisely mixing component gases of known concentrations with diluent (zero air). When the instrument is equipped with the optional O3 generator and photometer, it can also use the gas phase titration method for generating very precise concentrations of NO2.

In either case, it is necessary to program the concentrations of the component gases being used into the calibrator's memory.

To program the calibrator's source gas input ports for a single gas cylinder, press:

1. SETUP>GAS>CYL>PRT1>EDIT>NONE. Continue pressing the NONE button until the desired gas type is reached (ex, CO, SO2, or NO).
2. Toggle the concentration buttons to match the concentration in the cylinder.
3. Toggle the units of measure button to match the cylinder concentration units (ex, PPM or PPT).
4. ENTR accepts the new gas name, EXIT discards it.

To program the calibrator's source gas input ports for multiple gas cylinders, press:

1. Follow instructions above, then press ADD after selecting PRT1.
2. Follow instructions above to add desired gas type and gas concentration.
3. Repeat until all gases and concentrations in the cylinder are entered.

LL.4.3.3 Selecting an Operating Mode for the Ozone Generator

The O3 concentration control loop will use the photometer's O3 measurement as input. To select this as the default O3 generator mode, press:

1. SETUP>GAS>O3>MODE>BNCH (Bench).
2. ENTR accepts the new setting, EXIT discards it.

LL.4.3.4 Setting the Total Gas Flow Rate

The default total gas flow rate for the calibrator is 2 LPM. The calibrator uses this flow rate, along with the concentrations programmed into the calibrator for the component gas cylinders during set up, to compute individual flow rates for both diluent gas and calibration source gases in order to produce calibration mixtures that match the desired output concentrations.

This Total Flow rate may be changed to fit the users' application. Once the flow is changed, then the new flow value becomes the total flow for all the gas concentration generated and computes again the individual flow rates of the component gases and diluent accordingly.

NOTE:

- The minimum total flow should equal 150% of the flow requirements of all of the instruments to which the calibrator will be supplying calibration gas.
- When calculating total required flow for calibrators with O3 photometers installed, ensure to account for the 800 ccm flow it requires.

- Example: If the calibrator is will be expected to supply calibration gas mixtures simultaneously to a system in composed of three analyzers each requiring 2 LPM , and the calibrator will be running the O3 photometer, the proper Total Flow output should be set at:

$$(2 + 2 + 2 + 0.8) \times 1.5 = 10.2 \text{ LPM}$$

To set the total flow of the calibrator, press:

1. SETUP>MORE>FLOW>TARG.
2. Toggle the flow buttons to change the target total flow rate.
3. ENTR accepts the new target flow rate, EXIT discards it.

LL.5 Basic Operation

LL.5.1 Standby Mode

When the calibrator is in standby mode, it is at rest. All internal valves are closed except the diluent inlet valve. The mass flow controllers are turned off. On units with O3 generator and photometer options installed, these subsystems are inactive.

NOTE: The calibrator should always be placed in STANDBY mode when not needed to produce calibration gas. The last step of any calibration sequences should always be the STANDBY instruction.

LL.5.2 Generate Mode

The Generate Mode allows the user to generate the desired calibration gas mixtures. The types of gas include NO, NO2, SO2, CO, or ZERO gas based on the source gas concentration entered during initial setup. If the unit has an optional O3 generator installed, various concentrations of O3 can be generated as well.

LL.5.2.1 GENERATE>AUTO (Basic Generation of Calibration Mixtures)

This is the simplest procedure for generating calibration gas mixtures. In this mode, the user makes three choices:

- The type of component gas to be used from the list of gases input during initial set up.
- The target concentration.
- The TOTAL FLOW to be output by the calibrator.

Using this information, the calibrator automatically calculates and sets the individual flow rates for the Diluent and chosen component gases to create the desired calibration mixture.

To use the GENERATE>AUTO feature:

1. Make sure the calibrator is in STANDBY mode.
2. Press GEN>AUTO>ZERO. Continue pressing ZERO to scroll through the available gas types, as programmed in the initial setup (ex, CO, O3, SO2, or NO).

3. Toggle the units of measure button to set the unit of measure to be used (ex, PPM or PPB).
4. Toggle concentration buttons to set the target concentration.
5. ENTR accepts the new gas type and target concentration, EXIT discards it.
6. Toggle the flow buttons to set the total flow (see Section LL.4.3.4 regarding total flow).
7. ENTR accepts the flow rate and begins generating gas, EXIT discards it.
8. Press STANDBY to cancel GENERATE>AUTO mode.

LL.5.3.2 GENERATE>GPT (Performing a Gas Phase Titration)

To initiate GPT gas generation you will need to know:
- The TOTAL GAS FLOW for the mixture output.
- The Target O3 concentration (equal to the target NO2 concentration to be generated).
- The NO source gas concentration.

Then press:
1. GEN>GPT
2. Toggle the concentration buttons to set the target NO concentration.
3. ENTR accepts the new concentration, EXIT discards it.
4. Toggle the concentration buttons to set the O3 concentration (equal to the NO2 concentration to be generated).
5. ENTR accepts the new concentration, EXIT discards it.
6. Toggle the flow buttons to set the total flow (see Section LL.4.3.4 regarding total flow).
7. ENTR accepts the flow rate and begins generating the GPT, EXIT discards it.
8. Press STANDBY to cancel GENERATE>GPT mode.

LL.6 Calibration and Verification

LL.6.1 Calibrating MFC Output

NOTE: Before completing a MFC calibration, the calibrator must first pass an auto leak check. See Section LL.7.1 for procedures on completing a leak check, and record leak check results on MFC Certification Worksheet (Figure 4).

Equipment needed:
- NIST traceable MFC flow meter.
- MFC Certification Worksheet (Figure 4)
- Zero Air Generator

Each of the MFC's in each of the calibrators will need to be recertified and recalibrated annually.
1. Open the front panel of the calibrator. This is the easiest access to the MFC output ports.
2. Attach the flow meter directly to the output port of the MFC to be checked/tested (See Figure 3).
3. If calibrating the DIL1 MFC, ensure that a source of zero air is connected to the DILUENT IN port on the back panel of the calibrator and set to 30 PSI. If calibrating the

CAL1 or CAL2 MFC, the source of zero air will be connected to the CYL1 port (See Figure 1).

4. Press SETUP>MORE>DIAG>929>ENTR>NEXT. Continue pressing NEXT until MFC CONFIGURATION.
5. Press ENTR. Toggle <SET SET> buttons to choose a MFC to calibrate (ex, DIL1, CAL1, or CAL2).
6. Press EDIT. Press OFF to toggle the flow to ON.
7. Record Point #0 (0 mV Drive Voltage, 0 LPM) from the flow meter in the “Meas. Flow” column on the MFC worksheet (Figure 4).
8. Press the FLOW button. Toggle the flow buttons to match the value recorded from the flow meter. Press ENTR to accept new setting, EXIT to discard it.
9. Press the NEXT button to scroll to the next calibration point. Wait until the flow registers on the flow meter. After the flow registers on the flow meter, wait at least 2 minutes for the flow to stabilize before recording the flow on the MFC worksheet.
10. Press the FLOW button. Toggle the flow buttons to match the value recorded from the flow meter. Press ENTR to accept new setting, EXIT to discard it.
11. Repeat steps 9 and 10 for the rest of the 20 points programmed into the MFC calibration table.
12. Press EXIT. Pressing YES saves all changes made, NO ignores all changes made. CANC ignores all changes made and returns to last cal point displayed.
13. Check the linear regression equation calculated on the MFC worksheet to ensure that the MFC output is linear, with a correlation (R^2) of at least four nines (ex, 0.99998).
14. Save MFC worksheet and print two copies, one for the calibrator’s traceability folder, and one for the senior air quality specialist to file in the calibrator traceability binder.
15. Repeat steps 1 – 14 for each of the MFCs in the calibrator.

Figure 3 Location of MFC Outlet Ports

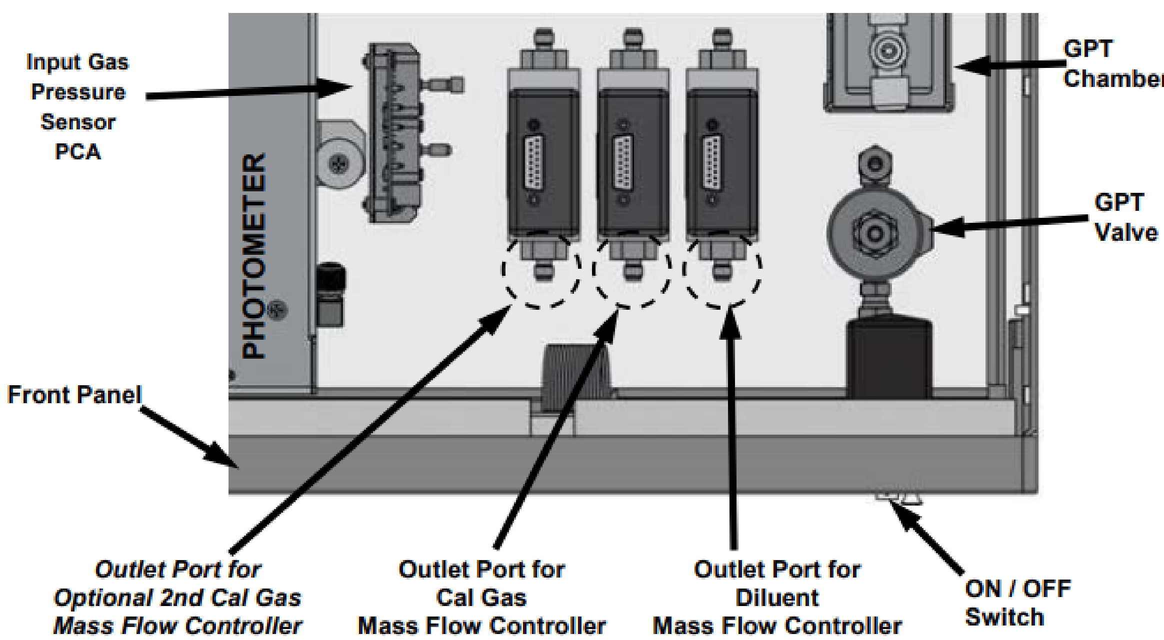


Figure 4 Example MFC Certification Worksheet

Washoe County Health District - Air Quality Management Division
Mass Flow Controller Certification

Date: 01/23/19
Operator: CAP

Multi-Gas Calibrator: TAPI
Model: T700
S/N: 2926
Site: Spanish Springs

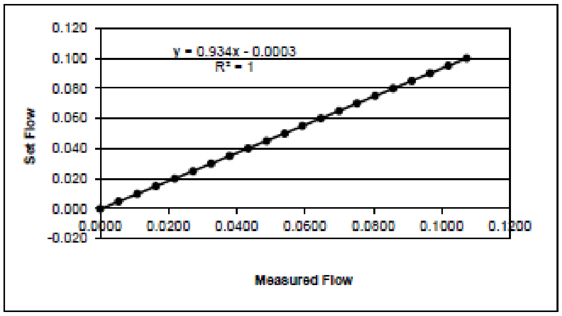
Primary Flow Device: Alicat
Model: MB-100SCCM-D
S/N: 156312

MFC #: CAL1
MFC Range: 100 ccm

Pre-Cert. Leak Test:
Starting PSI: 31.2
Ending PSI: 31.1
[1]Difference: 0.1 PSI

Last Certification: 01/18/18

Point #	Drive Voltage (mV)	Set Flow (LPM)	[2]Meas. Flow (std. ccm)	**[3]Meas. Flow (std. LPM)**
0	000	0.000	0.0	**0.0000**
1	250	0.005	5.4	**0.0054**
2	500	0.010	10.9	**0.0109**
3	750	0.015	16.3	**0.0163**
4	1000	0.020	21.8	**0.0218**
5	1250	0.025	27.2	**0.0272**
6	1500	0.030	32.5	**0.0325**
7	1750	0.035	37.9	**0.0379**
8	2000	0.040	43.3	**0.0433**
9	2250	0.045	48.7	**0.0487**
10	2500	0.050	54.0	**0.0540**
11	2750	0.055	59.2	**0.0592**
12	3000	0.060	64.6	**0.0646**
13	3250	0.065	69.9	**0.0699**
14	3500	0.070	75.2	**0.0752**
15	3750	0.075	80.5	**0.0805**
16	4000	0.080	85.8	**0.0858**
17	4250	0.085	91.2	**0.0912**
18	4500	0.090	96.6	**0.0966**
19	4750	0.095	101.9	**0.1019**
20	5000	0.100	107.3	**0.1073**



Notes:
1. Leak Test must be <2.0 PSI to pass.
2. Wait a minimum of 2 minutes between points for MFC to reach stability.

Comments:

File Name: 20190123 sn 2926 mfc CAL1
Last Revision: 01/18/18

LL.6.2 Ozone Photometer Verification

LL.6.2.1 Ozone Transfer Standard Initial 6x6 Verification

Prior to use, an ozone transfer standard must be verified by establishing a quantitative verification relationship between the transfer standard (calibrator) and the primary ozone standard. The verification shall consist of the average of 6 individual comparisons of the transfer standard to the primary ozone standard. Each comparison must be carried out on a different day.

To verify initial performance of the calibrator's internal photometer, perform the following steps:

1. Set up the calibrator to be tested and connect to the primary ozone standard and repair room zero air generator as shown in Figure 5.
2. Make sure the calibrator is in STANDBY mode.
3. Press GEN>AUTO>ZERO. Continue pressing ZERO key until O3 appears.
4. Toggle concentration buttons until they read 450.
5. Toggle units of measure button until it reads PPB. Press ENTR.
6. Toggle flow buttons until they read 5.0 LPM. Press ENTR.
7. Press <TST TST> keys on the primary O3 standard until STABIL is displayed.
8. Wait a minimum of 10 minutes and until the STABIL reading is <0.5 ppb.
9. Record the actual concentration from the calibrator display and the primary O3 concentration on the Photometer Verification Worksheet (Figure 7).
10. Repeat steps 3 – 9 above for the following points:
    - 350 ppb O3
    - 250 ppb O3
    - 150 ppb O3
    - 50 ppb O3
    - 0 ppb O3
11. All points must be within +/- 4 ppb or 4%, whichever is greater, to meet qualification.
12. This process must be repeated 6 times on 6 different days.
13. Ensure that the calculated relative standard deviation (RSD) of the 6 slopes is ≤ 3.7%.
14. Ensure that the calculated standard deviation (SD) of the 6 intercepts is ≤ 1.5 ppb.

Figure 5 Ozone Photometer Verification Set-up

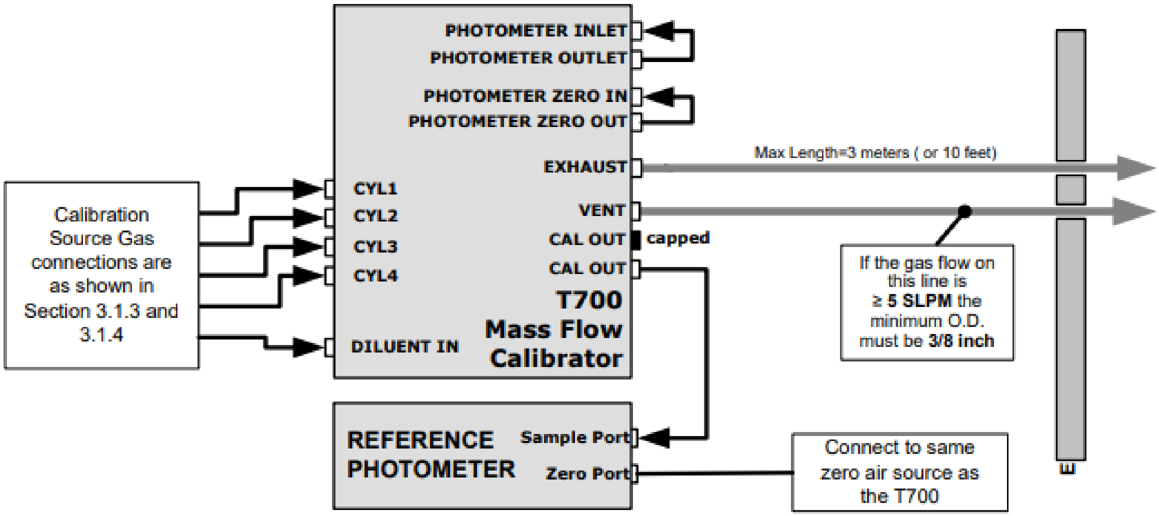


Figure 6 Example Ozone Transfer Standard Initial 6x6 Verification Worksheet

Washoe County Health District - Air Quality Management Division
Ozone Transfer Standard

Initial (6x6) Verification X **Reverification** ____

Transfer		Primary	
Manufacturer:	TAPI	Manufacturer:	TAPI
Model:	T700U	Model:	T400
Serial Number:	152	Serial Number:	1397
Site:	Reno 3		

Test (#)	Date (mm/dd/yy)	Set Point (ppb)	Transfer Standard (ppb)	Primary Standard (ppb)	Difference[1] (ppb)	Difference[1] (%)	Slope (m)	Intercept (b)
1	05/31/18	450	450	451	-1	-0.2		
		350	350	350	0	0.0		
		250	250	250	0	0.0		
		150	150	151	-1	-0.7		
		50	50	51	-1	-2.0		
		0	0	0	0	---	1.00016	0.47
2	06/04/18	450	450	449	1	0.2		
		350	350	349	1	0.3		
		250	249	249	0	0.0		
		150	149	150	-1	-0.7		
		50	50	51	-1	-2.0		
		0	0	0	0	---	0.99605	0.82
3	06/05/18	450	450	450	0	0.0		
		350	350	350	0	0.0		
		250	250	250	0	0.0		
		150	150	150	0	0.0		
		50	50	50	0	0.0		
		0	0	0	0	---	1.00000	0.00
4	06/06/18	450	450	452	-2	-0.4		
		350	351	351	0	0.0		
		250	250	250	0	0.0		
		150	150	152	-2	-1.3		
		50	50	51	-1	-2.0		
		0	0	0	0	---	1.00136	0.55
5	06/07/18	450	450	450	0	0.0		
		350	350	350	0	0.0		
		250	250	250	0	0.0		
		150	150	150	0	0.0		
		50	50	50	0	0.0		
		0	0	0	0	---	1.00000	0.00
6	06/08/18	450	450	450	0	0.0		
		350	350	350	0	0.0		
		250	250	250	0	0.0		
		150	150	151	-1	-0.7		
		50	50	50	0	0.0		
		0	0	0	0	---	0.99962	0.25

	m	b	Pass[2,3,4]	Fail[2,3,4]
Average:	0.99953	0.35	---	---
Previous Average:	0.99953	0.35	---	---
Difference (m):	0.00	---	X	
RSD (m):	0.18%	---	X	
Std. Dev. (b):	---	0.33	X	

Comments: ____

Acceptance Criteria:

1. Qualification: +/- 4% or +/- 4 ppb (whichever greater).
2. Average slope must be +/- 0.05 of previous average slope.
3. Relative Standard Deviation (RSD) of six slopes (m) must be ≤ 3.7%.
4. Standard Deviation of six intercepts (b) must be ≤ 1.5.

File Name: 20180608_T700U_152
Last Revision: 06/02/16

LL.6.2.2 Ozone Transfer Standard Reverification

To maintain continuous verification, an ozone transfer standard must be recertified at least every 6 months. At the time of reverification, a comparison of the transfer standard to the primary ozone standard is completed.

To reverify performance of the calibrator's internal photometer, perform the following steps:

1. Set up the calibrator to be tested and connect to the primary ozone standard and repair room zero air generator as shown in Figure 5.
2. Locate and open the Initial Photometer Verification Worksheet (Figure 6) or the most recent Photometer Reverification Worksheet (Figure 7) associated with the specific calibrator to be reverified.
3. Copy the "Previous Average" Slope (m) and "Previous Average" Intercept (b) to the "Average Slope" and "Average Intercept" cells on the reverification worksheet.
4. Move the 5 most recent averages on the reverification worksheet (Tests #2 – 6) to the top of the worksheet, making them Tests #1 – 5.
5. Clear the contents out of Test #6. The results of the reverification will be recorded there, making a running average of 6 comparisons.
6. Make sure the calibrator is in STANDBY mode.
7. Press GEN>AUTO>ZERO. Continue pressing ZERO key until O3 appears.
8. Toggle concentration buttons until they read 450.
9. Toggle units of measure button until it reads PPB. Press ENTR.
10. Toggle flow buttons until they read 5.0 LPM. Press ENTR.
11. Press <TST TST> keys on the primary O3 standard until STABIL is displayed.
12. Wait a minimum of 10 minutes and until the STABIL reading is <0.5 ppb.
13. Record the actual concentration from the calibrator display and the primary O3 concentration on the reverification worksheet.
14. Repeat steps 7 – 13 above for the following points:
    - 350 ppb O3
    - 250 ppb O3
    - 150 ppb O3
    - 50 ppb O3
    - 0 ppb O3
15. The average slope of the new comparison must be +/- 0.05 of the previous average slope.
16. All points must be within +/- 4 ppb or 4%, whichever is greater, to meet qualification.
17. Ensure that the calculated relative standard deviation (RSD) of the 6 slopes is ≤ 3.7%.
18. Ensure that the calculated standard deviation (SD) of the 6 intercepts is ≤ 1.5 ppb.

Figure 7 Example Ozone Transfer Standard Reverification Worksheet

Washoe County Health District - Air Quality Management Division
Ozone Transfer Standard

Initial (6x6) Verification ______ **Reverification** X

	Transfer		Primary
Manufacturer:	TAPI	Manufacturer:	TAPI
Model:	T700U	Model:	T400
Serial Number:	152	Serial Number:	1397
Site:	Reno 3		

Test (#)	Date (mm/dd/yy)	Set Point (ppb)	Transfer Standard (ppb)	Primary Standard (ppb)	Difference[1] (ppb)	Difference[1] (%)	Slope (m)	Intercept (b)
1	06/04/18	**450**	450	449	1	0.2		
		350	350	349	1	0.3		
		250	249	249	0	0.0		
		150	149	150	-1	-0.7		
		50	50	51	-1	-2.0		
		0	0	0	0	---	0.99605	0.82
2	06/05/18	**450**	450	450	0	0.0		
		350	350	350	0	0.0		
		250	250	250	0	0.0		
		150	150	150	0	0.0		
		50	50	50	0	0.0		
		0	0	0	0	---	1.00000	0.00
3	06/06/18	**450**	450	452	-2	-0.4		
		350	351	351	0	0.0		
		250	250	250	0	0.0		
		150	150	152	-2	-1.3		
		50	50	51	-1	-2.0		
		0	0	0	0	---	1.00136	0.55
4	06/07/18	**450**	450	450	0	0.0		
		350	350	350	0	0.0		
		250	250	250	0	0.0		
		150	150	150	0	0.0		
		50	50	50	0	0.0		
		0	0	0	0	---	1.00000	0.00
5	06/08/18	**450**	450	450	0	0.0		
		350	350	350	0	0.0		
		250	250	250	0	0.0		
		150	150	151	-1	-0.7		
		50	50	50	0	0.0		
		0	0	0	0	---	0.99962	0.25
6	01/16/19	**450**	450	448	2	0.4		
		350	350	349	1	0.3		
		250	250	249	1	0.4		
		150	150	149	1	0.7		
		50	50	49	1	2.0		
		0	0	1	-1	---	0.99567	0.07

	m	b	Pass[2,3,4]	Fail[2,3,4]
Average:	0.99878	0.28	---	---
Previous Average:	0.99953	0.35	---	---
Difference (m):	0.00	---	X	
RSD (m):	0.23%	---	X	
Std. Dev. (b):	---	0.34	X	

Comments: ______

Acceptance Criteria:

1. Qualification: +/- 4% or +/- 4 ppb (whichever greater).
2. Average slope must be +/- 0.05 of previous average slope.
3. Relative Standard Deviation (RSD) of six slopes (m) must be ≤ 3.7%.
4. Standard Deviation of six intercepts (b) must be ≤ 1.5.

File Name: 20190116_T700U_152_reverification
Last Revision: 06/02/16

LL.6.3 Photometer Calibration

LL.6.3.1 Photometer Zero Calibration

To set a zero point offset for the calibrator's photometer:

1. Press SETUP>GAS>O3>PHOT>BCAL>717>ENTR.
2. On the O3 PHOTOMETER BENCH CAL screen, press CAL>ZERO>ENTR.
3. Wait a minimum of 10 minutes, then press ZERO>ENTR.
4. Press YES to change offset, press NO to leave unchanged.

LL.6.3.2 Photometer Span Calibration

To set the response slope for the calibrator's photometer:

1. Press SETUP>GAS>O3>PHOT>BCAL>717>ENTR.
2. On the O3 PHOTOMETER BENCH CAL screen, press CAL>SPAN>ENTR.
3. Wait a minimum of 10 minutes, then press SPAN.
4. Toggle the concentration buttons to read 450 ppb. Press ENTR.
5. Press YES to change slope, press NO to leave slope unchanged.

LL.6.4 Ozone Photometer Backpressure Compensation

Any time there is a pneumatic configuration change, there is risk of impacting the internal measure/reference pressure. To compensate for this, a backpressure compensation calibration is required each time.

To run a backpressure compensation:

1. Set the calibrator to generate ozone at the flow rate intended for operation (see Section LL.5.2.1 for generating ozone):
2. Press SETUP>MORE>DIAG>818>ENTR.
3. Continue pressing NEXT until BACKPRESSURE COMPENSATION is displayed. Press ENTR.
4. The backpressure compensation will run automatically for approximately 10 to 15 minutes. Wait until display reads PASSED before exiting the menu.

LL.6.5 Ozone Generator Automatic Calibration

The calibrator's software includes a routine for automatically calibrating the O3 generator. A table of drive voltages stored in the calibrator's memory is the basis for this calibration.

To run the automatic ozone generator calibration program:

1. Make sure the calibrator is in STANDBY mode.
2. Press SETUP>MORE>DIAG>929>ENTR.
3. Continue pressing NEXT until O3 GEN CALIBRATION is displayed. Press ENTR.
4. Press CAL to begin the automatic calibration program. The program will run automatically for approximately 1 hour. Wait until the display reads O3 GEN CAL 100% COMPLETE before exiting the menu.

LL.7 Maintenance Procedures

LL.7.1 Auto Leak Check

Equipment required:

- Four (4) 1/4” Pneumatic Caps
- One (1) 1/8” Pneumatic Cap
- One (1) Pneumatic Tee Fitting

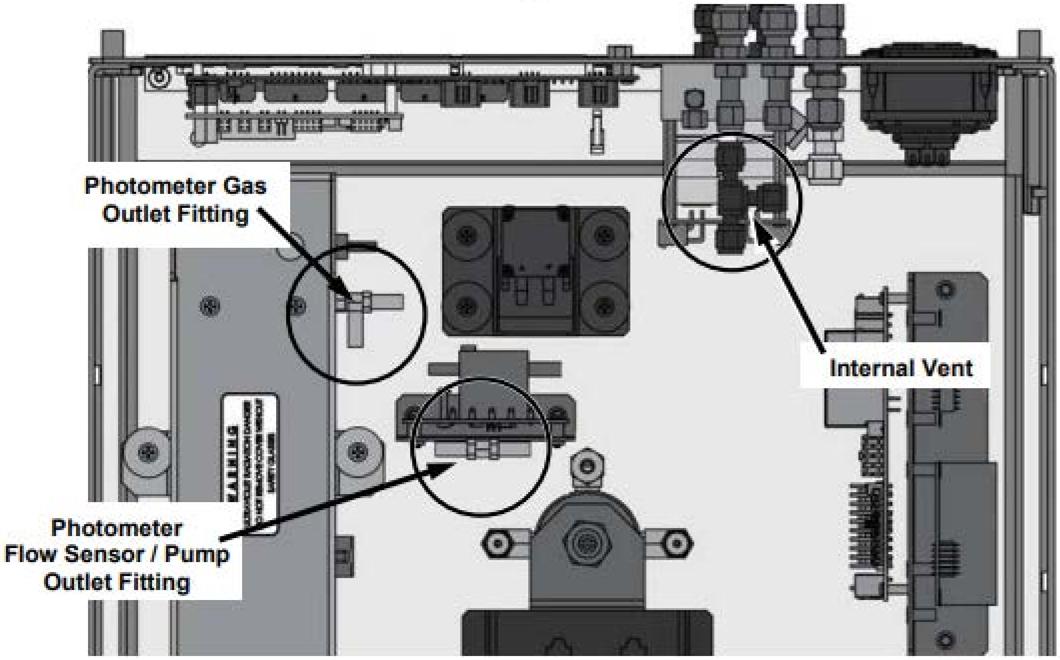
To perform an auto leak check on the calibrator, the photometer Flow/Pressure sensor board and photometer pump must be bypassed:

1. Remove the cover from the calibrator.
2. Remove the brass hexagonal nut located at the top of the photometer gas outlet (see Figure 8).
3. Remove the brass hexagonal nut located on the fitting on the back side of the Flow/Pressure sensor board (see Figure 8).
4. Connect the end of the line removed from the Flow/Pressure sensor board to the now vacant photometer gas outlet port.
5. Using a 1/8” cap, securely block the outlet of the internal vent located just behind the valve relay board (see Figure 8).
6. On the back panel of the calibrator, use 1/4" caps to block the EXHAUST port, both CAL GAS OUT ports, and the VENT port.
7. Use a 1/4” Tee to connect a line from the zero air generator to the CYL 1 port <u>and</u> the DILUENT IN port.

To perform an auto leak check:

1. Make sure the calibrator is in STANDBY mode.
2. Press SETUP>MORE>DIAG>929>ENTR.
3. Continue pressing NEXT until AUTO LEAK CHECK is displayed. Press ENTR. The test will run automatically.
4. At 17% of elapsed time, the program shuts the DILUENT IN an CYL 1 port valves and begins measuring the drop in internal gas pressure. At this time, record the displayed PSI reading in the “Starting PSI” cell on the MFC Certification Worksheet (Figure 4) and/or in the calibrator’s instrument log book.
5. The test will run for approximately 5 minutes.
6. After the test is complete, record the “Ending PSI” on the MFC Certification Worksheet and/or in the calibrator’s instrument logbook.
7. A drop of >2 PSI causes the test to FAIL.

Figure 8 Bypassing the Photometer Flow/Pressure Sensor Board and Pump



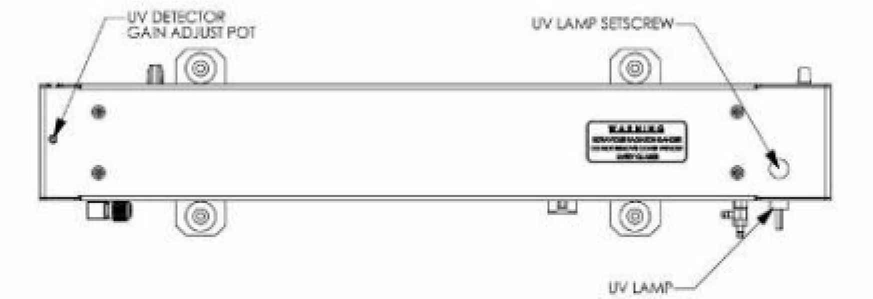
LL.7.2 UV Source Adjustment

This procedure should be done whenever the PHOTO REFERENCE test function value drops below 3000 mV.

1. Ensure that the calibrator is warmed-up and has been running for at least 30 minutes before proceeding.
2. Remove the cover from the calibrator.
3. Locate the UV detector gain adjust pot on the photometer assembly (see Figure 9).
4. Press SETUP>MORE>DIAG>929. Press ENTR.
5. SIGNAL I/O>ENTR.
6. Continue pressing NEXT until PHOTO_DET is displayed.
7. Using an insulated pot adjustment tool, turn the pot until the PHOTO_DET value is as close as possible to 4600 mV. If a minimum reading of 3500 mV cannot be reached, the lamp must be replaced.

NOTE: Additional adjustment can be made by physically rotating the UV lamp in its housing. To do this, slightly loosen the lamp setscrew and slowly rotate the lamp up to 1/4 turn in either direction while watching the PHOTO_DET signal. Retighten the lamp setscrew once the optimal position is determined.

Figure 9 Photometer Assembly



LL.8 Troubleshooting

See Section 9 of the Teledyne-API Model T700, T700U, or T751U Dynamic Dilution Calibrator Operation Manual for troubleshooting options specific to each calibrator.

Appendix M: Laboratory Procedures

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ____

Title of Author: ______________________________________

Signature: ___________________________ Date: _____________

Name: ____

Title: ____

Signature: ___________________________ Date: _____________

Name: ____

Title: ____

Signature: ___________________________ Date: _____________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Acronyms and Abbreviations

AQMD	Washoe County Air Quality Management Division
BP	Barometric Pressure
ºC	Degrees Celsius
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
ID	Identification
K	Kelvin
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter less than or equal to 2.5 microns in aerodynamic diameter
PM_{10}	Particulate Matter less than or equal to 10 microns in aerodynamic diameter
PM_{coarse}	PM_{10} minus $PM_{2.5}$
QA	Quality Assurance
QC	Quality Control
RH	Relative Humidity
SD	Standard Deviation
SOP	Standard Operating Procedures
µg	Micrograms

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M.1 Introduction

The purpose of this SOP is to describe the steps necessary to complete the analysis of all particulate matter filters collected from the AQMD monitoring network. The analysis of all filters complies with 40 CFR Part 50 Appendix L. The AQMD laboratory is maintained at 20-23°C +/- 2°C over 24 hours and Relative Humidity (RH) between 30-40% +/- 5% over 24 hours.

M.2 Teflon Filter Laboratory Procedures

M.2.1 Clean Filter Procedures

M.2.1.1 Filter Inspection

1. Obtain a lot of clean filters. The lots are used on a "first-in, first-out" basis. Each box of filters is labeled with the current year and an alphabet letter when the filter shipment arrives from EPA. Use the oldest filters first.
2. Prepare a batch (25) of Petri slides by writing the filter ID number corresponding to the lot chosen on the Petri slide.
3. Set-up the light table under the magnifying glass.
4. Remove a clean filter from the lot.
5. Inspect the filter under the magnifying glass for defections in the filter. Refer to the filter defection list posted on the hood in the laboratory for guidance on defective filters.
6. After passing inspection, place the filter in the Petri slide with the corresponding filter ID number. If a filter is determined to be defective, note this information in the Reject Filters/Comments section of the Teflon Filter Inspection/Conditioning Log (Figure 1).
7. Once all 25 filters have been inspected, place them in a pre-filter conditioning tray with the lids of the Petri slide open. Place the conditioning tray in the cabinet. Filters must be in the conditioning tray for at least three months.
8. Complete the information on the inspection log.
9. A new lab blank is selected from each new lot of filters received (approximately annually) and noted in the comments box on the Teflon Filter Inspection/Conditioning Log (Figure 1). "Lab Blank" is written on the Petri slide with a red permanent marker and it goes through the conditioning and pre-weighing process with the other filters in the lot. When initial weighing is completed, the new lab blank replaces the lab blank from the previous lot of filters.

Figure 1 Teflon Filter Inspection/Conditioning Log

Washoe County District Health Department
Air Quality Management Division

Teflon Filter Inspection/Conditioning Log

Conditioning Tray Number	Lot Number	Filter ID Number Ranges		Conditioning Start Date	Inspector Initials	Reject Filters/Comments
		From	To			

File Name: Filter Inspection Conditioning Log.xls
Reviewed: 03/19/2015

M.2.1.2 Pre Filter Weighing

1. Download Lab logger data and save to the monitoring network drive by following steps 4 and 5 in Section M.6.1 of this document.
2. Open the downloaded csv file and copy the date, time, model, serial number, temperature, and RH data for the 24 hours immediately prior to the filter weigh session. There will be 1440 1-minute readings for the 24-hour period.
3. Paste the copied data into the second tab of the PM Filter Weigh Log Excel workbook named “Temp and RH Calcs”. The spreadsheet will automatically calculate the mean temperature and RH and standard deviation (SD) of temperature and humidity.
4. Record the mean temperature and RH and the SD of temperature and humidity under the “Weigh Room Conditions” on the PM Filter Weigh Log (Figure 2). The RH 24-hour average must be between 30 and 40% with a SD of ≤5 to meet acceptance criteria. The temperature 24-hour average must be between 20 and 23°C with a SD of ≤3 to meet acceptance criteria.
5. Remove 10 filters from the conditioning tray with the longest amount of conditioning time.
6. Use the PM Filter Weigh Log for recording the weight information.
7. Record all filter ID and laboratory information on the weigh log.
8. Place the first mass standard (400 mg) onto the static master located next to the forceps.
9. Open the door to the Sartorius balance.
10. Pick up the mass standard using the forceps. Swipe the mass standard through the static masters on the stand before placing the standard on the pan inside the balance.
11. Place the mass standard on the pan and close the balance door.
12. Allow the weight display on the screen to stabilize. Wait 20 seconds to ensure stability before recording the weight.
13. Repeat this process with the 300 mg mass standard, Lab Blank filter, and all 10 pre-filters.
14. Complete the weighing process by re-weighing the mass standards and 1 of the 10 pre-filters.
15. Place all filters to the side of the balance for a QC check. See section M.4.1 for QC procedures.

Figure 2 PM Filter Weigh Log

Washoe County Health District - Air Quality Management Division
PM Filter Weigh Log

Balance: Sartorius MSE6.6S
S/N: 27602434
Cert. Date: ______

Date: ______
Time (PST): ______
Analyst: ______

Weigh Room Conditions

RH 24-hr Avg (%):		SD:		Criteria Passed? [1]	
Temp 24-hr Avg (^oC):		SD:		Criteria Passed? [2]	

Batch Type

Pre Sample: ______ Post Sample: ______

Post Sample Batch Only

Through Filter ID:		**Through Filter ID:**	
Pre Sample RH 24-hr Avg (%):		Pre Sample RH 24-hr Avg (%):	
Post Sample RH 24-hr Avg (%):		Post Sample RH 24-hr Avg (%):	
Difference:	0.0	Difference:	0.0
Criteria Passed? [3]		Criteria Passed? [3]	

Sample	Filter ID	Weight (mg)	Verified Weight (mg)	Difference	Criteria Passed? [4]	Comments
400 mg				0.000		
300 mg				0.000		
Lab Blank						
Filter						
Filter						
Filter						
Filter						
Filter						
Filter						
Filter						
Filter						
Filter						
Filter						

Sample	Filter ID	Weight (mg)	Verified Weight (mg)	Difference	Criteria Passed? [4,5]	Comments
400 mg				0.000		
300 mg				0.000		
Reweigh				0.000		

Sample	Filter ID	Weight (mg)	Verified Weight (mg)	Difference	Criteria Passed? [4,5]	Date	Initials
300 mg QC				0.000			
Filter QC				0.000			

<u>Acceptance Criteria</u>

1. RH 24-hr average must be between 30 and 40% with SD ≤ 5 to meet acceptance criteria.
2. Temp 24-hr average must be between 20 and 23^oC with SD ≤ 3 to meet acceptance criteria.
3. Pre sample RH and post sample RH must be +/- 5% to meet acceptance criteria.
4. Working standards must be within +/- 3 µg of the verified weight (true mass) to pass.
5. Reweigh and QC weights must be within +/- 15 µg of the batch weight to pass.

File Name: PM Filter Weigh Log_blank form.xlsx
Reviewed: 11/02/16

M.2.2 Exposed Filter Procedures

M.2.2.1 Exposed (Post) Filter Refrigeration

Follow the steps listed below for conditioning of filters once they have returned from the field. Filters should still be inside the filter transport case.

1. Obtain the Petri slides with the filter ID corresponding to the exposed filters.
2. Remove the filter cassette caps from both sides of the filter cassette.
3. Slide the filter cassette into the aluminum cassette opener. Carefully slide the filter cassette towards the top of the opener until the cassette has opened.
4. Remove the filter from the top of the screen inside the filter cassette by using forceps.
5. Place the exposed filter into the Petri slide with the corresponding filter ID number marked on the slide.
6. Remove the remaining filters from the filter cassettes and place in the corresponding Petri slides.
7. Place the Petri slides into the refrigerator. Exposed filters are placed in the refrigerator until a batch of 8 to 10 filters is ready for post weight. Note: filters must be removed from the refrigerator and weighed within 30 days.
8. Note the time of refrigeration on the Field Sample Report (Figure 3).

M.2.2.2 Exposed (Post) Filter Weighing

1. Remove the batch of 8 to 10 filters from refrigeration.
2. Place the filters in the post-filter conditioning tray located in the laboratory between the two balances. Open the top of the Petri slide to allow the filter to condition to the laboratory environment for at least 24 hours.
3. After the 24-hour post conditioning, replace the Petri slide tops and remove the filters from the tray.
4. Obtain a PM Filter Weigh Log (Figure 2) for recording the weight information.
5. Record all filter ID and laboratory information on the weigh log.
6. Download Lab logger data and save to the monitoring network drive by following steps 4 and 5 in Section M.6.1 of this document.
7. Open the downloaded csv file and copy the date, time, model, serial number, temperature, and RH data for the 24 hours immediately prior to the filter weigh session. There will be 1440 1-minute readings for the 24-hour period.
8. Paste the copied data into the second tab of the PM Filter Weigh Log Excel workbook named “Temp and RH Calcs”. The spreadsheet will automatically calculate the mean temperature and RH and standard deviation (SD) of temperature and humidity.
9. Record the mean temperature and RH and the SD of temperature and humidity under the “Weigh Room Conditions” and the “Post Sample Batch Only” sections on the PM Filter Weigh Log (Figure 2). The RH 24-hour average must be between 30 and 40% with a SD of ≤5 to meet acceptance criteria. The temperature 24-hour average must be between 20 and 23°C with a SD of ≤3 to meet acceptance criteria.

10. Record the RH 24-hour average from the corresponding “Pre” sample batch filter weigh log under the “Post Sample Batch Only” section. Pre sample RH and post sample RH must be +/- 5% to meet acceptance criteria.
11. Place the first mass standard (400 mg) onto the static master located next to the forceps.
12. Open the door to the Sartorius balance.
13. Pick up the mass standard using the forceps. Swipe the mass standard through the static masters on the stand before placing the standard on the pan inside the balance.
14. Place the mass standard on the pan and close the balance door.
15. Allow the weight display on the screen to stabilize. Wait 20 seconds to ensure stability before recording the weight.
16. Repeat this process with the 300 mg mass standard, Lab Blank filter, and all 8 to 10 post-filters.
17. Complete the weighing process by re-weighing the mass standard and 1 of the 8 to 10 post-filters.
18. Complete the calculations for the sample weight and concentration on each field form.
19. Place the weigh log and all filters to the side of the balance for a QC check. See section M.4.1 for QC procedures.

Figure 3 Field Sample Report

Washoe County Health District - Air Quality Management Division
Field Sample Report

Site: *Reno 3*
Sampler: *BGI, Inc.* Model: *PQ 200*

S/N: / ID:	*790* *PM2.5*	*794* *PM10*	*FB*

Filter Number:
Sample Date: Su M T W Th F Sa
Weigh by:
Pre Weighed on:
Post Weighed on:

Chain of Custody

Action	Date	Time (PST)	Cap ID	Operator
Sample Installed				
Sample Removed				
Sample Refrigerated				

Conditioning

Pre Conditioning Start			---	
Pre Conditioning End			---	
Post Conditioning Start			---	
Post Conditioning End			---	

Sample Summary

	Date	Time (PST)
Sample Start:		
Sample Stop:		
Elapsed Time:		

	Avg.	Max.	Min.	
T_A:				°C
Press:				mmHg
Flow:		---	---	lpm

Total Volume: m³
Flow Rate CV: %
Flags:
Max Transport Temp: °C

Operator Comments:

Filter Loading and Concentration

	Mass	Reweigh	Date	Analyst
Post-Sample:	. mg	. mg		
Pre-Sample:	. mg	. mg		
Loading:	µg			

Concentration: . µg/m³

PM_{10}		$PM_{2.5}$ Designated		PM_{COARSE}
. µg/m³	-	. µg/m³	=	. µg/m³

Laboratory Comments:

File Name: FIELD SAMPLE REPORT 3
Reviewed: 10/02/19

M.3 High-Volume Quartz Filter Laboratory Procedures

M.3.1 Clean Filter Procedures

M.3.1.1 Filter Inspection

1. Obtain 10 clean filters from the oldest lot of quartz filters.
2. Obtain 10 file folders. Write the filter ID number of each filter on a folder.
3. Examine each filter by holding the filter up to the light to look for major defects on the filter. Refer to the filter defection list posted on the hood in the laboratory for guidance on defective filters.
4. Place the examined clean filter in the file folder with the corresponding filter ID number.

M.3.1.2. Pre Filter Weighing

1. Obtain the 10 inspected filters in the file folders
2. Obtain the PM_{10} filter weigh log binder located in the laboratory.
3. Place the check weight (5 g) on the PM_{10} balance. Allow the balance to stabilize. Wait 30 seconds to ensure the weight is stable, and then record the check weight on the PM_{10}/TSP Filter Weighing Log (Figure 4).
4. Place the first clean filter in between the arms of the filter holder on the PM_{10} scale. Allow the balance to stabilize. Wait 30 seconds to ensure the weight is stable, and then record the filter weight on the Filter Weighing Log. Also record the filter weight on the front of the file folder next to the filter ID number.
5. Repeat step 4 for the remaining 9 filters and a final check weight. Record all information on the Filter Weighing Log.
6. Place the 10 filters in the PM_{10} QC tray. See section M.4.2 for QC procedures.

M.3.2 Exposed Filter Procedures

M.3.2.1 Exposed Filter Conditioning

1. Obtain the 10 exposed filters from the Incoming Filters tray located in the laboratory.
2. Remove the filter from the filter holder and place the filter in a slot in the conditioning rack located in the cabinet in the laboratory.
3. Replace the filter holders to their original location in the laboratory.
4. Place the empty file folders in the cabinet next to the conditioning rack.
5. Allow the filters to condition to the laboratory environment for at least 24 hours.

M.3.2.2 Exposed Filter Weighing

1. Place each exposed filter back into its corresponding file folder.
2. Obtain the PM_{10} filter weigh log binder located in the laboratory.
3. Place the check weight (5 g) on the PM_{10} balance. Allow the balance to stabilize. Wait 30 seconds to ensure the weight is stable, and then record the check weight on the PM_{10}/TSP Filter Weighing Log (Figure 4).

4. Place the first exposed filter in between the arms of the filter holder on the PM_{10} balance. Allow the balance to stabilize. Wait 30 seconds to ensure the weight is stable, and then record the filter weight on the PM_{10}/TSP Filter Weigh Log. Also record the filter weight on the field form on the line labeled Final Weight.
5. Repeat step 4 for the remaining 9 filters and a final check weight. Record all information on the PM_{10}/TSP Filter Weigh Log and the filters corresponding field form.
6. Place the stack of exposed filters in the QC tray. See section M.4.2 for QC procedures.

Figure 4 PM_{10}/TSP Filter Weighing Log

PM-10 / TSP Filter Weighing Log

Date	Oper.	Group #	Filter #	Pre-Weight (grams)	QC Check (Op. / grams)	Post-Weight (grams)	QC Check (Op. / grams)

M.4 QC Procedures

M.4.1. Teflon Filter QC Procedures (Pre and Post)

1. The stack of filters to have a QC check will be next to the microbalance along with the PM Filter Weigh Log.
2. Record the laboratory's current RH and Temperature onto the weigh log in the QC box.
3. Ensure the RH and Temperature is within the specifications listed.
4. Place the mass standard (300 mg) onto the static master located next to the forceps.
5. Open the door to the Sartorius balance.
6. Pick up the mass standard using the forceps. Swipe the mass standard through the static masters on the stand before placing the standard on the pan inside the balance.
7. Place the mass standard on the pan and close the balance door.
8. Allow the weight display on the screen to stabilize. Wait 20 seconds to ensure stability before recording the weight. The mass standard must be within +/- 3 µg to pass.
9. Remove the mass standard. Close the balance door to allow balance to come back to 0 mg.
10. Choose one of the filters from the stack and swipe the filter through the static masters. Open the balance door and place the filter on the sample pan. Allow the weight display on the screen to stabilize. Wait 20 seconds to ensure stability before recording the weight on the form.
11. The QC weight must be within 15 µg of the initial weight to pass.
12. Check for transcription errors on both the "pre" and "post" weights between the original PM Filter Weigh Log (Figure 2) and the Field Sample Report (Figure 3). Stamp the Field Sample Report with "QC – OK" stamp when transcription error check is complete.
13. Recalculate the sample concentrations on the field forms to ensure the correct concentration was computed from the original laboratory technician. Stamp the Field Sample Report with "QC – OK" stamp when the concentration calculation QC check is complete.
14. Place the weigh log in the PM Filter Log binder located in the laboratory and give the field forms to the Data Manager.
15. After the QC check is complete, all filters in the weigh batch should be stored in numerical order in the refrigerator in the tray labeled with the current year. The filters are archived in the refrigerator for 5 years, after which they are disposed of.

M.4.2 High-Volume Quartz Filter QC Procedures (Pre and Post)

1. The stack of filters to have a QC check will be in the PM_{10} tray labeled "QC".
2. Obtain the PM_{10} filter weigh log binder located in the laboratory.
3. Place the check weight (5 g) on the PM_{10} balance. Allow the balance to stabilize. Wait 30 seconds to ensure the weight is stable, and then record the check weight on the PM_{10}/TSP Filter Weighing Log (Figure 4).
4. At least 10% of the filters require a QC check. Choose the filters at random.
5. Place the QC filter in between the arms of the filter holder on the PM_{10} scale. Allow the balance to stabilize. Wait 30 seconds to ensure the weight is stable, and then record the filter weight on the Filter Weighing Log under QC check.

M.5 Laboratory Audits

M.5.1 Quarterly Weight Standard Verification

1. Zero the Sartorius balance by using the Tare key.
2. Open the Sartorius balance door.
3. Using the rubber-tipped forceps, gently place the 400 mg working standard (*w*) on the sample pan.
4. Close the balance door. Wait until the display of the selected unit of weight indicates that a stable reading has been obtained. Time twenty seconds and if the weight remains stable, record the weight on the Quarterly Weight Standard Verification form (Figure 6) as Observation 1 (O_1).
5. Open the balance door and remove the mass standard using the forceps.
6. Shut the balance door and allow the microbalance to come to zero. Wait at least 20 seconds to ensure zero is achieved. If not achieved by 20 seconds, manually zero the scale using the Tare key.
7. Repeat steps 2 through 6 for the 400 mg primary (p) and working standard (w) weights in the order outlined on the Quarterly Weight Standard Verification form (Figure 6) to weigh each standard 2 times.
8. Note: the time intervals between successive trials should not differ from one another by more than +/- 20%. If this difference is exceeded, reject the data and take a new series of measurements that agree.
9. Repeat steps 1 through 7 for the 300 mg standard.
10. Calculate C_w (see Figure 5) for both the 400 and 300 mg mass standards.

M.5.2. Mass Correction Calculation (C_w)

Calculate the apparent mass correction, C_w, for the test (working standard) weight (w) as follows, according to the sequence used. In each case, the apparent mass corrections for the primary standard weight, C_p, are included. The symbols N_p and N_w refer to the nominal values of *p* and *w*, respectively.

Figure 5 Mass Correction Calculation (C_w)

$$C_w + C_p + ((O_1 - O_2 + O_4 - O_3)/2) + N_p - N_w$$

Subsequent measurements of C_w must be within +/-2 µg of the initial C_w value. If the test results do not indicate acceptable agreement (2 µg) and a repetition produces the same results, complete a Corrective Action Request form (Figure 8). The Auditor should arrange to have the primary standard checked against an independent, certified weight, or the Lab Manager should arrange to have the balance checked by a qualified service technician.

Figure 6 Quarterly Mass Standard Verification

Washoe County Health District - Air Quality Management Division
Quarterly Mass Standard Verifications

Microbalance:	Sartorius	**Date:**	
Model:	MSE6.6S	**Time (PST):**	
S/N:	27602434	**Analyst:**	
Certification:			

400 mg Test

Meas. No.	Weight	Serial No.	C_p (mg)[1]	Observation (mg)
1	Working Standard (w)	83551		O_1=
2	Primary Standard (p)	78463		O_2=
3	Primary Standard (p)	78463		O_3=
4	Working Standard (w)	83551		O_4=

Apparent working standard correction (C_w) =	0.0	µg
Initial C_w[2] =		µg
Difference =	0.0	µg
Criteria Passed?[3]	Y	

300 mg Test

Meas. No.	Weight	Serial No.	C_p (mg)[1]	Observation (mg)
1	Working Standard (w)	65511		O_1=
2	Primary Standard (p)	78462		O_2=
3	Primary Standard (p)	78462		O_3=
4	Working Standard (w)	65511		O_4=

Apparent working standard correction (C_w) =	0.0	µg
Initial C_w[2] =		µg
Difference =	0.0	µg
Criteria Passed?[3]	Y	

Notes

1. C_p = correction after calibration from Primary Standard Traceable Certificate.
2. Initial C_w = first calculated apparent working standard correction after annual primary standard certification.
3. Subsequent measurements of C_w must be within +/- 2 µg of the initial C_w value to meet acceptance criteria.

Comments: ______________________________

File Name: Lab_mass standard verifications_blank form
Reviewed: 04/19/18

M.5.2 Relative Humidity and Temperature Audits

Relative humidity and temperature audits are conducted on a quarterly basis.

1. Remove the RH and Temperature standard from the case and place the sensor near the Dickson temperature and RH Logger in the laboratory.
2. Allow the standard to equilibrate for approximately 1 hour.
3. Obtain the PM Filter Weigh Lab Temperature and RH Audit worksheet (Figure 7) to record the RH and temperature readings.
4. Fill out the Lab Logger, Logger Sensor, and Audit Standard information on the worksheet.
5. Record the Temperature in °C and the RH in % every 5 minutes for a total of 30 minutes on the worksheet.

Acceptable range for temperature is +/- 2ºC and acceptable range for relative humidity is +/- 2% for individual observations and the calculated means. If the audits do not fall within these ranges, complete a Corrective Action Request form (Figure 8) and submit to Lab Manager. The Auditor should arrange to have the RH and temperature standard checked against and independent, certified standard, or the Lab Manager should arrange to have the lab logger and/or logger sensor checked by the manufacturer.

M.5.3 Recertification of Lab Relative Humidity and Temperature Data Logger

The lab relative humidity and temperature data logger recertification is conducted annually. The data logger has a replaceable sensor that makes it easy to monitor without interruption when it's time to recertify.

1. A couple weeks before recertification is due, order a new, certified sensor from the data logger manufacturer.
2. Unplug old sensor from data logger.
3. Plug new sensor in to data logger.
4. Scan the Certificate of Instrument Calibration (Figure 9) a save a soft copy onto the Monitoring drive: Save file in the following folder sequence: “Field Mgmt Functions”, “QA/QC”, “Traceability of Standards”, current year (20xx), “Temp_RH”.
5. File the original hard copy in the Traceability/Calibration Certifications binder maintained by the senior air quality specialist.
6. Update the Traceability/Maintenance Schedule (Figure 10) with the new sensor’s serial number and calibration date.

Figure 7 PM Filter Weigh Lab Temperature and RH Audit Worksheet

Washoe County Health District - Air Quality Management Division
PM Filter Weigh Lab Temperature and RH Audit

Lab Logger:	Dickson	Date:	
Model:	TWE	Time (PST):	
S/N:	16209683	Analyst:	

Temperature

Logger Sensor:		Audit Standard:	
Model:		Model:	
S/N:		S/N:	
Cal. Due:		Cal. Due:	

Observation Time (PST)	Lab Logger (°C)	Audit Standard (°C)	Difference (°C)	Criteria Passed? [1]
			0.0	Y
			0.0	Y
			0.0	Y
			0.0	Y
			0.0	Y
			0.0	Y
Mean:	#DIV/0!	#DIV/0!	0.0	Y

Relative Humidity

Logger Sensor:		Audit Standard:	
Model:		Model:	
S/N:		S/N:	
Cal. Due:		Cal. Due:	

Observation Time (PST)	Lab Logger (%)	Audit Standard (%)	Difference (%)	Criteria Passed? [2]
			0.0	Y
			0.0	Y
			0.0	Y
			0.0	Y
			0.0	Y
			0.0	Y
Mean:	#DIV/0!	#DIV/0!	0.0	Y

Acceptance Criteria

1. Temperature difference per observation and mean temperature difference must be +/- 2.0°C to meet acceptance criteria.
2. RH difference per observation and mean RH difference must be +/- 2.0% to meet acceptance criteria.

Comments: ______________________________

File Name: Lab_Temp-RH_audit_blank form.xlsx
Reviewed: 06/28/17

Figure 8 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ____________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ____________________________

Problem Identification:

Site: ____________________________
System: ____________________________
Date: ____________________________
Time: ____________________________
Nature of Problem: ____________________________

Recommended Action: ____________________________

Signature: ____________________________ Date: ________________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________________
Time corrective action taken: ____________________________
Corrective Action Summary: ____________________________

Signature: ____________________________ Date: ________________

QA Manager Signature: ____________________________ Date: ________________

Supervisor Signature: ____________________________ Date: ________________

Director Signature: ____________________________ Date: ________________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

Figure 9 Certificate of Instrument Calibration

Certificate of Instrument Calibration

Customer Instrument

Dickson Model Number: RTRH

Serial Number: 16387669

Approved By: *Juanita Sinon*

Calibration Date: 09/26/2019

Calibration Type: 3 PT NIST

Calibration Standards

EdgeTech DM S/N: 43964/44603/44604/41935/52290/52291/41562/52788/52787/43963
EdgeTech DP S/N: 31048/34231/33054
Azonix A1011 S/N: T2472-8204/T2584-9364
Fluke 1502A/1529-R S/N: A42459/B2A200/B02453/B24057/B68192/B79488/B68186/B88755/B88759/B79486/B82610/B84646/B84647/B47139/B54298

Customer Notes Field: ____________________

(for entry of name/address/location or internal unit ID)

The calibration is traceable to the SI through the National Institute of Standards and Technology.

Calibration Procedure P1130

The customer instrument was compared to the calibration standard. Drifts and faults were determined, and any necessary mechanical or electronic adjustments were taken. The Dickson calibration system conforms to the requirements of MIL-STD-45662A, ANSI/NCSL Z540-1, and ISO/IEC 17025 as appropriate. This certificate only relates to this specific unit. The unique certificate number equals the model # + serial # + cal date.

Environmental Conditions 72 °F 41 %RH

Calibration Standard Reading	Customer Instrument Reading	Unit Specification
Humidity (%RH)	Humidity (%RH)	Humidity
11.8	11.9	± 2% RH
49.4	50.6	± 2% RH
90.9	91.2	± 2% RH
Temperature °F (°C)	Temperature °F (°C)	Temperature
10 (-12.2)	9.8 (-12.3)	±.8°F (± .44°C) from 20°F to 122°F, ±1.8°F (± 1°C) over any remaining operating range
75.2 (24)	75.1 (23.9)	
110 (43.3)	110 (43.3)	

FOR YOUR NEXT CALIBRATION NO PHONE CALLS REQUIRED

Fill out and send this form along with your instrument to Dickson. Label the outside of the box with "CCM" - that is your RA#.
That's all there is to it!

1. Purchase Order #: ____________
   Name: ____________
   Phone: ____________
   Model #: RTRH
   Serial #: 16387669

A 3-pt Deluxe NIST will be performed unless otherwise requested

2. ☐ 1-Point Deluxe NIST Calibration $156.00
   ☐ 3-Point Deluxe NIST Calibration $209.00
   ☐ 3-Point A2LA Accredited Calibration $315.00 (includes incoming readings)
   ☐ N995 - User selectable NIST Temperature points $50.00 each
   (to be selected in addition to one of the above calibration options)
   ☐ N997- Priority Service $53.00 (Not available for A2LA Accredited service)

3. Please return via:
   ☐ Ground Freight*
   ☐ 2nd Day Air*
   ☐ Next Day Air*
   *Charges added at factory
   2nd Day unless otherwise requested

4. Ship To: ____________

   Bill To: ____________

Prices are subject to change

Let Dickson remind you the next time your unit is due for calibration. Register for our FREE Calibration Club now at **www.dicksondata.com**

Dickson

930 South Westwood Avenue Addison, Illinois 60101 630-543-3747 Fax 630-543-0498

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Figure 10 Traceability/Maintenance Schedule

Traceability/Maintenance Schedule — Year: 2019

Standard	Instrument	Model	Serial #	Date Completed Last	Due	Actual
Primary Ozone	TAPI	T400	1397	08/21/18	Aug-19	
Audit Ozone	TAPI	T750U	72	08/20/18	Aug-19	
Audit MFC	TAPI	T750U	72	08/20/18	Aug-19	
Flow (MFC)	Alicat	MB-100SCCM-D	156312	09/11/18	Sep-19	
	Alicat	MB-20SLPM-D	156313	09/11/18	Sep-19	
Flow/Temp/Press	Alicat	FP-25BT	157522	10/27/18	Oct-19	
	Alicat	FP-25BT	157523	11/10/18	Nov-19	
	Alicat	FP-25	157524	10/27/18	Oct-19	
Temperature/RH	Dickson (Lab)	RTRH	16270353	09/20/18	Sep-19	
	Dickson (Handheld)	R250	16316036	08/24/18	Aug-19	
	Control Company	1235D02	122168475	10/24/18	Oct-19	
Balance (Lab)	Sartorius	MSE6.6S	27602434	04/12/18	Apr-19	
	Sartorius	ME-5	16210916	04/12/18	Apr-19	
Mass	Primary	400 mg	78463	05/01/18	May-19	
	Primary	300 mg	78462	05/01/18	May-19	
Staticmasters	Thomas Scientific	500 µc	3620A30	05/03/18	May-19	
NO_X Scrubber	TAPI	200EU	213	07/23/18	Jul-19	
	TAPI	200EU	109	07/23/18	Jul-19	
WSP/WDR	Met One (Reno 3)	50.5H	N11876	03/13/18	Mar-19	
	Met One (Spare)	50.5H	N11877		Dec-00	
	Met One (Sparks)	50.5H	N11878	06/14/18	Jun-19	
	Met One (Spare)	50.5H	N12431		Dec-00	
	Met One (Spare)	50.5H	N12432		Dec-00	
	Met One (Spare)	50.5H	N12434		Dec-00	
	Met One (Toll)	50.5H	D5668	09/11/18	Sep-19	
	Met One (So Reno)	50.5H	D5669	09/11/18	Sep-19	
	Met One (SS)	50.5H	D5670	09/26/18	Sep-19	
Zero Air	TAPI	751H	132	06/27/18	Jun-19	
BAM Zero Tests	Met One (Reno 3)	BAM 1020 (PM2.5)	K1286	01/28/19	Jan-20	
	Met One (Reno 3)	BAM 1020 (PM10)	K1287	01/28/19	Jan-20	
	Met One (SS)	BAM 1020 (PM2.5)	N10985	02/05/18	Feb-19	
	Met One (SS)	BAM 1020 (PM10)	N10986	02/05/18	Feb-19	
	Met One (Sparks)	BAM 1020 (PM2.5)	M4380	05/03/18	May-19	
	Met One (Sparks)	BAM 1020 (PM10)	R10379	05/03/18	May-19	
	Met One (Toll)	BAM 1020 (PM2.5)	M7605		Dec-00	
	Met One (Toll)	BAM 1020 (PM10)	M7649		Dec-00	

Manifolds	Site	Tubing	Length	Date Completed Last	Due	Completed
	Incline	1/4" OD, 1/8" ID	274"	11/06/18	Nov-19	
	Lemmon Valley	1/4" OD, 1/8" ID	214"	10/31/18	Oct-19	
	Reno 3 CO,O3,SO2	3/8" OD, 1/4" ID	188"	10/24/18	Oct-19	
	Reno 3 CO,O3,SO2	1/4" OD, 1/8" ID	44"	10/24/18	Oct-19	
	Reno 3 NOx	1/4" OD, 1/8" ID	148"	10/24/18	Oct-19	
	Reno 3 NOy	1/4" OD, 1/8" ID	600"	10/25/17	Oct-18	
	South Reno	1/4" OD, 1/8" ID	132"	10/25/18	Oct-19	
	Spanish Springs	1/4" OD, 1/8" ID	123"	10/30/18	Oct-19	
	Sparks	1/4" OD, 1/8" ID	206"	10/30/18	Oct-19	
	Toll	1/4" OD, 1/8" ID	152"	10/25/18	Oct-19	

M.6 Routine Maintenance

M.6.1 Weekly Maintenance

Weekly maintenance is completed every Wednesday. Weekly maintenance includes:

1. Cleaning all horizontal surface in the laboratory with a dry Swiffer Duster wand.
2. Cleaning the floor of the laboratory and airlock thoroughly with the Swiffer Wet mop.
3. Removing the top layer of the sticky mat located just before entering the laboratory. Removing the top layer will expose a new, clean sticky mat.
4. Downloading data from the Dickson Logger in the laboratory onto a USB flash drive:
    a. Insert USB flash drive into USB port on left side of logger's back panel.
    b. Press the "Settings" icon on the lower right corner of the logger's touch screen.
    c. Press the "USB" icon on the left side menu of the touch screen.
    d. Press "Save to USB" button on touch screen.
    e. Choose "csv connected channels" for data format. Data will download onto the USB flash drive. Screen will read "Data is saving. Please wait".
    f. After screen reads "Data saved successfully", press OK.
    g. Press "Home" icon on upper right corner of touch screen.
    h. Remove USB flash drive.
5. Downloading data from the USB flash drive to the network:
    a. Insert the USB flash drive into USB port on computer.
    b. An "Auto Play" window will pop up. Click "Open folder to view files".
    c. Right click the file corresponding to the download date.
    d. Copy and Paste the file onto the Monitoring drive: Save file in the following folder sequence: "Dickson", "Download", current year (20<u>xx</u>), "Weekly Downloads".
    e. After file is saved in proper folder, open file to make sure download is complete.
    f. Safely remove hardware on start bar to remove USB flash drive.
6. When weekly maintenance items have been completed, document their completion in the "Lab" Station Logbook.

Appendix N: Meteorology

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division (AQMD) to follow the elements described within.

Approved:

Name: ____

Title of Author: ______________________________________

Signature:____________________________Date:____________

Name: ____

Title: ____

Signature:____________________________Date:____________

Name: ____

Title: ____

Signature:____________________________Date:____________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:____________________________Date:______________

Name: ____

Title: ____

Signature:____________________________Date:______________

Name: ____

Title: ____

Signature:____________________________Date:______________

Name: ____

Title: ____

Signature:____________________________Date:______________

Name: ____

Title: ____

Signature:____________________________Date:______________

Acronyms and Abbreviations

AQMD	Washoe County Health District, Air Quality Management Division
^oC	Degrees Celsius
MQO	Measurement Quality Objectives
NCore	National Core Multi-pollutant Monitoring Station
RH	Relative Humidity
SLAMS	State and Local Air Monitoring Station
T_A	Ambient Temperature
WDR	Wind Direction
WSP	Wind Speed

List of Figures

Figure 1: Meteorological QA/QC Worksheet N-8
Figure 2: Corrective Action Request N-9
Figure 3: Data Exception Log N-10

N.1 Introduction

N.1.1 Wind Speed and Wind Direction

The Met One Instruments 50.5H wind sensor is a solid-state ultrasonic instrument capable of measuring wind speed and wind direction in the U and V axes. Sonic pulses are generated at transducers and are received by opposing transducers. Mathematics derived for these sonic pulses provide a wind velocity measurement in each of the corresponding axes.

N.1.2 Relative Humidity

The Met One Instruments 083E relative humidity sensor is an extremely accurate microprocessor-controlled instrument. It responds to the full range of 0 to100% humidity.

N.1.3 Ambient Temperature

The YSI 700 sensor uses thermilinear components designed for applications requiring linear electrical response to temperature changes, ranging from -30 to 50 degrees Celsius (^{o}C).

N.2 Theory of Operation

N.2.1 Wind Speed and Wind Direction

The speed of sound in still air can be measured accurately between two points a few centimeters apart by two ultrasonic transducers set at that distance. The resulting speed of sound is a known function of the air temperature and composition. The transit time of a sound signal traveling from one end of a sound path to the other separated by a distance is used to compute the velocity of the air in the path between two opposing transducers.

N.2.2 Relative Humidity

The 083E relative humidity sensor measures variance in the capacitance change of a one micron thick dielectric polymer layer. This film absorbs water molecules through a metal electrode, and causes capacitance change proportional to relative humidity. The thin polymer layer reacts very quickly, providing up to 90% of the final value of relative humidity in fewer than five seconds. The sensor's response is essentially linear, with small hysteresis, and negligible temperature dependence.

N.2.3 Ambient Temperature

Thermistors have an exponential non-linear resistance curve. Over small ranges of temperature, linearization is achieved with a single resistor. YSI thermilinear components use multiple thermistors and fixed resistors to provide a linear output over wider temperature ranges.

N.3 Precautions

N.3.1 Wind Speed and Wind Direction

1. Always handle the sensor with care. Do not subject it to side loading, shock, or other abuse. Keep the sensor in its shipping container until actual installation.
2. Use care when installing the aviary deterrent, and be careful after installation as they are very sharp. Protective glasses should be worn during installation.

N.3.2 Relative Humidity

1. The sensor can be incorrectly calibrated or permanently damaged through improper acts. Do not attempt a repair or calibration if you are unsure of the procedure.
2. Do not touch the sensor element if you do not know the correct procedure. The instrument should operate for an extended period of time with a minimum of care or maintenance.

N.4 Instrument Operation

N.4.1 Wind Speed and Wind Direction

Refer to the manufacturer's operation manual for siting criteria, sensor orientation, external heater option, and installation of aviary deterrents. The sensor will be operated per the measurement quality objectives (MQO) described in the QA Handbook, Volume IV.

The 50.5H uses a microprocessor-based, digital electronic measurement system to control the sample rate and compute the wind speed and wind direction. The sensor is factory calibrated and requires no field calibration. In the field, the operation of the sensor can be quickly checked using a combination of simple tests. These tests are outlined in Section N.6 (Quarterly Audits).

N.4.2. Relative Humidity

Refer to the manufacturer's operation manual for sensor siting and installation instructions. The sensor will be operated per the measurement quality objectives (MQO) described in the QA Handbook, Volume IV.

N.5 Monthly Verifications

N.5.1 Relative Humidity

A single-point, monthly verification will be completed on the relative humidity (RH) sensor at the National Core Multi-pollutant Monitoring Station (NCore).

1. Place the "verification" relative humidity and temperature standard out of direct sunlight near the station RH sensor.
2. Allow readings on verification standard to stabilize for a minimum of 5 minutes (may take up to 30 minutes).

3. Record the RH readings from site instrument and the verification standard in the Relative Humidity section on the Meteorological QA/QC Worksheet (Figure 1).
4. The site RH reading must be within +/- 7% RH of the verification standard to pass.

If the RH verification fails, retest ensuring the standard is out of direct sunlight and 5 minute stability has been achieved. If the retest fails, contact the factory for a Return Authorization to repair/recalibrate sensor.

N.5.2 Ambient Temperature

A single-point, monthly verification will be completed on the ambient temperature (T_A) sensor at the NCore station.

1. Place the "verification" relative humidity and temperature standard out of direct sunlight near the station T_A sensor.
2. Allow readings on verification standard to stabilize for a minimum of 5 minutes.
3. Record the T_A readings from site instrument and the verification standard in the Ambient Temperature section on the Meteorological Worksheet.
4. The site T_A reading must be within +/- 0.5^{o}C of the verification standard to pass.

If the T_A verification fails, retest ensuring the standard is out of direct sunlight and 5 minute stability has been achieved. If the retest fails, contact the factory for a Return Authorization to repair/recalibrate sensor.

N.6 Quarterly Audits

N.6.1 Wind Speed and Wind Direction

N.6.1.1 Wind Speed Zero Test

Every quarter, a wind speed (WSP) zero test is completed at all SLAMS and the NCore station. A zero test requires no air movement across the sensor array, so a means of covering the array is needed.

1. Put the WSP and wind direction (WDR) channels in the data logger into Maintenance Mode. From the data logger Home Menu, choose *Configuration Menu, Configure (Data) Channels, Put Channel in Maint.* Highlight the WSP and WDR channels and press *Enter*.
2. Log "Start Time" on the Meteorological Worksheet.
3. Place a plastic bag over the array, using care not to contact the transducers or block the sonic paths between transducers. The bag should be spaced at least 2" above the transducers to avoid sonic reflections, which may affect readings.
4. Record wind speed readings in m/s on the Meteorological Worksheet in the WSP Zero Test box.
5. The reading must be +/- 0.25 m/s to pass.
6. Take the WSP and WDR channels in the data logger out of Maintenance Mode. From the data logger Home Menu, choose *Configuration Menu, Configure (Data) Channels, Take Channel out of Maint.* Highlight the WSP and WDR channels and press *Enter*.

7. Log “End Time” on the Meteorological Worksheet.
8. Back at the office, print three copies of the Meteorological Worksheet. One copy will be filed in the “Met” Station QA/QC Logbook, another will be filed in the office Data Exception binder, and the third will be given to the senior air quality specialist for filing in the quarterly audit folder.
9. Record the Date, Start Time, End Time, and Parameter affected on the Data Exception Log (Figure 3). Circle the appropriate Error Code.

If wind speed zero test fails, retest ensuring that the bag if completely sealed at the bottom to prevent air movement from below. Keep in mind that wind can also deflect the bag, causing air movement inside. If the retest fails, issue a Corrective Action Request (Figure 2) to the station operator. The station operator may need to contact the factory for a Return Authorization to repair/recalibrate sensor.

N.6.1.2 Wind Speed and Wind Direction Span Tests

Every quarter, a wind speed and wind direction span test is completed at all SLAMS and the NCore station. The sensor is designed to produce known default outputs if an object blocks the sonic signal path between the transducers. For testing purposes, the sonic path can be blocked by placing a finger (or any solid object) on the face of one or more transducers.

1. Put the WSP and WDR channels in the data logger into Maintenance Mode. From the data logger Home Menu, choose *Configuration Menu, Configure (Data) Channels, Put Channel in Maint.* Highlight the WSP and WDR channels and press *Enter.*
2. Log “Start Time” on the Meteorological Worksheet.
3. Block the North-South axis.
4. Record the wind speed and wind direction readings on the Meteorological Worksheet in the “North-South” sections of the WSP and WDR Blocked Axis Test box.
5. The wind speed reading must be within +/- 2.5 m/s of 50 m/s to pass.
6. The wind direction reading must be with +/- 5 degrees of 10 degrees to pass.
7. Block the East-West axis.
8. Record the wind speed and wind direction readings on the Meteorological Worksheet in the “East-West” sections of the WSP and WDR Blocked Axis Test box.
9. The wind speed reading must be within +/- 2.5 m/s of 50 m/s to pass.
10. The wind direction reading must be with +/- 5 degrees of 160 degrees to pass.
11. Block both the North-South axis and the East-West axis.
12. Record the wind speed and wind direction readings on the Meteorological Worksheet in the “Both” sections of the WSP and WDR Blocked Axis Test box.
13. The wind speed reading must be within +/- 2.5 m/s of 50 m/s to pass.
14. The wind direction reading must be with +/- 5 degrees of 170 degrees to pass.
15. Take the WSP and WDR channels in the data logger out of Maintenance Mode. From the data logger Home Menu, choose *Configuration Menu, Configure (Data) Channels, Take Channel out of Maint.* Highlight the WSP and WDR channels and press *Enter*.
16. Log “End Time” on the Meteorological Worksheet.
17. Back at the office, print three copies of the Meteorological Worksheet. One copy will be filed in the “Met” Station QA/QC Logbook, another will be filed in the office Data

Exception binder, and the third will be given to the senior air quality specialist for filing in the quarterly audit folder.

18. Record the Date, Start Time, End Time, and Parameter affected on the Data Exception Log. Circle the appropriate Error Code.

If wind speed and wind direction span tests fail, see “Troubleshooting” section 4.2 in operation manual for probable causes and actions to repair. If failure cannot be identified, issue a Corrective Action Request (Figure 2) to the station operator. The station operator may need to contact the factory for a Return Authorization to repair/recalibrate sensor.

N.6.1.3 True North Orientation Audit

The largest source of error in wind direction measurement is the sensor orientation to the north. Every quarter, the sensor’s orientation to true north will be checked. True north is deviated from magnetic north depending on your position on Earth. Real-time magnetic declination can be obtained using the National Geomagnetism Program on the USGS website (http://www.ngdc.noaa.gov/geomag-web/). The actual declination of Reno, NV on the date of this document is approximately 13^{o}E. Make sure the zero pin on the compass is set to 13^{o} instead of 0^{o}.

1. Using the compass, establish a reference point on the horizon for true north.
2. Sighting down the crossarm centerline, make sure crossarm is pointed true north.
3. The sensor should be aligned with the crossarm, so that both the crossarm and North-South transducers are all aligned true north.
4. The alignment must be within +/- 5 degrees to pass.
5. Mark “Yes” or “No” for True North Alignment in the Crossarm Compass Check section of the Meteorological Worksheet.

If the sensor and/or crossarm fail the true north alignment audit, issue a Corrective Action Request (Figure 2) to the station operator. The station operator may need to make an adjustment to the cross arm and/or sensor keyed bushing.

N.6.2 Relative Humidity

Every quarter, a single-point audit will be completed on the RH sensor at the NCore station.

1. Place “Audit” relative humidity and temperature standard out of direct sunlight near the station RH sensor.
2. Allow readings on the audit standard to stabilize for a minimum of 5 minutes.
3. Record the RH readings from site instrument and the audit standard in the Relative Humidity section on the Meteorological Worksheet.
4. The site RH reading must be within +/- 7% RH of the audit standard to pass.

If the RH audit fails, issue a Corrective Action Request (Figure 2) to the station operator. The station operator should verify functionality using the Relative Humidity Monthly Verification procedure in Section N.5.1.

N.6.3 Ambient Temperature

Every quarter, a three-point audit will be completed on the T_A sensor at all SLAMS and the NCore station.

1. Prepare one Thermos container by filling it with a slurry of shaved ice and water.
2. Prepare another Thermos container by filling it with hot water, approximately 40-50°C.
3. Put the T_A channel in the data logger into Maintenance Mode. From the data logger Home Menu, choose *Configuration Menu, Configure (Data) Channels, Put Channel in Maint.* Highlight the ATEMP channel and press *Enter.*
4. Log "Start Time" on the Meteorological Worksheet.
5. Leaving T_A sensor in its gill shield, insert the probe of the "Audit" temperature standard into the gill shield.
6. Wait approximately 2 minutes for stabilization.
7. Record the temperature readings from the site instrument and the audit standard in the Ambient Temperature section of the Meteorological Worksheet.
8. Remove site T_A probe from its gill shield and insert into Thermos containing the ice bath along with the audit standard probe. Slight stirring may be required for both probes to stabilize.
9. Record the temperature readings from the site instrument and the audit standard in the Ambient Temperature section of the Meteorological Worksheet.
10. Repeat steps 6 and 7 using the Thermos containing the hot water.
11. All three points must be within +/- 1.0°C at SLAMS and +/- 0.5°C at the NCore station to pass.
12. Take the T_A channel in the data logger out of Maintenance Mode. From the data logger Home Menu, choose *Configuration Menu, Configure (Data) Channels, Take Channel out of Maint.* Highlight the ATEMP channel and press *Enter.*
13. Log "End Time" on the Meteorological Worksheet.
14. Back at the office, print three copies of the Meteorological Worksheet. One copy will be filed in the "Met" Station QA/QC Logbook, another will be filed in the office Data Exception binder, and the third will be given to the senior air quality specialist for filing in the quarterly audit folder.
15. Record the Date, Start Time, End Time, and Parameter affected on the Data Exception Log. Circle the appropriate Error Code.

If the T_A audit fails, issue a Corrective Action Request form to the station operator. The station operator should verify functionality using the Ambient Temperature Monthly Verification procedure in Section N.5.2.

N.7 Annual Calibration

N.7.1 Wind Speed and Wind Direction

Every 12 months, every 50.5 sensor in the network will be replaced with a factory-calibrated sensor. The sensor removed from operation will be sent back to the factory for a 14-point, NIST wind tunnel calibration. When returned from the factory, the newly calibrated sensor will be added to the sensor rotation.

N.8 Troubleshooting

Refer to the manufacturer's operation manuals for troubleshooting.

Figure 1 Meteorological QA/QC Worksheet

Air Quality Management Division
Meteorological QA/QC Worksheet

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Verification: ______ Audit: ______

Date: ______ Operator: ______ Site: ______

Start Time (PST): ______ **End Time (PST):** ______

Ambient Temperature

	Site Instrument		Audit Instrument
Manufacturer:		Manufacturer:	
Model:		Model:	
Serial No.		Serial No.	

	Site T_A (°C)	Audit T_A (°C)	Difference (°C)			
Ambient:			0.0	+/- 1.0°C?	Yes____	No____
Low:			0.0	+/- 1.0°C?	Yes____	No____
High:			0.0	+/- 1.0°C?	Yes____	No____

(+/- 0.5°C? NCore)

Relative Humidity

	Site Instrument		Audit Instrument
Manufacturer:		Manufacturer:	
Model:		Model:	
Serial No.		Serial No.	

Site RH (%)	Audit RH (%)	Difference (%)			
		0.0	+/- 10 %?	Yes____	No____

(+/- 7 %? Ncore)

Sonic Anemometer

	Site Instrument		Audit Compass
Manufacturer:		Manufacturer:	
Model:		Model:	
Serial No.		Serial No.	

WSP Zero Test	Site WSP (m/s)	Reference WSP (m/s)	Difference (%)			
		0.00	0.00	+/- 0.25 m/s?	Yes____	No____

WSP Blocked Axis Test	Site WSP (m/s)	Reference WSP (m/s)	Difference (m/s)			
North-South		50.0	-50.0	+/- 2.5 m/s?	Yes____	No____
East-West		50.0	-50.0	+/- 2.5 m/s?	Yes____	No____
Both		50.0	-50.0	+/- 2.5 m/s?	Yes____	No____

WDR Blocked Axis Test	Site WDR (Deg)	Reference WDR (Deg)	Difference (Deg)			
North-South		10.0	-10.0	+/- 5 Deg?	Yes____	No____
East-West		160.0	-160.0	+/- 5 Deg?	Yes____	No____
Both		170.0	-170.0	+/- 5 Deg?	Yes____	No____

Crossarm Compass Check True North Alignment +/- 5 Deg? Yes____ No____

Comments: ______________________________

Master_Template_Met
Last Revision: 10/11/19

Figure 2 Corrective Action Request

Air Quality Management Division
Corrective Action Request

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Part A (to be completed by requestor)

To: (Site/Instrument Operator) ______________________________

Urgency: (check one)

- ☐ Emergency (failure to take action immediately may result in injury or property damage)
- ☐ Immediate (4 hours)
- ☐ Urgent (24 hours)
- ☐ Routine (7 days)
- ☐ As resources allow
- ☐ For information only

From: (Requestor) ______________________________

Problem Identification:

Site: ____________________________
System: ____________________________
Date: ____________________________
Time: ____________________________
Nature of Problem: ____________________________
____
____
____
Recommended Action: ____________________________
____

Signature: ____________________________ Date: ________________

Part B (to be completed by site/instrument operator)

Problem Resolution:

Date corrective action taken: ____________________________
Time corrective action taken: ____________________________
Corrective Action Summary: ____________________________
____
____
____

Signature: ____________________________ Date: ________________

QA Manager Signature: ____________________________ Date: ________________

Supervisor Signature: ____________________________ Date: ________________

Director Signature: ____________________________ Date: ________________

File completed original form in audit folder and file copies in instrument and data exception logs.

File Name: Corrective Action.xls
Last Revision: 11/21/19

Figure 3 Data Exception Log

Site: Year: Quarter:

Date	Begin Time	End Time	Parameter	Error Code											
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a
				g	P	s	i	+or-	x	m	C	e	f	o	a

Notes:

Appendix O: RadNet Procedures

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ______________________________

Title of Author: ______________________________

Signature: ______________________ Date: ____________

Name: ______________________________

Title: ______________________________

Signature: ______________________ Date: ____________

Name: ______________________________

Title: ______________________________

Signature: ______________________ Date: ____________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Acronyms and Abbreviations

AQMD	Washoe County Air Quality Management Division
CPM	Counts per Minute
EPA	U.S. Environmental Protection Agency
LPU	Local Processing Unit
NAREL	National Air and Radiation Environmental Laboratory
Pu	Plutonium
U	Uranium
UTC	Coordinated Universal Time

List of Figures and Tables

Figure 1: RadNet Sampler O-2
Figure 2: Map of RadNet Sampler Location O-3
Figure 3: RadNet Air Particulate Sample Report O-8

O.1. Introduction

The nationwide RadNet system monitors the nation's air, precipitation, drinking water, and pasteurized milk to track radiation in the environment. Over time, RadNet sample testing and monitoring results show the normal background levels of environmental radiation. The system will also detect higher than normal radiation levels during a radiological incident. RadNet has tracked radiation from atmospheric nuclear weapons tests and nuclear accidents at Chernobyl, Ukraine, and Fukushima, Japan.

O.2. Theory of Operation

RadNet has more than 100 stationary (fixed) radiation air monitors in 48 states. Another 40 portable (deployable) air monitors can be sent anywhere in the United States if needed. RadNet runs 24 hours a day, 7 days a week, and sends near-real-time measurements of beta and gamma radiation to EPA's National Air and Radiation Laboratory (NAREL). Computers continuously review this data. If there is a meaningful increase in radiation levels, laboratory staff immediately investigates. Continuously operating samplers (Figure 1) collect airborne particulates on filters that are collected twice weekly and sent to NAREL for analysis. Annual composites of the air particulates filters are analyzed for plutonium (Pu-238, Pu-239, Pu-240) and uranium (U-234, U-235, U-238).

Figure 1 RadNet Sampler

O.3. Instrument Operation

O.3.1 Sampling Procedure – Pulling and Installing a Clean Filter

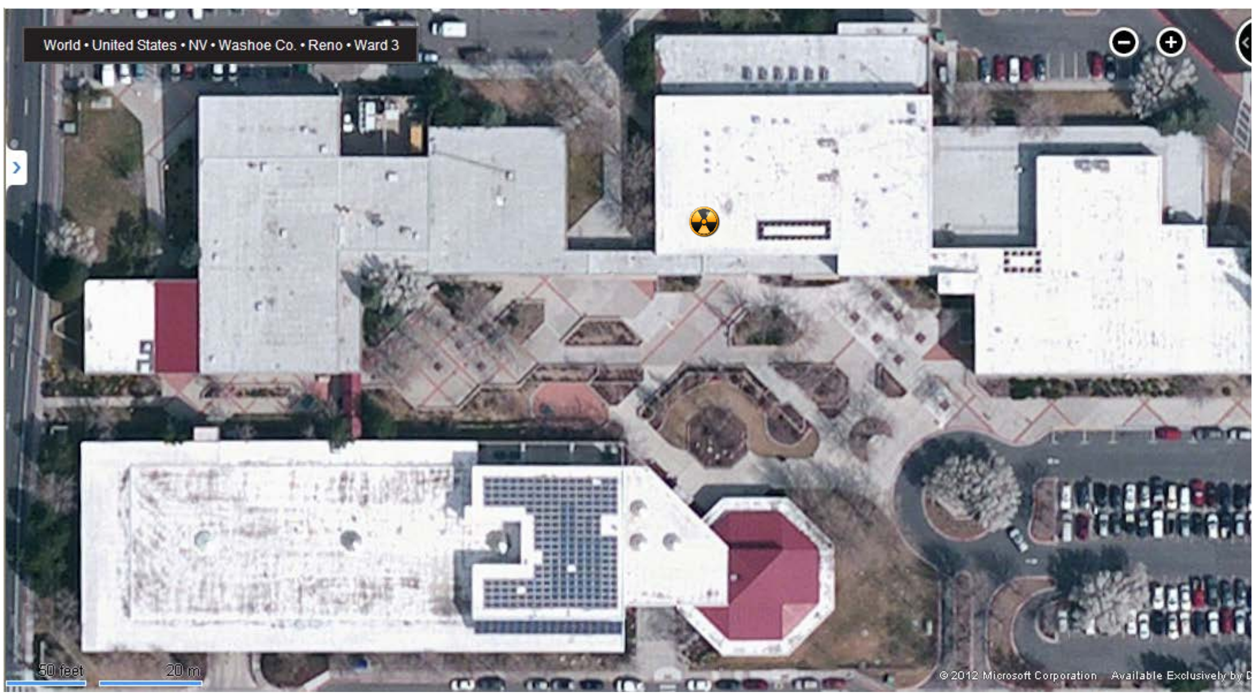
Equipment Needed

- Clean Filter
- Clean Glassine Sleeve
- EPA RadNet Mailing Envelope

Note: Filters should be replaced twice per week, preferably on Tuesday and Friday. However, the filter must be pulled within 6 days of installation.

Location:
Access the roof by going up the stairs across the hallway from the Assessor's Office in Building D. Keep going up the stairs until you see to a door labeled "Roof Access 2." Unlock using key labeled "SC9." Continue up the remaining flight of stairs to the door to the roof. Be sure to leave door propped open while working on the roof. Once on the roof, climb the ladder on the left and walk west toward the RadNet Sampler (see Figure 2 below).

Figure 2 Map of RadNet Sampler Location (☢ indicates location on rooftop of County Complex)



1. Open the front of the instrument using the key supplied by NAREL.
2. Pull out the keyboard from the Local Processing Unit (LPU).
3. Initiate the sequence to terminate by depressing the F2 function key. A prompt window will appear on the screen asking if you want to stop the monitor.
4. Press F1 (Final Stop) function key.

5. Record the STP Total Sampling Volume (m^3) from the screen onto the back of the EPA RadNet mailing envelope.
6. Record the Universal Time Coordinated (UTC) Sampling Start date and time on the back of the EPA RadNet mailing envelope.
7. Unlock and open the top of the instrument.
8. Lift the locking pin located at the base of the detector out of the positioning slot.
9. Gently push the detector assembly towards the back of the sampler until it is completely clear of the filter.
10. Unscrew the filter holder ring.
11. Remove the exposed filter with forceps and place filter in a clean glassine sleeve and place sleeve into the EPA provided mailing envelope.
12. Install the clean filter on top of the filter screen.
13. Replace and hand tighten the filter ring.
14. Return the detector to its operating position over the filter and lower the locking pin into the positioning slot.
15. Close and lock the top of the instrument.
16. Press the F2 (Gamma) function key. A warning will appear giving the operator time to provide any comments regarding the run.
17. Press F2 (Start) function key. Note: the Sampler will not begin pulling air for 12 minutes after the start function key has been pressed.
18. Latch and lock the front of the instrument. Return the envelope with the exposed filter to the Washoe County Air Quality Management Division (AQMD) office.
19. Open the RadNet folder located here: \\wcadmin\AQMonitoring$\Field Management Functions\RadNet
20. Open the current year folder and the most recent RadNet Air Particulate Sample Report.
21. Fill in the top portion of this form, shown with red outline in Figure 3.
22. "Save as" using date of filter removal.
23. Print out form and mail in RadNet mailing envelope with filter to EPA.

Figure 3 Air Particulate Sample Report

AIR PARTICULATE SAMPLE REPORT

RADNET
Tracking Environmental Radiation Nationwide

UNITED STATES ENVIRONMENT PROTECTION AGENCY
NATIONAL AIR AND RADIATION ENVIRONMENTAL LABORATORY
540 SOUTH MORRIS AVENUE
MONTGOMERY, AL 36115-2601
PHONE: (334) 270-3400 FACSIMILE: (334) 270-3454

THIS SECTION FOR USE BY NAREL PERSONNEL ONLY

SAMPLE ID: RAN - ____________ DATE RECEIVED: ____________

COMMENTS: ____________

SAMPLE INFORMATION

STATION NUMBER: 910 LOCATION: Reno, NV

DATE/TIME OF COLLECTION (Coordinated Universal Time): 4-Jan-19 17:26

NAME OF STATION OPERATOR: Michael Crawford

STATION OPERATOR'S TELEPHONE: (775) 784-7221

COMMENTS:

AIR SAMPLING DATA

SAMPLE START DATE/TIME (Coordinated Universal Time): 31-Dec-18 15:56

SAMPLE STOP DATE/TIME (Coordinated Universal Time): 4-Jan-19 17:26

TOTAL SAMPLE TIME (hours): 97.50 SAMPLE VOLUME (m^3): 5833.9

AVERAGE SAMPLE FLOW RATE (m^3/hour): 59.8

FIELD ACTIVITY CALCULATION

MEASUREMENT DATE/TIME (Coordinated Universal Time):
(UCT = EST +5 or EDT +4)

GROSS ALPHA/BETA CPM:

BACKGROUND CPM:

NET ALPHA/BETA CPM: 0

ALPHA CPM:		ALPHA CPM:	0
		NET BETA CPM:	0
ALPHA EFFICIENCY: X (pCi/cpm)	1.67	BETA EFFICIENCY: X (pCi/cpm)	1.16
ALPHA ACTIVITY (pCi):	0	BETA ACTIVITY (pCi):	0
SAMPLE VOLUME: (m^3) /	5833.9	SAMPLE VOLUME (m^3): /	5833.9
ALPHA CONCENTRATION:	0.000 (pCi/m^3)	BETA CONCENTRATION:	0.000 (pCi/m^3)
BETA/ALPHA RATIO:	#DIV/0!		

O.5.3 Annual RadNet Calibration

NAREL will perform annual calibrations on the RadNet Sampler.

O.5.4 Monthly Maintenance

Cleaning of the RadNet Sampler is done monthly or as needed. To clean RadNet Sampler, wipe the inside the top of the Sampler while it is in Final Stop mode so that it is free of dust and debris.

O.6 Troubleshooting

Contact the NAREL for troubleshooting and repair of the RadNet Sampler.

Contact Information:

- Dan Askren, Askren.Dan@epa.gov
- Scott Telofski, telofski.scott@epa.gov

Appendix P: Data Retrieval

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ______________________________

Title of Author: ______________________________

Signature: ______________________ Date: ____________

Name: ______________________________

Title: ______________________________

Signature: ______________________ Date: ____________

Name: ______________________________

Title: ______________________________

Signature: ______________________ Date: ____________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:__________________________Date:_____________

Name: ____

Title: ____

Signature:__________________________Date:_____________

Name: ____

Title: ____

Signature:__________________________Date:_____________

Name: ____

Title: ____

Signature:__________________________Date:_____________

Name: ____

Title: ____

Signature:__________________________Date:_____________

Acronyms and Abbreviations

AQMD	Washoe County Air Quality Management Division
AQS	Air Quality System
BAM	Beta Attenuation Monitor
EPA	U.S. Environmental Protection Agency
SOP	Standard Operating Procedure
WCAIRVIS	Washoe County AirVision Server

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Figure 2: AirVision Task Scheduler Screen P-2
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Figure 5: Task Schedule Details P-3

P.1. Purpose

The purpose of this Standard Operating Procedure (SOP) is to establish uniform procedures for the retrieval, all data collected by the Washoe County Air Quality Management Division (AQMD) Ambient Air Monitoring Program.

P.2. Summary of Method

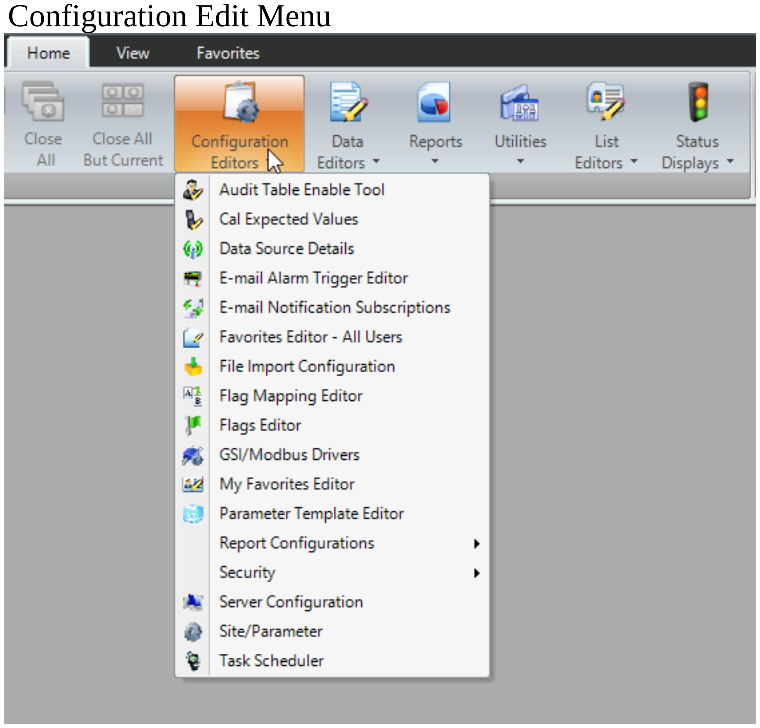
The AQMD collects data for both continuous and manual methods. Agilaire LLC is the data acquisition software and data logger vendor. AirVision software is used to communicate with the Model 8872 Agilaire data loggers and Met-One Beta Attenuation Monitors (BAMs) via direct polling that are located at the monitoring sites. The AirVision data management system downloads all continuous data from each monitoring site to a dedicated Washoe County AirVision Server (WCAIRVIS) located in the AQMD office. All manual methods are collected in the field by the air monitoring staff and returned to the lab located in the AQMD. After post filters are equilibrated and weighed, data is manually entered into AirVision's Sample Data Editor (See Appendix Q). All data collected by the Ambient Air Monitoring Program goes through a rigorous review process before being submitted to the U.S. Environmental Protection Agency's (EPA) Air Quality System (AQS).

P.3. Procedure

Data is collected hourly from all AQMD sites that perform continuous pollutant monitoring. The collection of data is done automatically by AirVision. The hourly polling schedule is configured on the Task Scheduler Configuration Editor of the AirVision application.

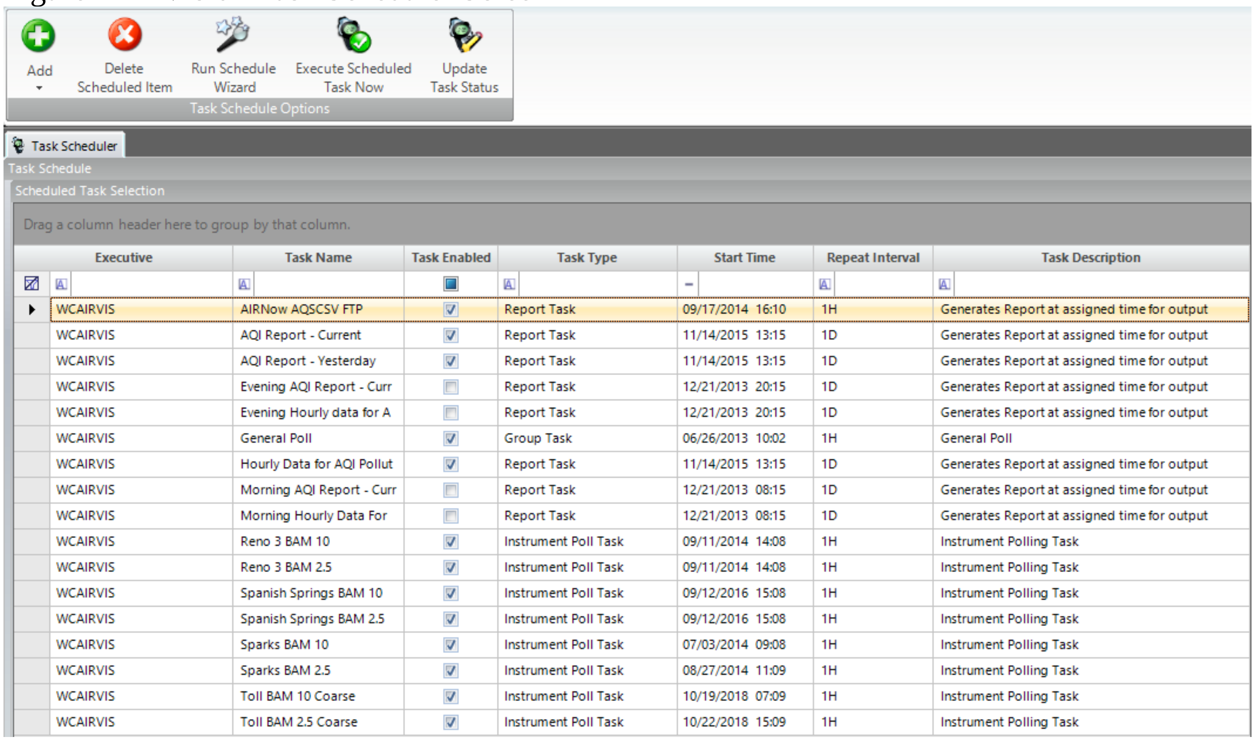
1. To configure the polling schedule launch AirVision and select the Configuration Editor task. See Figure 1.

Figure 1 AirVision Configuration Edit Menu



2. From the drop down, select Task Scheduler. This lists all of the polling, file transfer processes, report, and group tasks that are conducted by AirVision. See Figure 2.

Figure 2 AirVision Task Scheduler Screen



Executive	Task Name	Task Enabled	Task Type	Start Time	Repeat Interval	Task Description
WCAIRVIS	AIRNow AQSCSV FTP	☑	Report Task	09/17/2014 16:10	1H	Generates Report at assigned time for output
WCAIRVIS	AQI Report - Current	☑	Report Task	11/14/2015 13:15	1D	Generates Report at assigned time for output
WCAIRVIS	AQI Report - Yesterday	☑	Report Task	11/14/2015 13:15	1D	Generates Report at assigned time for output
WCAIRVIS	Evening AQI Report - Curr	☐	Report Task	12/21/2013 20:15	1D	Generates Report at assigned time for output
WCAIRVIS	Evening Hourly data for A	☐	Report Task	12/21/2013 20:15	1D	Generates Report at assigned time for output
WCAIRVIS	General Poll	☑	Group Task	06/26/2013 10:02	1H	General Poll
WCAIRVIS	Hourly Data for AQI Pollut	☑	Report Task	11/14/2015 13:15	1D	Generates Report at assigned time for output
WCAIRVIS	Morning AQI Report - Curr	☐	Report Task	12/21/2013 08:15	1D	Generates Report at assigned time for output
WCAIRVIS	Morning Hourly Data For	☐	Report Task	12/21/2013 08:15	1D	Generates Report at assigned time for output
WCAIRVIS	Reno 3 BAM 10	☑	Instrument Poll Task	09/11/2014 14:08	1H	Instrument Polling Task
WCAIRVIS	Reno 3 BAM 2.5	☑	Instrument Poll Task	09/11/2014 14:08	1H	Instrument Polling Task
WCAIRVIS	Spanish Springs BAM 10	☑	Instrument Poll Task	09/12/2016 15:08	1H	Instrument Polling Task
WCAIRVIS	Spanish Springs BAM 2.5	☑	Instrument Poll Task	09/12/2016 15:08	1H	Instrument Polling Task
WCAIRVIS	Sparks BAM 10	☑	Instrument Poll Task	07/03/2014 09:08	1H	Instrument Polling Task
WCAIRVIS	Sparks BAM 2.5	☑	Instrument Poll Task	08/27/2014 11:09	1H	Instrument Polling Task
WCAIRVIS	Toll BAM 10 Coarse	☑	Instrument Poll Task	10/19/2018 07:09	1H	Instrument Polling Task
WCAIRVIS	Toll BAM 2.5 Coarse	☑	Instrument Poll Task	10/22/2018 15:09	1H	Instrument Polling Task

3. To configure a new task click on Add. Select from the drop down the relevant task. To start a new site click on the General Poll Group Task. The lower window will appear where you then click on Edit Task. Here you can add, edit, or remove the monitoring site level Sub Tasks of the General Poll Group Task. Set the schedule for time and how often the system will perform data polling. Click Save.

Figure 3 AirVision General Poll Task Detail

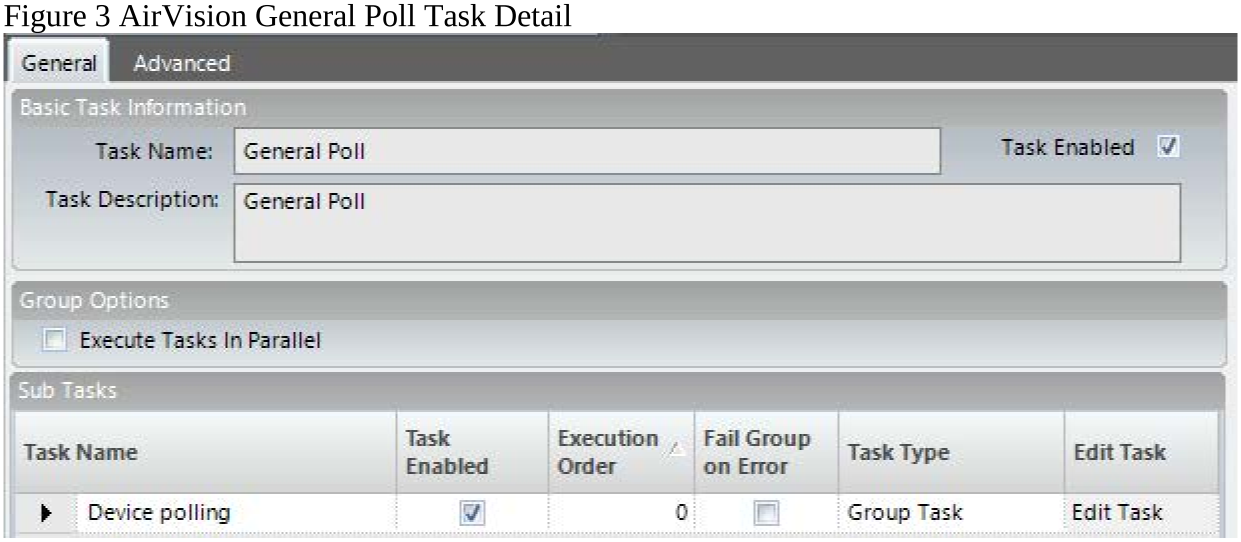
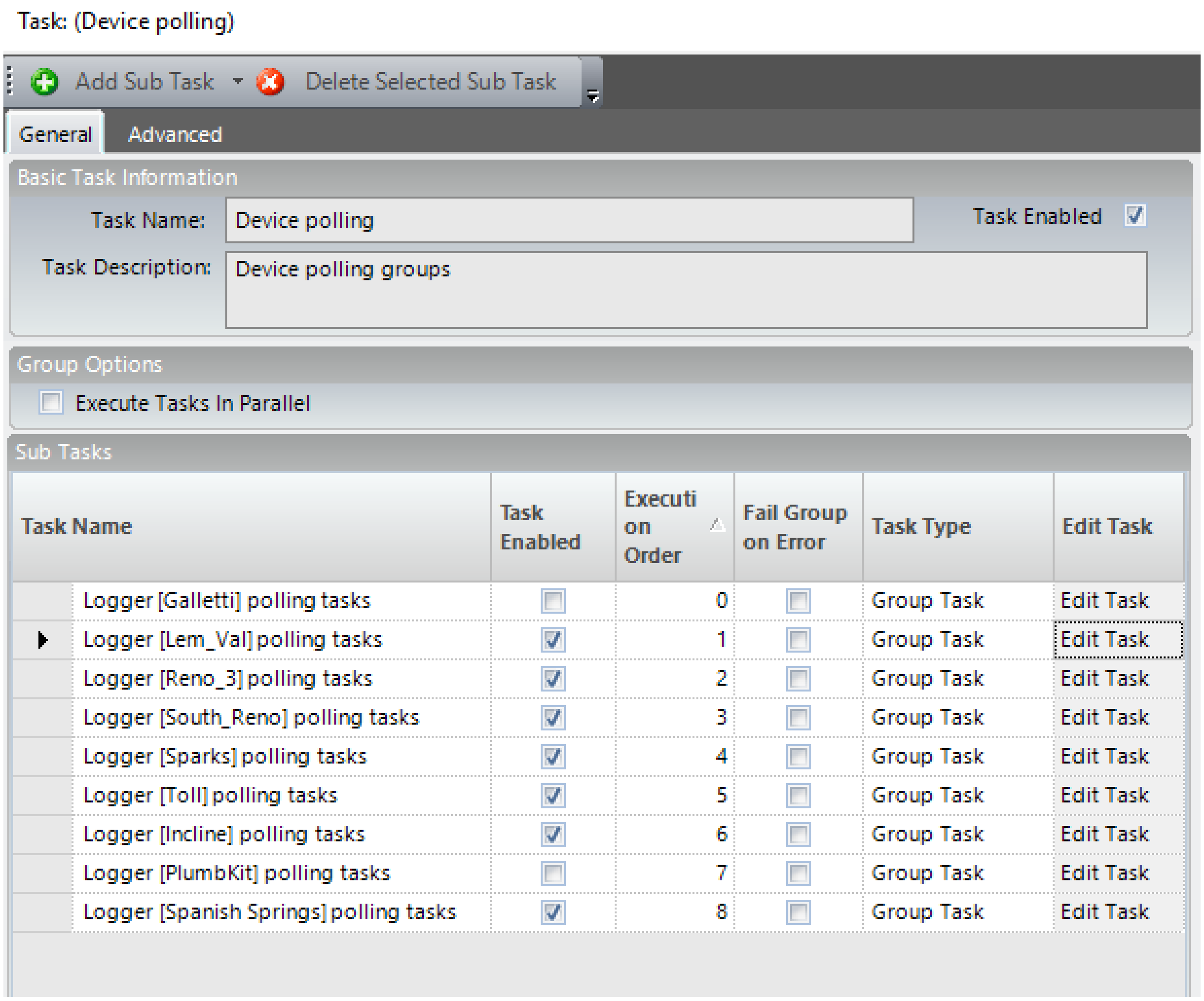
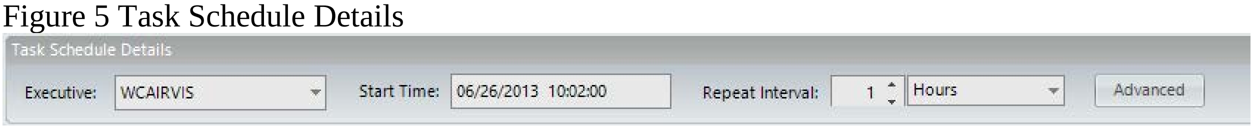


Figure 4 AirVision Group Task within a General Poll Task Detail



5. To edit an existing schedule, launch the Task Scheduler and make the necessary changes to the start time and interval in the Task Schedule Details. Once the changes are complete, click on Save.

Figure 5 Task Schedule Details



6. Once the configuration process is in place the polling module will begin polling each site by use of a wireless service and download the data to WCAIRVIS.

P.4. Quality Control and Quality Assurance

To ensure that the data polling system is collecting the correct pollutant concentrations from the correct sites, the data housed in the WCAIRVIS server is compared directly to the values from and the site's data logger. This system of cross checking is performed until staff determines that the data acquisition system is performing with 100 percent accuracy.

Appendix Q: Data Validation for Data Management System (Continuous and Manual Monitoring Methods)

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ____

Title of Author: ______________________________________

Signature: ___________________________ Date: ______________

Name: ____

Title: ____

Signature: ___________________________ Date: ______________

Name: ____

Title: ____

Signature: ___________________________ Date: ______________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Name: ____

Title: ____

Signature:___________________________Date:_____________

Acronyms and Abbreviations

AQS	Air Quality System
AV	Agilaire AirVision
BAM	Beta Attenuation Monitor
EPA	U.S. Environmental Protection Agency
ESC	Environmental Systems Corporation
QC	Quality Check
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedure
AQMD	Washoe County Health District Air Quality Management Division

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Q.1. Purpose

The purpose of this Standard Operating Procedure (SOP) is to establish uniform procedures for the review and editing of all continuous methods data collected by the Agilaire AirVision (AV) data management system for the Washoe County Health District Air Quality Management Division (AQMD) Ambient Air Monitoring Program.

Q.2. Summary of Method

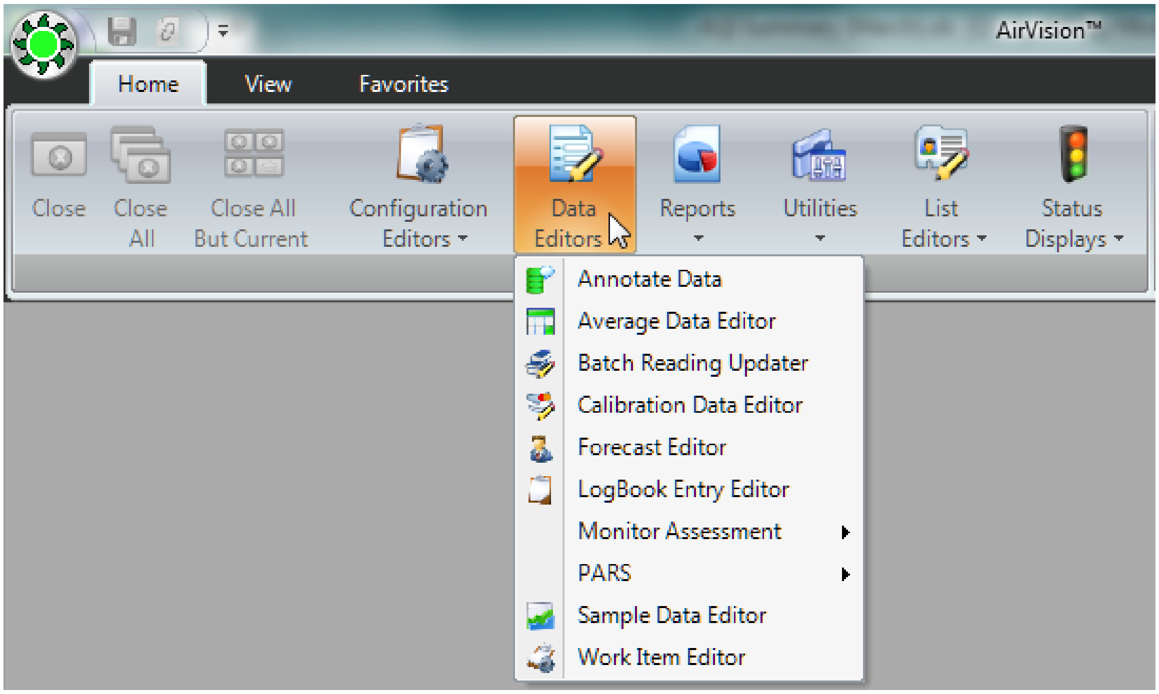
AQMD collects data for both continuous and manual methods. The AV data management system is used to review and edit all data collected from the individual monitoring sites. All the data is stored on an off-site secure server operated by Agilaire, LLC. All manual methods are collected in the field by the air monitoring staff and returned to the lab located in the AQMD office. Each monitoring site has an ESC (Environmental Systems Corporations) Data Logger that stores the all of the sample values from the field equipment. Monitoring sites with at least one beta attenuation monitor (BAM) also send the data via direct polling. When AQMD staff performs any type of equipment maintenance, span checks, multipoint checks, etc; field staff puts the pollutant channel into maintenance which flags the data as being invalid. The data loggers and BAMs are automatically programmed to flag data when there is a power interruption at the site. All data collected by the Ambient Air Monitoring Program goes through a rigorous review process before being submitted to the United States Environmental Protection Agency's (EPA) Air Quality System (AQS).

Q.3. Procedure

1) Once a month the Data Manager reviews, edits and prepares the data for distribution to the monitoring staff for a final quality check (QC) and approval. To begin the edit process, retrieve the data exception log for the corresponding site to be edited located in the monitoring site binders found in the Data Manager's office.

2) Next, launch the AV data management system and choose the Data Editors drop down in the Tasks Menu seen in Figure 1.

Figure 1 Data Editors Menu

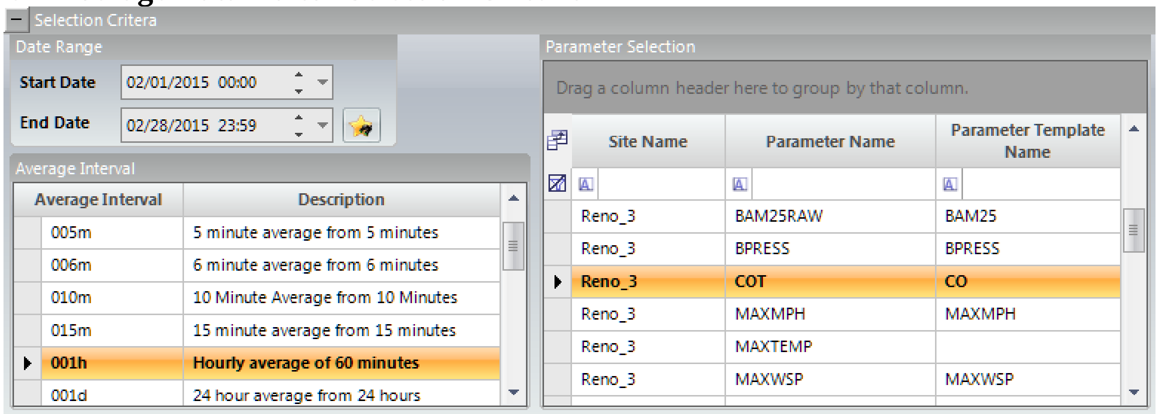


3) From the Data Editor drop down choose the Average Data Editor to edit continuous data, the Sample Data Editor to edit filter data, and Monitor Assessment to edit precision & accuracy data.

Average Data Editor

1) For the Average Data Editor, maximize the Selection Criteria and choose the desired date and hour ranges, parameter, and average interval
   a) Use “001h - Hourly average of 60 minutes” for continuous hourly data
   b) Use “005m – 5 minute average from 5 minutes” for continuous 5 minute Sulfur Dioxide (SO_2) data.
2) Click Retrieve Data.
3) Average Data Editor defaults to the Linear Data Presentation Option. Change to other presentation formats if desired.
   a) Matrix Data presentation is the preferred option.

Figure 2 Average Data Editor Selection Criteria



4) Referring to the data exception log, edit the hours or minutes of data by left clicking.
   a) To edit individual hours or minutes represented by one cell, right click on that cell. See Figure 3.
      i) Select the View All Flags option.
      ii) Select the relevant flag for the hour or minute average by left clicking the square in the Selected column.
         (1) For an invalid hour, less than 75% data capture, make sure the Logger Invalid and the desired flag are selected in combination.
         (2) For a valid hour, greater than 75% data capture, make sure the Some Data Missing and the desired flag are selected in combination.
   b) To edit more than one hour or minute hold the left click and drag or hold CTRL and left click cells. Right click one of the cells selected. See Figure 4.
      i) Select the Batch Edit option.
      ii) Select Set Flags.
      iii) Click the Enabled box.
      iv) Select the relevant flag for the hours or minutes average by left clicking the square in the Selected column.
         (1) For an invalid hour, less than 75% data capture, make sure the Logger Invalid and the desired flag are selected in combination.
         (2) For a valid hour, greater than 75% data capture, make sure the Some Data Missing and the desired flag are selected in combination.

5) Click OK followed by the save icon ( ) located in the upper left corner after each edit. See Figure 1.

Figure 3 Setting Data Flags for One Cell

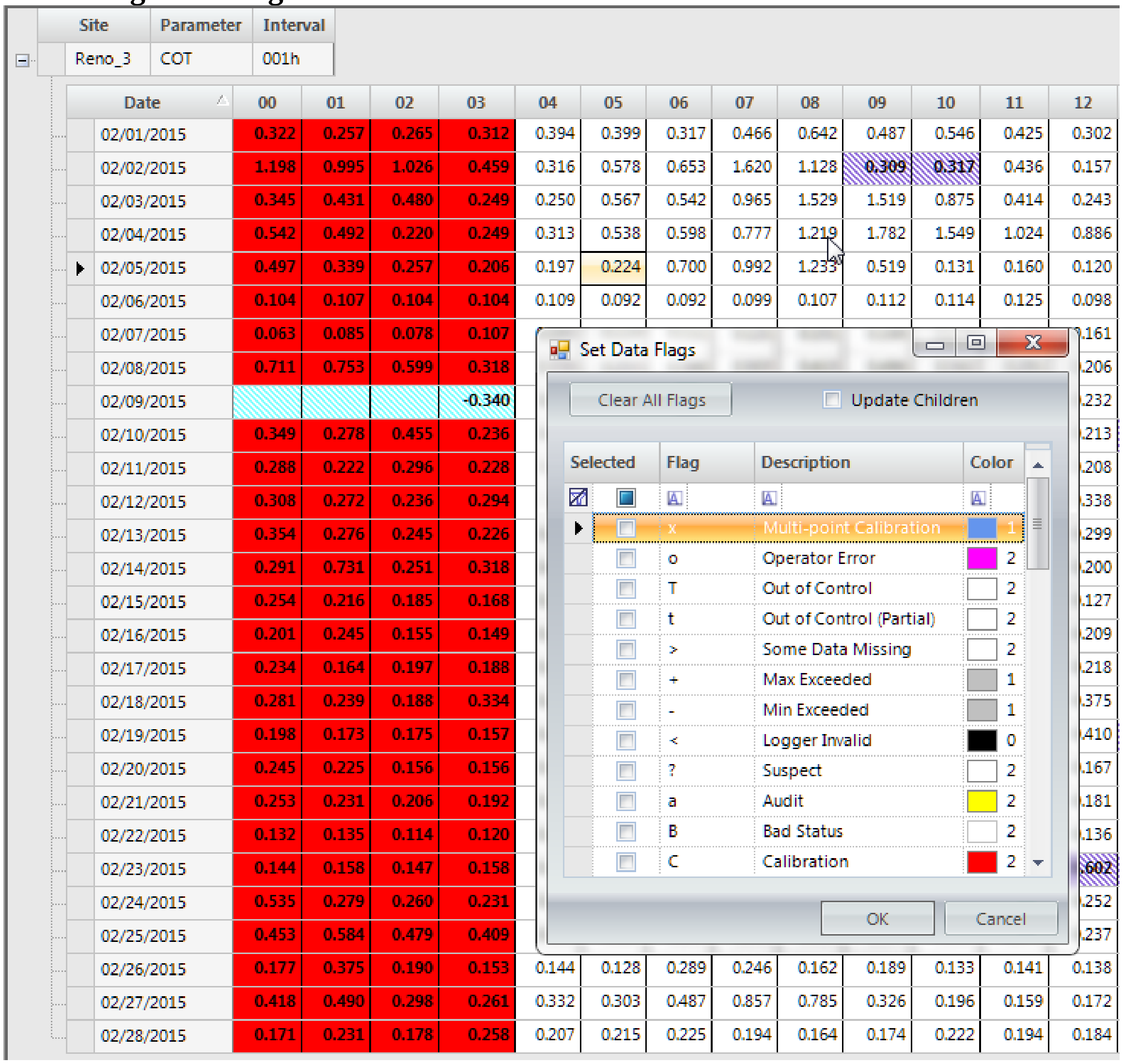
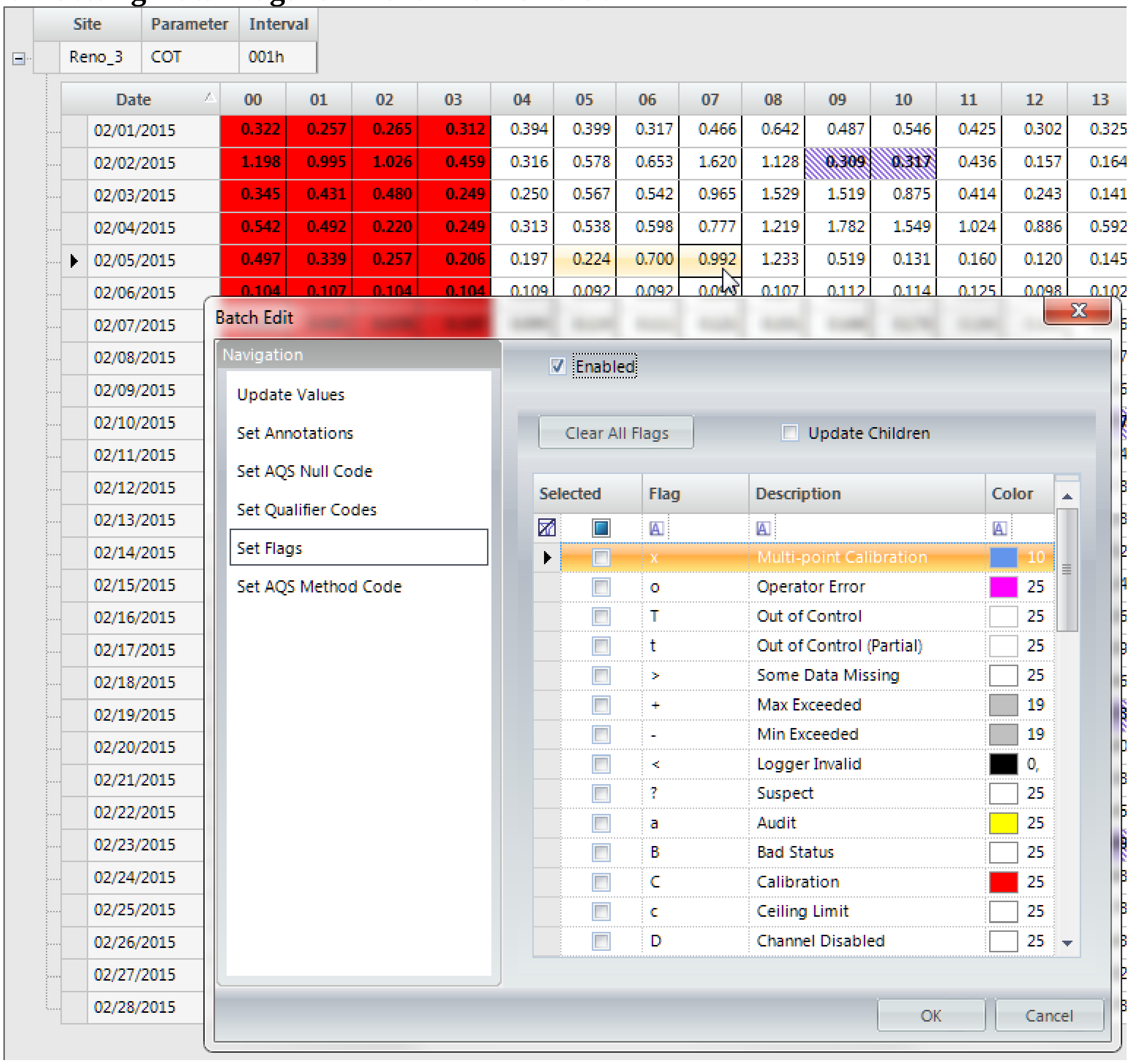


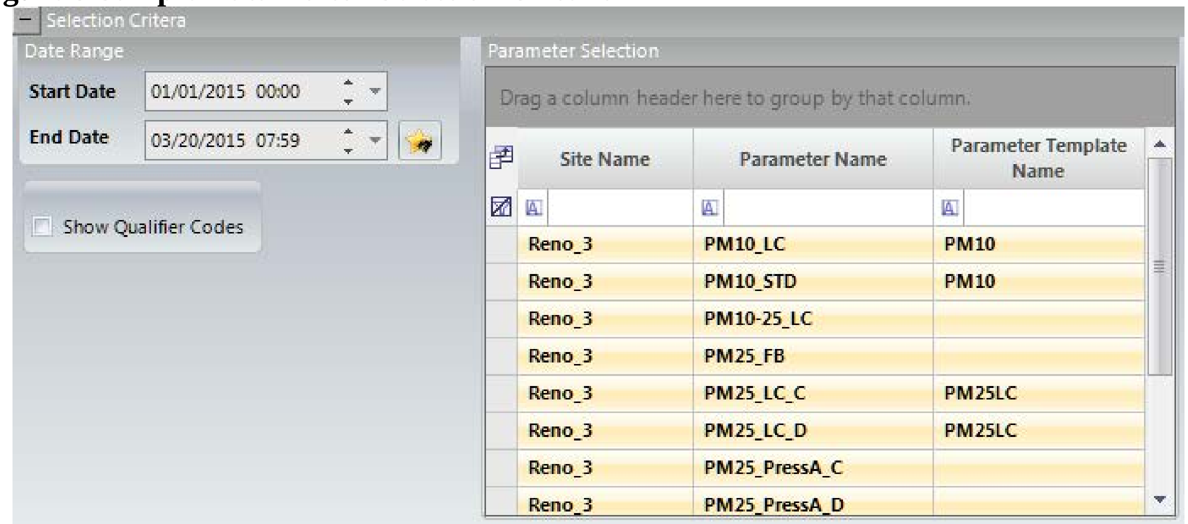
Figure 4 Setting Data Flags for More Than One Cell



Sample Data Editor

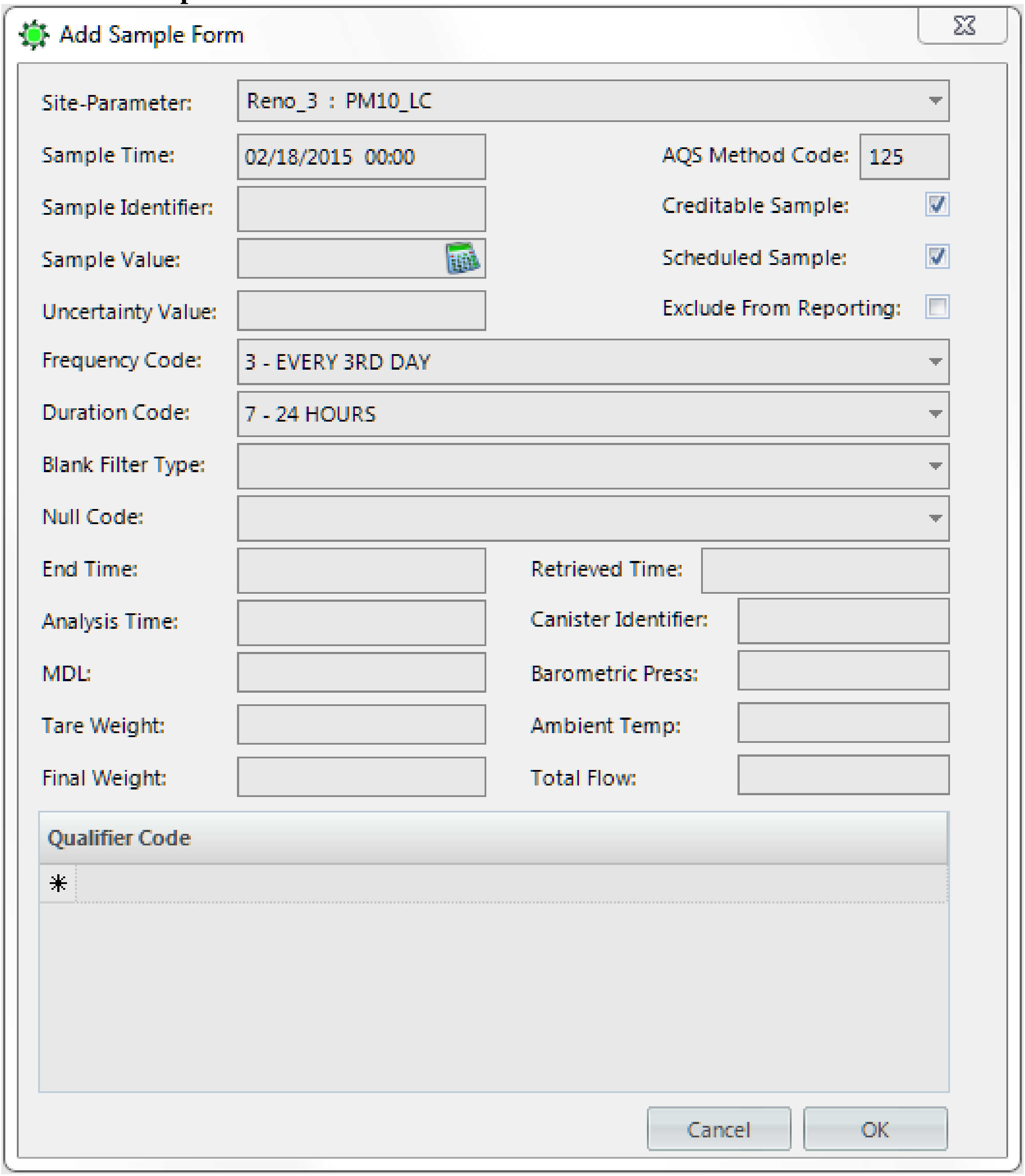
1) For the Sample Data Editor, maximize the Selection Criteria and choose the desired date and hour ranges and parameter.
    a) Click and drag on all of the parameters listed in the Parameter Selection.
2) Click Retrieve Data.
3) Sample Data Editor defaults to the Linear Data Presentation Option. Change to other presentation formats if desired
    a) Linear Data presentation is the preferred option.

Figure 5 Sample Data Editor Selection Criteria



4) Click Retrieve Data. This is to show previous sample data entries if there are any.
5) To create a data point Click the Add button.
6) Select the Site-Parameter from the drop down menu in the Add Sample Form. See Figure 6.
7) Select the Sample Time with the date and always use 00:00 for the time.
    a) Make sure:
        i) Creditable and Scheduled Sample boxes are selected.
        ii) Frequency Code is set to 3 – Every 3rd Day
        iii) Duration Code is set to 7 – 24 Hours
8) Type in sample value from the relevant Field Sample Reports (Appendix E BGI; Figure 3).
    a) For Field Blank values select FIELD from the drop down Blank Filter Type Menu.
9) To edit sample value select the relevant null code from the Null Code drop down menu.
10) Click OK followed by the save icon ( ) located in the upper left corner after each entry and edit. See Figure 1.

Figure 6 Add Sample Form



Monitor Assessment Data Editors

1) For the Monitor Assessment data editors, find the Monitor Assessment option under the Data Editor.
2) There are four types of Monitor Assessments to be edited. Select from four possible Monitor Assessment Types.
    a. 1-Point Quality Control – Precision Data
    b. Annual Performance Evaluation – Audit Data
    c. Flow Rate Verification – Bi-weekly Flow Check Data
    d. Semi-Annual Flow Rate Audit – Flow Check Audit Data
3) Input values from the parameter worksheets and forms found in the Control Charts folder and/or Monitoring Site binders in Test Results.
4) Click the save icon ( ) located in the upper left corner after each entry.

Figure 7 Monitor Assessment: 1-Point QC

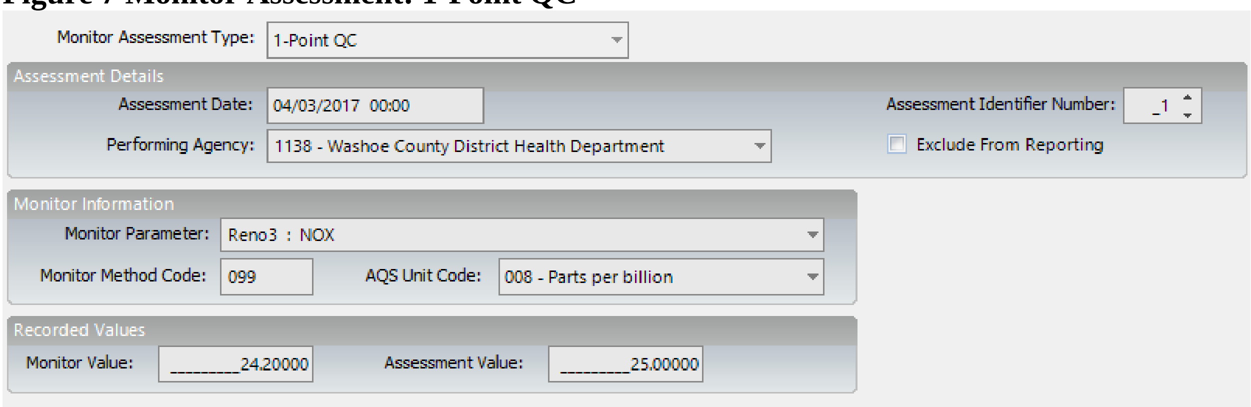


Figure 8 Monitor Assessment: Annual Performance Evaluation

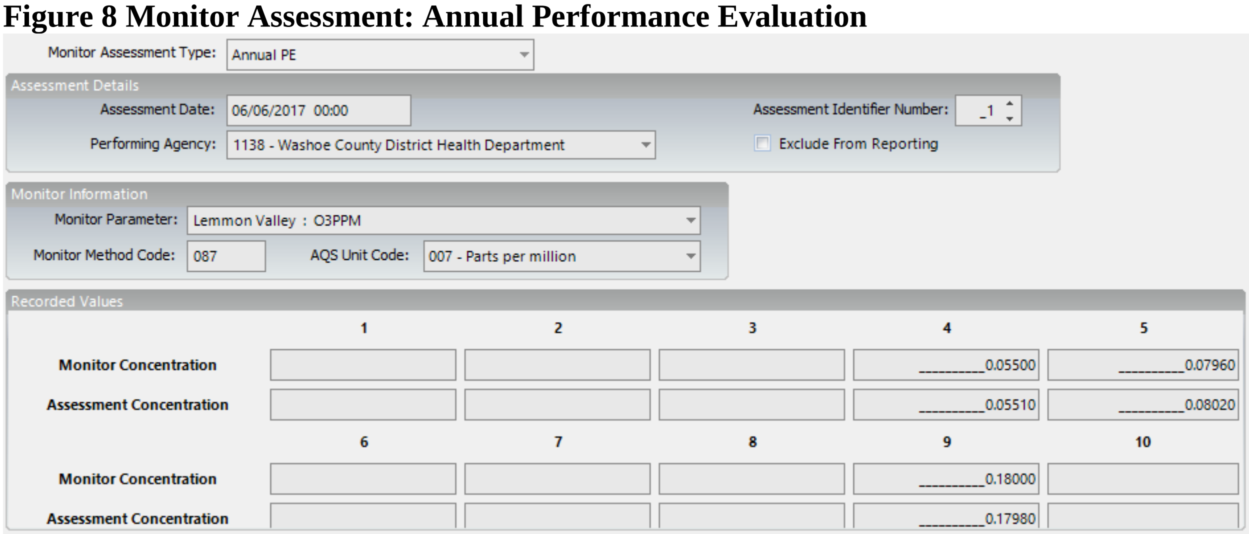
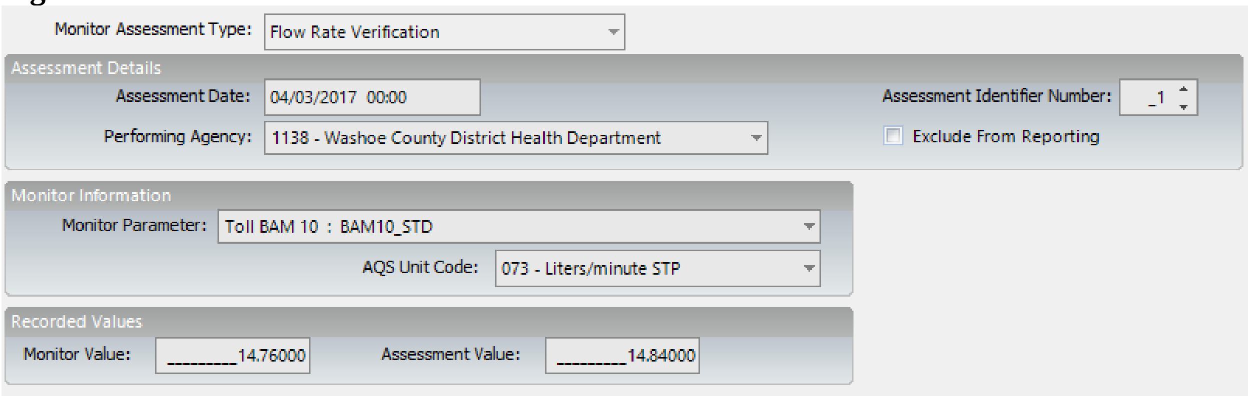


Figure 9 Monitor Assessment: Flow Rate Verification


Monitor Assessment Type: Flow Rate Verification

Assessment Details

Assessment Date: 04/03/2017 00:00
Performing Agency: 1138 - Washoe County District Health Department
Assessment Identifier Number: _1
Exclude From Reporting

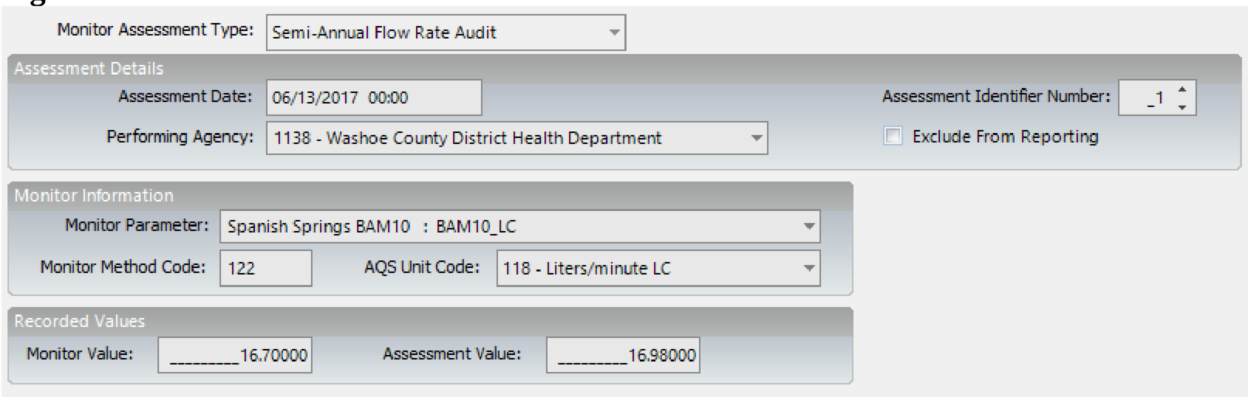
Monitor Information

Monitor Parameter: Toll BAM 10 : BAM10_STD
AQS Unit Code: 073 - Liters/minute STP

Recorded Values

Monitor Value: _________14.76000
Assessment Value: _________14.84000

Figure 10 Monitor Assessment Semi-Annual Flow Rate Audit


Monitor Assessment Type: Semi-Annual Flow Rate Audit

Assessment Details

Assessment Date: 06/13/2017 00:00
Performing Agency: 1138 - Washoe County District Health Department
Assessment Identifier Number: _1
Exclude From Reporting

Monitor Information

Monitor Parameter: Spanish Springs BAM10 : BAM10_LC
Monitor Method Code: 122
AQS Unit Code: 118 - Liters/minute LC

Recorded Values

Monitor Value: _________16.70000
Assessment Value: _________16.98000

Q.4. Quality Control and Quality Assurance

Once the monthly data has been edited a monthly data matrix report for each site is printed out and given to all the Site Technicians for review.

Monthly Report Generation Procedure
1) To create the report in AV, go to the Reports Task and select Monthly Report.
2) Select relevant parameters and make sure Show Flags option is selected.
3) Click Generate Report.
4) Click Excel to export for post-processing.
5) Click OK.
6) Save in the Data Review folder.
7) Post-process in Excel to include Max and Min columns.

The Senior Site Technician takes an inventory of the printed monthly reports to ensure a complete data package using the Monthly Data QC Parameter Checklist (see Figure 9). All Site Technicians review and make any necessary notes and corrections to the data and return the marked up matrix reports to the Data Manager. If any corrections to the current month's data review affect a previous month's data, then that is noted on the current month's Monthly Data QC Parameter Checklist. The Data Manager reviews the matrix reports. If all comments for the flagged values match then the final changes are made in the data editor and saved. If there is disagreement among the technicians, the Data Manger will meet with the Site Technicians to discuss the data and a final conclusion can be reached.

Once the second set of edits are complete a new set of matrix reports are printed out and disseminated among the Site Technicians for final review and approval. If more edits are noted in the second (third, fourth, etc.) set, another review is required before a final approval.

Figure 11 Monthly Data QC Parameter Checklist

WASHOE COUNTY HEALTH DISTRICT
ENHANCING QUALITY OF LIFE

Monthly Data QC Parameter Checklist

Month/Year:___________ /___________

Reno 3

- ☐ COT
- ☐ O3
- ☐ SO2T
- ☐ NO
- ☐ NO2
- ☐ NOX
- ☐ NOT
- ☐ NO2Y
- ☐ NOY
- ☐ BAM10_STD
- ☐ BAM10_LC
- ☐ BAM2.5
- ☐ BAM10-2.5
- ☐ WSP
- ☐ WSPVECT
- ☐ WDR
- ☐ WDRVECT
- ☐ ATEMP
- ☐ RELHUM

Incline

- ☐ O3

South Reno

- ☐ O3
- ☐ WSP
- ☐ WDR
- ☐ ATEMP

Sparks

- ☐ CO
- ☐ O3
- ☐ BAM10_STD
- ☐ BAM10_LC
- ☐ BAM2.5
- ☐ BAM10-2.5
- ☐ WSP
- ☐ WDR
- ☐ ATEMP

Lemmon Valley

- ☐ O3

Spanish Springs

- ☐ O3
- ☐ BAM10_STD
- ☐ BAM10_LC
- ☐ BAM2.5
- ☐ BAM10-2.5
- ☐ WSP
- ☐ WDR
- ☐ ATEMP

Toll

- ☐ O3
- ☐ BAM10_STD
- ☐ BAM10_LC
- ☐ BAM2.5
- ☐ BAM10-2.5
- ☐ WSP
- ☐ WDR
- ☐ ATEMP

Previous Month(s) Data Affected? Y or N

If Yes, Site / Parameter / Month(s) __________ /__________ /__________

Data Package Completeness Check

Date:___________ Initials:___________

Appendix S: File Generation for Continuous, Manual, and Quality Assurance Data

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ____

Title of Author: ______________________________________

Signature: ___________________________ Date: ______________

Name: ____

Title: ____

Signature: ___________________________ Date: ______________

Name: ____

Title: ____

Signature: ___________________________ Date: ______________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:____________________________Date:____________

Name: ____

Title: ____

Signature:____________________________Date:____________

Name: ____

Title: ____

Signature:____________________________Date:____________

Name: ____

Title: ____

Signature:____________________________Date:____________

Name: ____

Title: ____

Signature:____________________________Date:____________

Acronyms and Abbreviations

AQMD	Washoe County Health District, Air Quality Management Division
AQS	Air Quality System
CO	Carbon Monoxide
EPA	U.S. Environmental Protection Agency
FRM	Federal Reference Method
NCore	National Core Multi-Pollutant Monitoring Station
QA	Quality Assurance
QC	Quality Control
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedures
$PM_{2.5}$	Particulate Matter less than or equal to 2.5 microns in aerodynamic diameter
PM_{10}	Particulate Matter less than or equal to 10 microns in aerodynamic diameter
PM_{coarse}	PM_{10} minus $PM_{2.5}$
Z/P/S	Zero/Precision/Span

Figures and Tables

Figure 1: AirVision Report Menu S-2
Figure 2: Data Editing Main Menu S-3
Figure 3: Sample Text File Generated S-3
Table 1: Flag Table: AirVision to AQS S-4

S.1 Purpose

The purpose of this Standard Operating Procedure (SOP) is to establish uniform procedures for the generation of files for continuous, manual, and quality assurance (QA) monitoring data. These data files of criteria, non-criteria, meteorological, and QA parameters are then loaded into the Air Quality System (AQS) in order to meet the Environmental Protection Agency (EPA) regulations. The EPA requires environmental agencies to report air monitoring data at least quarterly to AQS. Data for one calendar quarter are due to EPA by the end of the following quarter.

S.2 Summary of Method

The AQMD collects data for both continuous and manual methods in addition to the QA data for these methods. Agileaire is the data acquisition software vendor. AirVision is used to communicate with the Model 8872 Agilaire data loggers and Met-One Beta Attenuation Monitors (BAMs) via direct polling that are located at the monitoring sites. The AirVision data management system downloads all continuous data from each monitoring site to a dedicated Washoe County AirVision Server (WCAIRVIS) located in the IT Department. All manual methods are collected in the field by the air monitoring staff and returned to the lab located in the AQMD. After post filters are equilibrated and weighed, data is manually entered into AirVision's Sample Data Editor (See Appendix Q). Quality assurance data is manually entered in AirVision after field staff records data on worksheets.

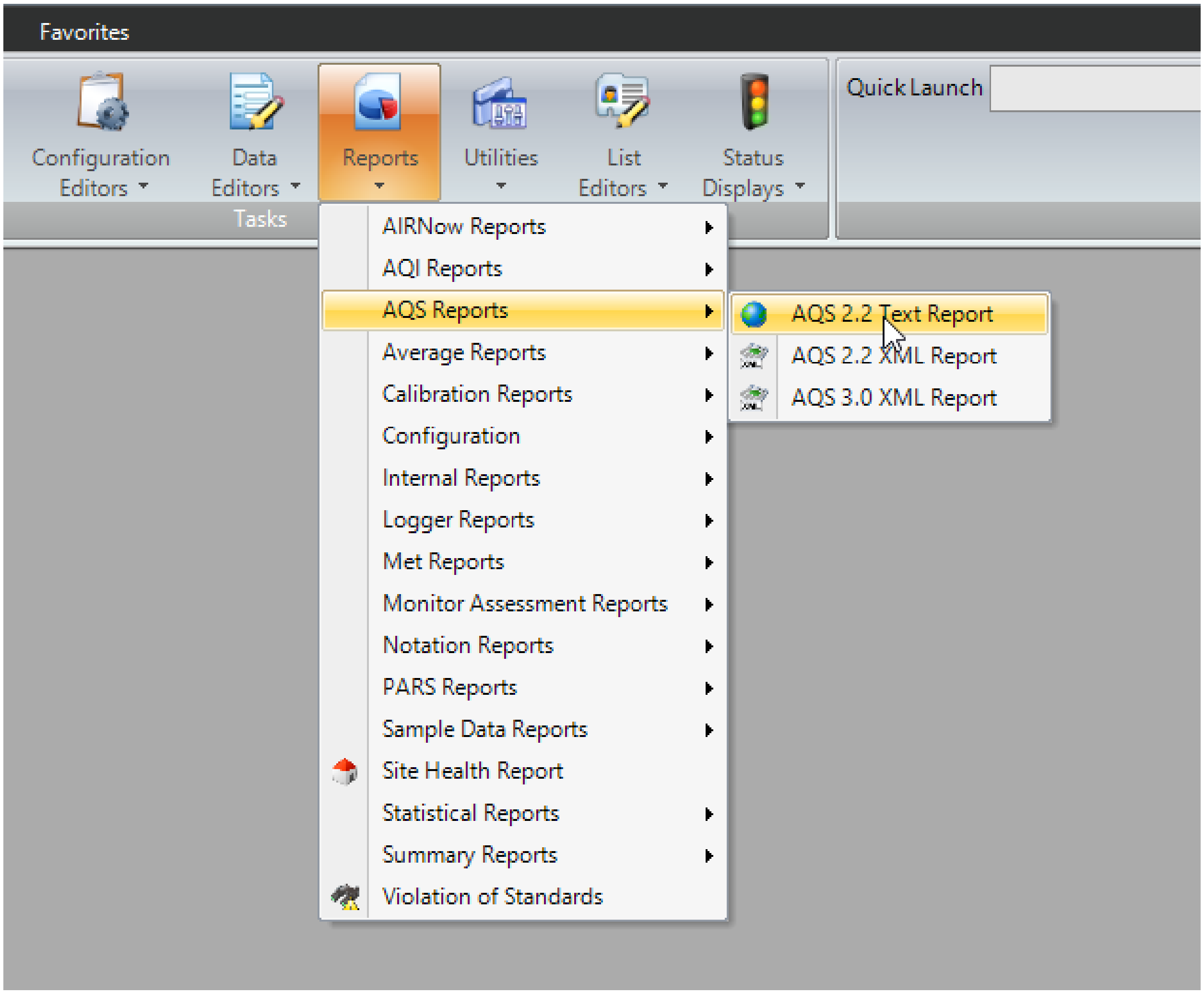
In order to meet the EPA's requirements of loading the continuous, manual, and QA monitoring data into AQS every quarter before the end of the following quarter, the Washoe County Health District, Air Quality Management Division (AQMD) generates data files and loads the previous quarter data a month prior to the end of the quarter to ensure quality assurance and quality control (QC) measures on the continuous monitoring data have been conducted and that any troubleshooting involving the review of the data during these procedures or the loading of the data into AQS can be resolved.

S.3. Continuous Data Procedure

Data is collected hourly from all AQMD sites that perform continuous pollutant monitoring. The collection of data is done automatically by AirVision's Task Scheduler (See Appendix P). A month before the end of the current quarter, last quarter's data files are to be generated. The following steps are to be followed in order to generate AQS compatible text files.

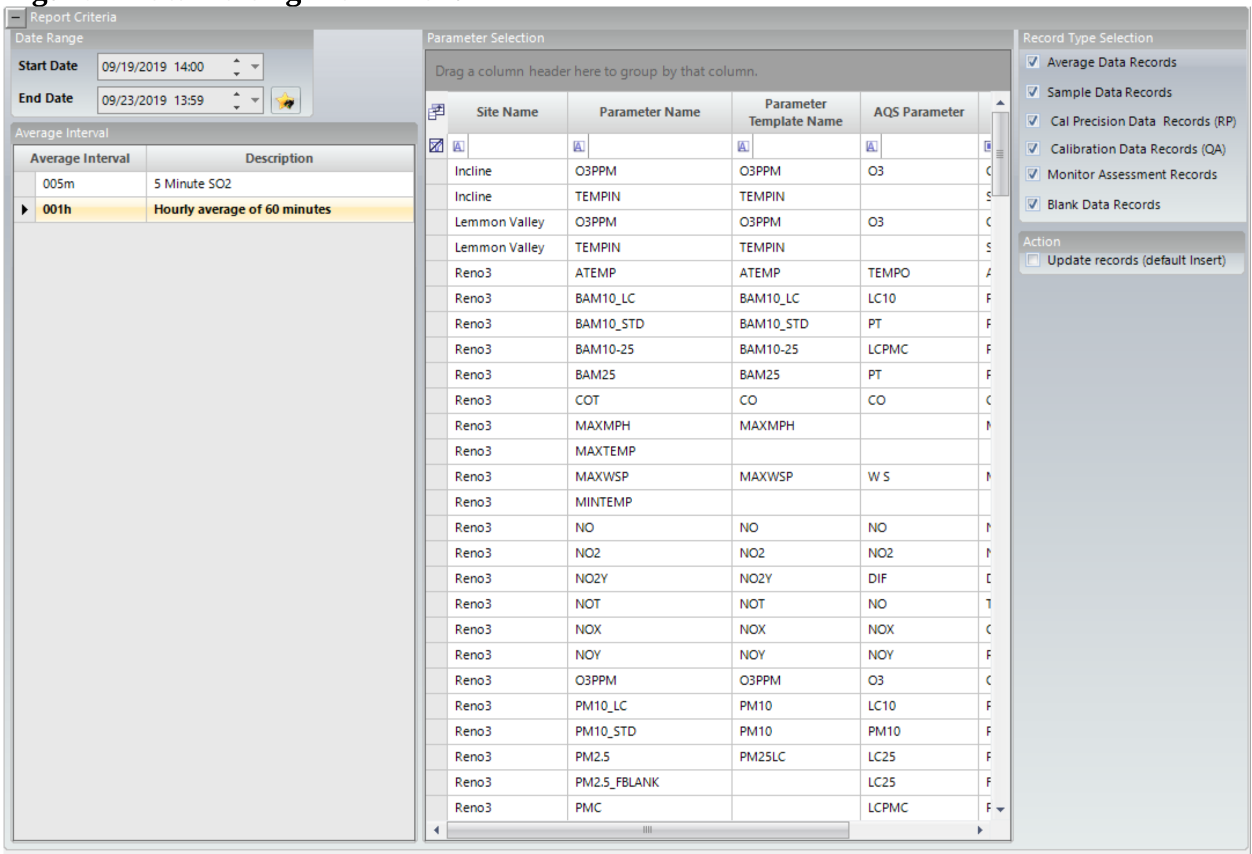
1. To generate files for the continuous monitoring methods, launch AirVision.

Figure 1 AirVision Report Menu



2. Select Reports followed by AQS Reports and then AQS 2.2 Text Reports.

Figure 2 Data Editing Main Menu



3. Deselect all except for "Average Data Records" in the Record Type Selection.
4. Select the appropriate range from the 1st of the month to the last day, e.g. 01 Dec 2019 00:00 to 31 Dec 2019 23:59.
5. Select the "Hourly average of 60 minutes" in the Average Interval field
    a. Select 5 minute SO2 for 5 minute SO2 data.
6. Select only one station and parameter at a time. Click Generate Report. A list of files similar to Figure 3 will be populated in the Report Output viewer.
7. Click "Save to File" to save it on the Monitoring Drive under the Continuous AQS Submittal Files folder. Select the appropriate year and month folders with the following format:
    a. SPK_CO_Dec19: Sample file name for Sparks Carbon Monoxide (CO) for December 2019.
8. Click Save to generate the file.

Figure 3 Sample Text File Generated

```
RD|I|32|031|1005|88101|1|1|105|170|20191217|01:00||AN|||||||||||||
RD|I|32|031|1005|88101|1|1|105|170|20191217|02:00||AN|||||||||||||
RD|I|32|031|1005|88101|1|1|105|170|20191217|03:00|0.2||||||||||||||
RD|I|32|031|1005|88101|1|1|105|170|20191217|04:00|0.5||||||||||||||
RD|I|32|031|1005|88101|1|1|105|170|20191217|05:00|1.6||||||||||||||
RD|I|32|031|1005|88101|1|1|105|170|20191217|06:00||AN|||||||||||||
```

Table 1 Flag Table: AirVision to AQS

AirVision Name (Invalid)	AirVision Identifier	AQS Null Code
Power Failure	**P**	**AV**
Calibration	**C**	**AT**
Malfunction	**e**	**AN**
Misc. Error	**i**	**AM**
Maintenance	**m**	**BA**
Operator Error	**o**	**BJ**
Audit	**a**	**AZ**
Zero/Precision/Span	**s**	**BF**
Multi-point	**x**	**BC**
Precision Check	**g**	**AX**
Max/Min Exceeded	**+ or -**	**AN**
Failed Audit/Precision	**f**	**AS**

S.4 Manual Data Procedure

Manual data is collected every three days at the NCore monitoring site. The collection of data is done manually by air quality specialists in the monitoring branch onto field forms. Within one week of QC of the transcription and calculation of the data, concentrations for the FRM $PM_{2.5}$, PM_{10}, and PM_{coarse} are entered into AirVision. A month before the end of the current quarter, last quarter's data files are to be generated. The following steps are to be followed in order to generate AQS compatible text files.

1. To generate files for the manual monitoring methods, launch AirVision.
2. Select Reports followed by AQS Reports and then AQS 2.2 Text Reports.
3. Deselect all except for "Sample Data Records" in the Record Type Selection.
4. Select the appropriate range from the 1st of the quarter to the last day of the quarter, e.g. 01 Oct 2019 00:00 to 31 Dec 2019 23:59.
5. Select the "Hourly average of 60 minutes" in the Average Interval field
6. Select all of the manual data to be generated from the NCore site:
   a. PM10_LC
   b. PM2.5
   c. PMC
7. Click Generate Report. A list of files similar to Figure 3 will be populated in the Report Output viewer.
8. Click "Save to File" to save it on the Monitoring Drive under the Filter AQS Submittal Files folder. Select the appropriate year folder with the following format:
   a. Ren_PM_Q1_2019: Sample file name for Reno3 Particulate Matter for 4th Quarter 2019.
9. Click Save to generate the file.

S.5 Quality Assurance Data Procedure

QA data is collected from all of our monitoring sites as field staff completes the QA tasks. The collection of QA data is done manually by air quality specialists in the monitoring branch onto field worksheets and entered on a Control Chart Excel file. Before the last month of a quarter, the Data Manager enters the relevant Z/P/S, multi-points audits, and flow checks from all sites manually into AirVision. A month before the end of the current quarter, last quarter's data files are to be generated. The following steps are to be followed in order to generate AQS compatible text files.

1. To generate files for the QA monitoring methods, launch AirVision.
2. Select Reports followed by AQS Reports and then AQS 2.2 Text Reports.
3. Deselect all except for "Monitor Assessment Records" in the Record Type Selection.
4. Select the appropriate range from the 1st of the quarter to the last day of the quarter, e.g. 01 Oct 2019 00:00 to 31 Dec 2019 23:59.
5. Select the "Hourly average of 60 minutes" in the Average Interval field
6. Select only one station with all of the QA parameters at a time. Click Generate Report. A list of files similar to Figure 3 will be populated in the Report Output viewer.
7. Click "Save to File" to save it on the Monitoring Drive under the P&A folder. Select the appropriate year and quarter folders with the following format:
    a. SPK_Q1_2019: Sample file name for Sparks 1st Quarter QA data of 2019
8. Click Save to generate the file.

Appendix U: Uploading Data to AIRNow

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ____

Title of Author: ______________________________________

Signature: __________________________ Date: _____________

Name: ____

Title: ____

Signature: __________________________ Date: _____________

Name: ____

Title: ____

Signature: __________________________ Date: _____________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:_____________________________________Date:__________________

Name: ____

Title: ____

Signature:_____________________________________Date:__________________

Name: ____

Title: ____

Signature:_____________________________________Date:__________________

Name: ____

Title: ____

Signature:_____________________________________Date:__________________

Name: ____

Title: ____

Signature:_____________________________________Date:__________________

Acronyms and Abbreviations

AIRNow	Refers to the web site created by the EPA and their partners to provide the public with easy access to national air quality information
AQI	Air Quality Index
AQS	Air Quality System
AV	Agilaire AirVision
EPA	U.S. Environmental Protection Agency
FTP	File Transfer Process
SOP	Standard Operating Procedure
AQMD	Washoe County Air Quality Management Division

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Figure 4: AIRNow Quality Control Report U-4

Sub-Appendices

Appendix U_1: AIRNow DMC Real-time Data Quality Control (QC) Guidance....................... U-5

U.1. Purpose

The purpose of this Standard Operating Procedure (SOP) is to establish uniform procedures for the preparation of, and the performance of submitting data to AIRNow.

U.2. Summary of Method

The Washoe County Air Quality Management Division (AQMD) submits hourly data to the AIRNow website in an effort to provide the public with real time AQI (Air Quality Index) conditions and daily forecasts. Once the initial configuration is set up, the Agilaire AirVision (AV) Software will run this file transfer process (FTP) task automatically every hour of every day.

All continuous hourly data is sent to AIRNow before 15 minutes after the top of an hour. This includes criteria, non-criteria, and meteorological data.

U.3. Procedure

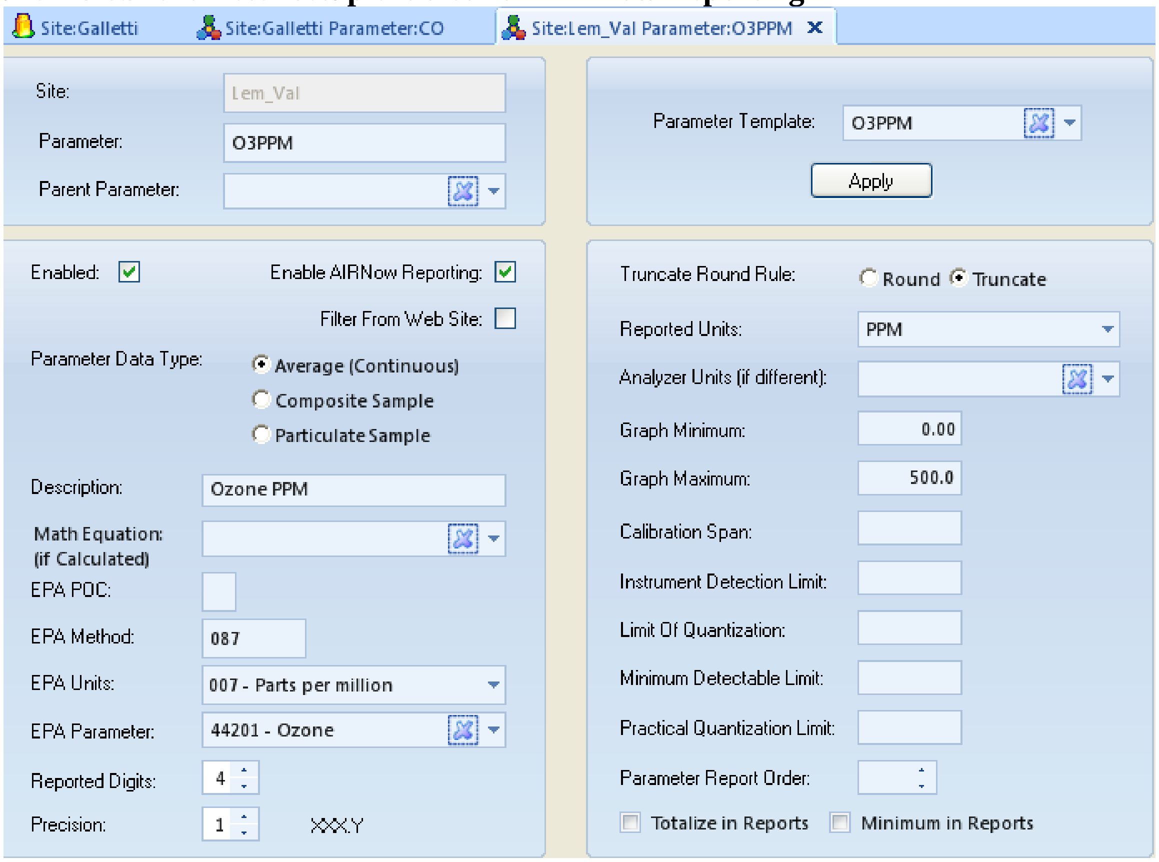
U.3.1. Initial Set up

1. Open AIRNow/FTP Setup from the Configuration menu.
2. To add a new transfer program select the Add FTP Program button on the Ribbon above the Main Navigation menu. As transfer programs are added they will appear in the AIRNow FTP Program Selection section.
3. To set up a new AIRNow Transfer program, click the Add FTP Program button and enter the following fields:
   - Name – The name that you choose to use to identify the transfer program.
   - FTP Host – EPA's FTP address provided by EPA.
   - Directory –Path to the destination directory provided by EPA.
   - User Name – User ID provided by EPA.
   - Agency – Agency Code provided by EPA.
   - Enable – Enables the transfer program to function.
   - AIRNow – Submits the report being transferred in AIRNow format.
   - Port – Port 21 as required by EPA.
   - Set User Password – Clicking this button brings up a password box where you enter and confirm the password provided by EPA.
4. To open an existing transfer program, click the program name in the AIRNow FTP Program Selection section and edit the appropriate information.
5. Click the Save icon.
6. AIRNow/FTP is now set up.

U.3.2. File Transfer Process

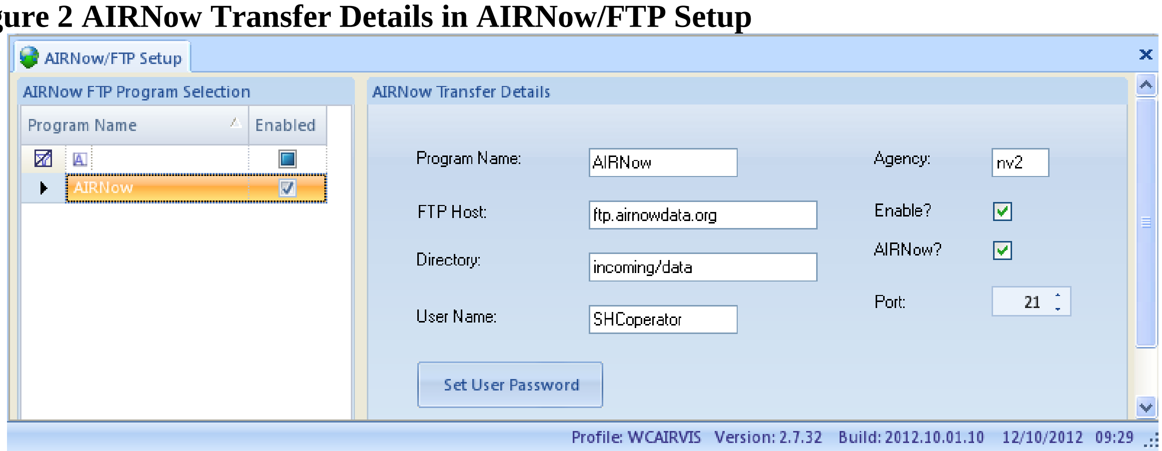
1. Check the Enable AIRNow Reporting box in the Site/Parameter setup (Configuration Editors) for all continuous data.

Figure 1 Site/Parameter setup enabled for AIRNow Reporting



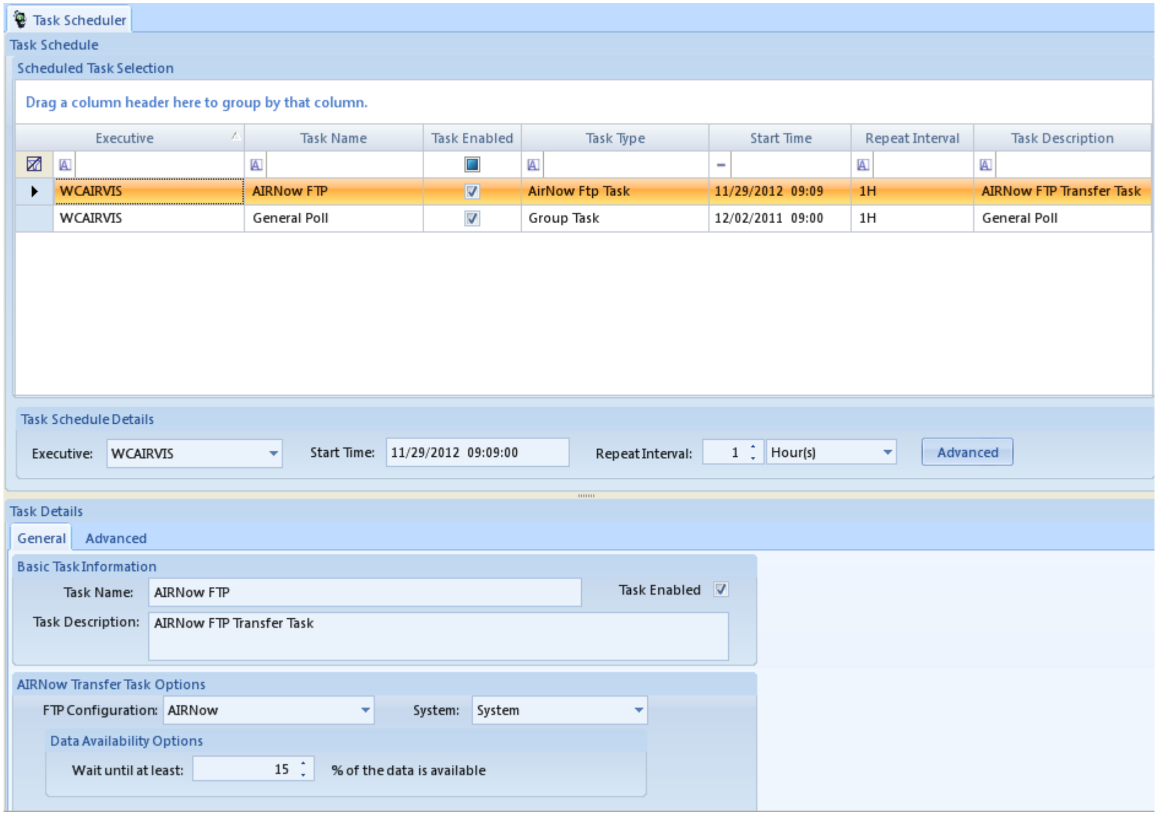
2. Enter AIRNow Transfer Details in AIRNow/FTP Setup (Configuration Editors)

Figure 2 AIRNow Transfer Details in AIRNow/FTP Setup



3. Schedule AIRNow FTP Transfer task in Task Scheduler (Configuration Editors).

Figure 3 AIRNow FTP Transfer task in Task Scheduler



U.4. Quality Control and Quality Assurance

The AIRNow system automatically quality controls the data prior to including it in the AQI calculation including removing maximums, minimums, exceeds rate of change, etc. For more information on these quality control procedures go to the attached form AIRNow DMC Real-time Data Quality Control (QC) Guidance. At the end of every day, AIRNow sends a QC report (Figure 4) to the Data Manager indicating how many QC actions were taken for a given pollutant and which gives an indication on any data that needs to be reviewed or edited.

Figure 4 AIRNow Quality Control Report

OZONE			PM2.5			PM10		
Hour	#Sites	#QC	Hour	#Sites	#QC	Hour	#Sites	#QC
0000	6 of 6	0	0000	2 of 2	0	0000	5 of 5	0
0100	6 of 6	0	0100	2 of 2	0	0100	5 of 5	0
0200	6 of 6	0	0200	2 of 2	0	0200	5 of 5	0
0300	6 of 6	0	0300	2 of 2	0	0300	5 of 5	0
0400	6 of 6	0	0400	2 of 2	0	0400	5 of 5	0
0500	6 of 6	0	0500	2 of 2	0	0500	5 of 5	0
0600	6 of 6	0	0600	2 of 2	0	0600	5 of 5	0
0700	6 of 6	0	0700	2 of 2	0	0700	5 of 5	0
0800	6 of 6	0	0800	2 of 2	0	0800	5 of 5	0
0900	6 of 6	0	0900	2 of 2	0	0900	5 of 5	0
1000	6 of 6	0	1000	2 of 2	0	1000	5 of 5	0
1100	6 of 6	0	1100	2 of 2	0	1100	5 of 5	0
1200	6 of 6	0	1200	2 of 2	0	1200	5 of 5	0
1300	6 of 6	0	1300	2 of 2	0	1300	5 of 5	0
1400	6 of 6	0	1400	2 of 2	0	1400	5 of 5	0
1500	6 of 6	0	1500	2 of 2	0	1500	5 of 5	0
1600	6 of 6	0	1600	2 of 2	0	1600	5 of 5	0
1700	6 of 6	0	1700	2 of 2	0	1700	5 of 5	0
1800	6 of 6	0	1800	2 of 2	0	1800	5 of 5	0
1900	6 of 6	0	1900	2 of 2	0	1900	5 of 5	0
2000	6 of 6	0	2000	2 of 2	0	2000	5 of 5	0
2100	6 of 6	0	2100	2 of 2	0	2100	5 of 5	0
2200	0 of 6	0	2200	0 of 2	0	2200	0 of 5	0
2300	0 of 6	0	2300	0 of 2	0	2300	0 of 5	0

Appendix U1

AIRNow DMC Real-time Data Quality Control (QC) Guidance

Appendix V: Environmental Systems Corporation (ESC) 8832 Data Loggers

Standard Operating Procedures

For

Washoe County Health District
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Washoe County Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Washoe County Health District, Air Quality Management Division to follow the elements described within.

Approved:

Name: ______________________________

Title of Author: ______________________________

Signature: ______________________ Date: ____________

Name: ______________________________

Title: ______________________________

Signature: ______________________ Date: ____________

Name: ______________________________

Title: ______________________________

Signature: ______________________ Date: ____________

Air Quality Management Division
Required Reading Form

The required reading form must be signed by all staff performing tasks associated with the Air Quality Management Division Ambient Air Quality Monitoring Network as well as new employees as part of training.

Air Quality Management Division Employees

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Name: ____

Title: ____

Signature:______________________________Date:______________

Acronyms and Abbreviations

AQMD	Washoe County Health District, Air Quality Management Division
DAS	Data Acquisition System
ESC	Environmental Systems Corporation

List of Figures

Figure 1: Reno 3 8832 Program V-1

V.1 Introduction

The ESC Model 8832 Data System Controller is a microprocessor-based data acquisition system designed to acquire, process, store, report, and telemeter data in a multi-tasking environment. The 8832 is designed around an expansion bus that gives the user great flexibility in configuring the unit with almost any combination of input and output types.

V.2 Instrument Operation

All instrumentation at the SLAMS and NCore stations are connected to the data logger via analog connections. Refer to the manufacturers' operation manual for the proper logger configuration. Upon connection to the data logger, each parameter at each site must be programmed into the data logger. Figure 1 shows a complete program of the Reno 3 NCore site, which includes all parameter programming needed throughout the network, including auto calibrations.

To view and/or download individual station data logger programs:

1. Open NetTerm on a computer or laptop connected to the county network.
2. Click on File, choose Phone Directory.
3. Choose site.
4. Click "Connect" button to connect to logger.
5. Log in to logger.
6. Status Menu.
7. Dump Setup.
8. Click on File, choose Session Logging.
9. Name file and Save location.
10. Dump All to Current Port.
11. Click on File, choose Session Logging again.
12. ESC to Home Menu.
13. Log Out.

Figure 1 Reno3 8832 Program

```
                    System Configuration Screen#1
Logger Date              :  11/05/19
Logger Time              :  10:10:46
Time Zone                :  PST
Logger ID Code           :  04
Station ID Code          :
Logger Description       :  ESC 8832
Modbus ID Code           :  100
Baud Rate - Ext. Modem   :  9600
Baud Rate - Port 1       :  9600
Baud Rate - Port 2       :  N/A
Baud Rate - Port 3       :  N/A
```

Parallel Port Timeout : 5s
Automatic Logout Time : 10m
% For Valid Base Avg : 100
% For Valid Ext. Avg : 75
Debounce Digital Inputs ? : N
Default Dig. Inputs to OR ? : N
Alarm Deadband (% of limit) : 0.0
Allow Auto Corr if Config'd?: Y

System Configuration Screen#2
Changes should be reflected in System Configuration.

System Configuration Menu#1
Serial Number : 2609
Logger ID Code : 04
Feature Mask : 0x14AD
LCD Type : 1
AC Line Freq. (Hz) : 60
Real-time Clock Freq. (Hz) : 512.0112
Development System (Y/N) : N
DRAM Memory Size (Mbytes) : 32
Memory Card Type (0=none) : 0
Memory Card Size (Mbytes) : 0
Math Eqn Update Rate : 1
Min % for Valid Base Avg : 100
Min % for Valid Ext Avg : 75
If Cal is in Maint (D/S/N) : NORMAL
Maximize Longterm Storage ? : N
Key Beep (Y/N) : Y
Offline Drift Alarms (Y/N) : N

System Configuration Menu#2
Card Slot 1 : VOLTAGE IN CARD
Card Slot 2 : VOLTAGE IN CARD
Card Slot 3 : RELAY OUT CARD
Card Slot 4 : MET CARD
Card Slot 5 : NO CARD
Card Slot 6 : NO CARD
Card Slot 7 : NO CARD
Card Slot 8 : NO CARD
Card Slot 9 : NO CARD
Card Slot 10 : NO CARD
Card Slot 11 : NO CARD
Card Slot 12 : NO CARD

System Configuration Menu#3

System Configuration Menu#4

Modbus ID Code : 100
Def.Modbus AddrTbl Start : 40001
Def.Modbus InputTbl Start : 40005
Def.Modbus OutputTbl Start : 41005
ModbusQuietIfNoRegMatch : N
ModbusAddrTabl[0]= : 1
ModbusAddrTabl[1]= : 1001
Modbus Channel Integer Start: 0
Modbus Channel Integer End : 0
Modbus Channel Float Start : 1
Modbus Channel Float End : 99

System Configuration Menu#5

Port0(COM0) Enable (Y/N) : Y
Port0(COM0) Baud/Bits/Parity: 9600/8/N
Port0(COM0) Delay (ticks) : 0
Port0(COM0) 232/485 : 232
Port0(COM0) Device Type : VT100
Port0(COM0) Interface : CEN

Port1(COM1) Enable (Y/N) : Y
Port1(COM1) Baud/Bits/Parity: 9600/8/N
Port1(COM1) Delay (ticks) : 0
Port1(COM1) 232/485 : 232
Port1(COM1) Device Type : VT100
Port1(COM1) Interface : GSI2

Port2(COM2) Enable (Y/N) : N
Port2(COM2) Baud/Bits/Parity: 9600/8/N
Port2(COM2) Delay (ticks) : 0
Port2(COM2) Device Type : VT100
Port2(COM2) Interface : CEN

System Configuration Menu#6

Port3(COM3) Enable (Y/N) : N
Port3(COM3) Baud/Bits/Parity: 9600/8/N
Port3(COM3) Delay (ticks) : 0
Port3(COM3) Device Type : VT100
Port3(COM3) Interface : CEN

Port4(LCD0) Enable (Y/N) : Y
Port4(LCD0) Device Type : LCD
Port4(LCD0) Interface : MDI

Port5(LPT0) Enable (Y/N) : N
Port5(LPT0) Delay (ticks) : 10
Port5(LPT0) Device Type : PRINTER
Port5(LPT0) Interface : PRN

Report Printer Port : 5
Alarm Printer Port : 5
FINISHED (Configure Now) 07/16/13 10:12:06

Standard Channel Config.

Instrument Name : SO2T
Analog Input Number : 08
Report Channel Number : 10
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 100
Low Output (E.U.s) : 0
Units : ppb
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): Y
FINISHED (Configure Now) 07/16/13 10:20:21

Config. Channel Options

Name (not editable) : SO2T
Chl Number (not editable) : 10
Decimal Positioner : 02
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 10
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.

Instrument Name : O3
Analog Input Number : 05
Report Channel Number : 40
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 200
Low Output (E.U.s) : 0

Units : ppb
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): Y
FINISHED (Configure Now) 08/26/19 12:27:39

Config. Channel Options

Name (not editable) : O3
Chl Number (not editable) : 40
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 40
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.

Instrument Name : NOT
Analog Input Number : 14
Report Channel Number : 20
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 500
Low Output (E.U.s) : 0
Units : ppb
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): Y
FINISHED (Configure Now) 07/16/13 12:54:15

Config. Channel Options

Name (not editable) : NOT
Chl Number (not editable) : 20
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 20
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.

Instrument Name : NOY
Analog Input Number : 13
Report Channel Number : 22
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 500
Low Output (E.U.s) : 0
Units : ppb
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): Y
FINISHED (Configure Now) 07/16/13 12:54:00

Config. Channel Options

Name (not editable) : NOY
Chl Number (not editable) : 22
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 22
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.

Instrument Name : NO2Y
Analog Input Number : 15
Report Channel Number : 21
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 500
Low Output (E.U.s) : 0
Units : ppb
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): Y
FINISHED (Configure Now) 07/16/13 12:54:27

Config. Channel Options

Name (not editable) : NO2Y
Chl Number (not editable) : 21
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 21
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.
Instrument Name : COT
Analog Input Number : 04
Report Channel Number : 30
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 10
Low Output (E.U.s) : 0
Units : ppm
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): Y
FINISHED (Configure Now) 07/16/13 10:24:23

Config. Channel Options
Name (not editable) : COT
Chl Number (not editable) : 30
Decimal Positioner : 03
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 30
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.
Instrument Name : BAM10RAW
Analog Input Number : 01
Report Channel Number : 01
Volts Full Scale : 1
High Input : 1 V
Low Input : 0 V

High Output (E.U.s) : 985
Low Output (E.U.s) : -15
Units : ug/m3
Base Avg. Interval, Storage : 1m , 1d 55m
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 0s
Use Time-on-line Valid (Y/N): N
FINISHED (Configure Now) 07/16/13 10:51:54

Config. Channel Options
Name (not editable) : BAM10RAW
Chl Number (not editable) : 01
Decimal Positioner : 00
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 01
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Average Math Channel Config.
Instrument Name : BAM10
Report Channel Number : 02
Equation : 0*BAM10RAW+K1=
Units : ug/m3
Base Avg. Interval, Storage : 1m , 0s
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 33d 13h
Round Constituents (Y/N) : N
Constituent BO Flags (Y/N) : Y
FINISHED (Configure Now) 07/16/13 10:27:24

Config. Channel Options
Name (not editable) : BAM10
Chl Number (not editable) : 02
Decimal Positioner : 00
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 02
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.

Instrument Name : BAM25RAW
Analog Input Number : 03
Report Channel Number : 03
Volts Full Scale : 1
High Input : 1 V
Low Input : 0 V
High Output (E.U.s) : 985
Low Output (E.U.s) : -15
Units : ug/m3
Base Avg. Interval, Storage : 1m , 1d 55m
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 0s
Use Time-on-line Valid (Y/N): N
FINISHED (Configure Now) 07/16/13 10:52:13

Config. Channel Options
Name (not editable) : BAM25RAW
Chl Number (not editable) : 03
Decimal Positioner : 00
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 03
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Average Math Channel Config.
Instrument Name : BAM25
Report Channel Number : 04
Equation : 0*BAM25RAW+K2=
Units : ug/m3
Base Avg. Interval, Storage : 1m , 0s
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 33d 13h
Round Constituents (Y/N) : N
Constituent BO Flags (Y/N) : Y
FINISHED (Configure Now) 07/16/13 10:29:15

Config. Channel Options
Name (not editable) : BAM25
Chl Number (not editable) : 04
Decimal Positioner : 00
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 04
Span for Cal Err : (not set)

Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Average Math Channel Config.
Instrument Name : BAM10-25
Report Channel Number : 05
Equation : BAM10-BAM25
Units : ug/m3
Base Avg. Interval, Storage : 1m , 0s
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 33d 13h
Round Constituents (Y/N) : N
Constituent BO Flags (Y/N) : Y
FINISHED (Configure Now) 07/16/13 10:30:00

Config. Channel Options
Name (not editable) : BAM10-25
Chl Number (not editable) : 05
Decimal Positioner : 00
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 05
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.
Instrument Name : WSP
Analog Input Number : 06
Report Channel Number : 61
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 50
Low Output (E.U.s) : 0
Units : m/s
Base Avg. Interval, Storage : 5s , 0s
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): N
FINISHED (Configure Now) 07/16/13 10:31:52

Config. Channel Options

Name (not editable) : WSP
Chl Number (not editable) : 61
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 61
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.

Instrument Name : WDR
Analog Input Number : 07
Report Channel Number : 60
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 360
Low Output (E.U.s) : 0
Units : deg
Base Avg. Interval, Storage : 1m , 0s
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): N
FINISHED (Configure Now) 07/16/13 10:32:30

Config. Channel Options

Name (not editable) : WDR
Chl Number (not editable) : 60
Decimal Positioner : 00
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 60
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

General Channel Config

Instrument Name : MAXWSP
Report Channel Number : 66
Input Channel : WSP
Input Average Interval : 5s
Units : m/s
Data Channel Type : MAXIMUM

Reset Input Status Pattern : (none)
General Val Duration,Storage: 1h , 4d 19h
Ignore Input Channel Flag(s): (none)
FINISHED (Configure Now) 07/16/13 10:33:27

Config. Channel Options

Name (not editable) : MAXWSP
Chl Number (not editable) : 66
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 66
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.

Instrument Name : RELHUM
Analog Input Number : 02
Report Channel Number : 64
Volts Full Scale : 1
High Input : 1 V
Low Input : 0 V
High Output (E.U.s) : 100
Low Output (E.U.s) : 0
Units : percent
Base Avg. Interval, Storage : 1m , 0s
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): N
FINISHED (Configure Now) 07/16/13 10:34:12

Config. Channel Options

Name (not editable) : RELHUM
Chl Number (not editable) : 64
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 64
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Math Channel Configuration

Instrument Name : WSPMPH
Report Channel Number : 67
Equation : WSP*2.23693629
Units : mph
Base Avg. Interval, Storage : 5s , 0s
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 14d 9h
Round Constituents (Y/N) : N
Constituent BO Flags (Y/N) : Y
Use Time-on-line Valid (Y/N): N
FINISHED (Configure Now) 07/16/13 10:35:34

Config. Channel Options
Name (not editable) : WSPMPH
Chl Number (not editable) : 67
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 67
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.
Instrument Name : NO
Analog Input Number : 10
Report Channel Number : 50
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 500
Low Output (E.U.s) : 0
Units : ppb
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): Y
FINISHED (Configure Now) 07/16/13 10:36:26

Config. Channel Options
Name (not editable) : NO
Chl Number (not editable) : 50
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 50

Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.

Instrument Name : NO2
Analog Input Number : 11
Report Channel Number : 51
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 500
Low Output (E.U.s) : 0
Units : ppb
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): Y
FINISHED (Configure Now) 07/16/13 10:37:08

Config. Channel Options

Name (not editable) : NO2
Chl Number (not editable) : 51
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 51
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.

Instrument Name : NOX
Analog Input Number : 09
Report Channel Number : 52
Volts Full Scale : 5
High Input : 5 V
Low Input : 0 V
High Output (E.U.s) : 500
Low Output (E.U.s) : 0
Units : ppb
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m

Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): Y
FINISHED (Configure Now) 07/16/13 10:37:42

Config. Channel Options
Name (not editable) : NOX
Chl Number (not editable) : 52
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 52
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.
Instrument Name : TEMPIN
Analog Input Number : 12
Report Channel Number : 69
Volts Full Scale : 1
High Input : 1 V
Low Input : 0 V
High Output (E.U.s) : 100
Low Output (E.U.s) : 0
Units : degC
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): N
FINISHED (Configure Now) 07/16/13 10:38:41

Config. Channel Options
Name (not editable) : TEMPIN
Chl Number (not editable) : 69
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 69
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Math Channel Configuration
Instrument Name : O3PPM

Report Channel Number : 41
Equation : (O3)*.001=
Units : ppm
Base Avg. Interval, Storage : 1m , 7d 40m
Average #1 Interval, Storage: 5m , 7d 4h 30m
Average #2 Interval, Storage: 1h , 33d 13h
Round Constituents (Y/N) : N
Constituent BO Flags (Y/N) : Y
Use Time-on-line Valid (Y/N): Y
FINISHED (Configure Now) 07/16/13 10:39:51

Config. Channel Options
Name (not editable) : O3PPM
Chl Number (not editable) : 41
Decimal Positioner : 04
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 41
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Standard Channel Config.
Instrument Name : ATEMP
Analog Input Number : T1
Report Channel Number : 62
Volts Full Scale : N/A
High Input : 0.3112 V/V
Low Input : 0.855 V/V
High Output (E.U.s) : 50
Low Output (E.U.s) : -30
Units : degC
Base Avg. Interval, Storage : 1m , 0s
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 33d 13h
Use Time-on-line Valid (Y/N): N
FINISHED (Configure Now) 07/16/13 10:41:04

Config. Channel Options
Name (not editable) : ATEMP
Chl Number (not editable) : 62
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 62
Span for Cal Err : (not set)

Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

General Channel Config

Instrument Name : MAXMPH
Report Channel Number : 74
Input Channel : WSPMPH
Input Average Interval : 5s
Units : mph
Data Channel Type : MAXIMUM
Reset Input Status Pattern : (none)
General Val Duration,Storage: 1h , 4d 19h
Ignore Input Channel Flag(s): (none)
FINISHED (Configure Now) 07/16/13 10:41:44

Config. Channel Options

Name (not editable) : MAXMPH
Chl Number (not editable) : 74
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 74
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Vector Wind Speed Config

Instrument Name : WSPVECT
Report Channel Number : 72
WDR Input Number : 07
WDR Volts Full Scale : 5
WDR High Input : 5 V
WDR Low Input : 0 V
WDR High Output (E.U.s) : 360
WDR Low Output (E.U.s) : 0
WSP Input Number : 06
WSP Volts Full Scale : 5
WSP High Input : 5 V
WSP Low Input : 0 V
WSP High Output (E.U.s) : 50
WSP Low Output (E.U.s) : 0
Units : m/s
Base Avg. Interval, Storage : 1m , 0s

Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 14d 9h
FINISHED (Configure Now)   07/16/13 10:42:51

Config. Channel Options

Name (not editable)   : WSPVECT
Chl Number (not editable)   : 72
Decimal Positioner   : 01
MODBUS Scale Factor   :   0.0100
MODBUS/SIO Register #   : 72
Span for Cal Err   : (not set)
Round Precision   : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26)   : (none)
Input Scan Interval   : 0s

Vector Wind Direction Config

Instrument Name   : WDRVECT
Report Channel Number   : 73
WDR Input Number   : 07
WDR Volts Full Scale   : 5
WDR High Input   : 5 V
WDR Low Input   : 0 V
WDR High Output (E.U.s)   : 360
WDR Low Output (E.U.s)   : 0
WSP Input Number   : 06
WSP Volts Full Scale   : 5
WSP High Input   : 5 V
WSP Low Input   : 0 V
WSP High Output (E.U.s)   : 50
WSP Low Output (E.U.s)   : 0
Units   : deg
Base Avg. Interval, Storage : 1m , 0s
Average #1 Interval, Storage: 15m , 0s
Average #2 Interval, Storage: 1h , 14d 9h
FINISHED (Configure Now)   07/16/13 10:44:02

Config. Channel Options

Name (not editable)   : WDRVECT
Chl Number (not editable)   : 73
Decimal Positioner   : 00
MODBUS Scale Factor   :   0.0100
MODBUS/SIO Register #   : 73
Span for Cal Err   : (not set)
Round Precision   : (none)
Allow Offline Calibrations? : N

Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

General Channel Config
Instrument Name : MINTEMP
Report Channel Number : 70
Input Channel : ATEMP
Input Average Interval : 0s
Units : degC
Data Channel Type : MINIMUM
Reset Input Status Pattern : (none)
General Val Duration,Storage: 1h , 4d 19h
Ignore Input Channel Flag(s): (none)
FINISHED (Configure Now) 07/16/13 10:44:41

Config. Channel Options
Name (not editable) : MINTEMP
Chl Number (not editable) : 70
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 70
Span for Cal Err : (not set)
Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

General Channel Config
Instrument Name : MAXTEMP
Report Channel Number : 71
Input Channel : ATEMP
Input Average Interval : 0s
Units : degC
Data Channel Type : MAXIMUM
Reset Input Status Pattern : (none)
General Val Duration,Storage: 1h , 4d 19h
Ignore Input Channel Flag(s): (none)
FINISHED (Configure Now) 07/16/13 10:45:11

Config. Channel Options
Name (not editable) : MAXTEMP
Chl Number (not editable) : 71
Decimal Positioner : 01
MODBUS Scale Factor : 0.0100
MODBUS/SIO Register # : 71
Span for Cal Err : (not set)

Round Precision : (none)
Allow Offline Calibrations? : N
Online Cal. Hour (0-26) : (none)
Input Scan Interval : 0s

Set Constants/Secondary

Constant # (not editable) : 1
Primary Value = : 905.930662
Alternate Value#1 = : 0.000000
Alternate Status#1 : (none)
Alternate Value#2 = : 0.000000
Alternate Status#2 : (none)

Set Constants/Secondary

Constant # (not editable) : 2
Primary Value = : 904.814650
Alternate Value#1 = : 0.000000
Alternate Status#1 : (none)
Alternate Value#2 = : 0.000000
Alternate Status#2 : (none)

Automatic (A) Cal Cfg.

Name of Cal Sequence : COSO2_SZ
Starting Time : 11/06/19 00:45:00
Interval : 1d
Affected Channels : COT,SO2T,O3,O3PPM
Calibration Records Stored : 7
MODIFY PHASE :
ADD PHASE :
DELETE PHASE :
Recovery Time : 0s
FINISHED (Configure Now) 06/04/18 07:41:49

Phase Configuration Screen

Name of Cal (not editable) : COSO2_SZ
Name of Phase : SPAN
Data Channels : COT,SO2T,O3,O3PPM
Output Control Lines : 2,
Phase Data Time : 1m
Phase Duration : 15m
Edit Expected Values :

Expected Value Configuration

Name of Cal (not editable) : COSO2_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : COT

Expected Value : 8.83
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): L

Expected Value Configuration
Name of Cal (not editable) : COSO2_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : SO2T
Expected Value : 90
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): L

Expected Value Configuration
Name of Cal (not editable) : COSO2_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : O3
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration

Name of Cal (not editable) : COSO2_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : O3PPM
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Phase Configuration Screen

Name of Cal (not editable) : COSO2_SZ
Name of Phase : ZERO
Data Channels : COT,SO2T,O3,O3PPM
Output Control Lines : 2,
Phase Data Time : 1m
Phase Duration : 14m 50s
Edit Expected Values :

Expected Value Configuration

Name of Cal (not editable) : COSO2_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : COT
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration

Name of Cal (not editable) : COSO2_SZ

Name of Phase (not editable): ZERO
Channel Name (not editable) : SO2T
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration
Name of Cal (not editable) : COSO2_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : O3
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration
Name of Cal (not editable) : COSO2_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : O3PPM
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y

Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Phase Configuration Screen

Name of Cal (not editable) : COSO2_SZ
Name of Phase : END
Data Channels : (none)
Output Control Lines : 2=0,
Phase Data Time : 0s
Phase Duration : 5s
Edit Expected Values :

Automatic (A) Cal Cfg.

Name of Cal Sequence : NOY_SZ
Starting Time : 11/06/19 23:00:00
Interval : 3d
Affected Channels : NOT,NO2Y,NOY,NO,NO2,NOX
Calibration Records Stored : 7
MODIFY PHASE :
ADD PHASE :
DELETE PHASE :
Recovery Time : 0s
FINISHED (Configure Now) 06/04/18 07:42:24

Phase Configuration Screen

Name of Cal (not editable) : NOY_SZ
Name of Phase : SPAN
Data Channels : NOT,NO2Y,NOY,NO,NO2,NOX
Output Control Lines : 4,
Phase Data Time : 1m
Phase Duration : 45m
Edit Expected Values :

Expected Value Configuration

Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : NOT
Expected Value : 450
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N

Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): L

Expected Value Configuration

Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : NO2Y
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration

Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : NOY
Expected Value : 450
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): L

Expected Value Configuration

Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : NO
Expected Value : 450
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)

Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): L

Expected Value Configuration
Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : NO2
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration
Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : NOX
Expected Value : 450
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): L

Phase Configuration Screen
Name of Cal (not editable) : NOY_SZ
Name of Phase : ZERO

Data Channels : NOT,NO2Y,NOY,NO,NO2,NOX
Output Control Lines : 4,
Phase Data Time : 1m
Phase Duration : 14m 50s
Edit Expected Values :

Expected Value Configuration
Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : NOT
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration
Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : NO2Y
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration
Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : NOY
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000

Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration
Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : NO
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration
Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : NO2
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration

Name of Cal (not editable) : NOY_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : NOX
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Phase Configuration Screen
Name of Cal (not editable) : NOY_SZ
Name of Phase : END
Data Channels : (none)
Output Control Lines : 4=0,
Phase Data Time : 0s
Phase Duration : 5s
Edit Expected Values :

Automatic (A) Cal Cfg.
Name of Cal Sequence : O3_SZ
Starting Time : 11/06/19 02:45:00
Interval : 1d
Affected Channels : COT,SO2T,O3,O3PPM
Calibration Records Stored : 7
MODIFY PHASE :
ADD PHASE :
DELETE PHASE :
Recovery Time : 0s
FINISHED (Configure Now) 06/04/18 07:42:05

Phase Configuration Screen
Name of Cal (not editable) : O3_SZ
Name of Phase : SPAN
Data Channels : COT,SO2T,O3,O3PPM
Output Control Lines : 3,
Phase Data Time : 1m
Phase Duration : 15m
Edit Expected Values :

Expected Value Configuration

Name of Cal (not editable) : O3_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : COT
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration

Name of Cal (not editable) : O3_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : SO2T
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration

Name of Cal (not editable) : O3_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : O3
Expected Value : 180
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N

No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): L

Expected Value Configuration

Name of Cal (not editable) : O3_SZ
Name of Phase (not editable): SPAN
Channel Name (not editable) : O3PPM
Expected Value : 0.18
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): L

Phase Configuration Screen

Name of Cal (not editable) : O3_SZ
Name of Phase : ZERO
Data Channels : COT,SO2T,O3,O3PPM
Output Control Lines : 3,
Phase Data Time : 1m
Phase Duration : 14m 50s
Edit Expected Values :

Expected Value Configuration

Name of Cal (not editable) : O3_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : COT
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y

Method of Error Calc.(S,D,L): D

Expected Value Configuration

Name of Cal (not editable) : O3_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : SO2T
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration

Name of Cal (not editable) : O3_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : O3
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)
OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Expected Value Configuration

Name of Cal (not editable) : O3_SZ
Name of Phase (not editable): ZERO
Channel Name (not editable) : O3PPM
Expected Value : 0
Tracer/ID Code (0000-9999) : 0000
Use EV For Automatic Correct? N
Write EV to Math Constant : (none)
Write Result to Math Constant (none)
Warning Drift Tolerance : (not set)

OOC Drift Tolerance : (not set)
No Recovery If Warning Drift? N
No Recovery If OOC Drift? : N
Store Result in Cal Record? : Y
Use Rounded Results? : Y
Method of Error Calc.(S,D,L): D

Phase Configuration Screen
Name of Cal (not editable) : O3_SZ
Name of Phase : END
Data Channels : (none)
Output Control Lines : 3=0,
Phase Data Time : 0s
Phase Duration : 5s
Edit Expected Values :

Config. Dig. Event Program
Dig. Event Program Name : BAM
Starting Time : 11/06/19 00:55:00
Repeat Interval : 1d
Output Line(s) : 1,
Output Duration : 5s
Disable During Cal(s) : (none)
FINISHED (Configure Now) 07/16/13 10:47:12

V.5 Maintenance

Firmware upgrades may need to be completed on the 8832 for setting up auto-calibrations and wireless connections. To complete a firmware upgrade:

1) Data logger program download “screen capture”
   - Open putty
   - Connect serial cable
   - Open connection
     - ❖ Serial “Connection Type”
     - ❖ Open
   - Right click on putty at the bottom of the screen
     - ❖ Change settings
     - ❖ Choose logging
     - ❖ Mark “all session output”
     - ❖ Browse to save file
     - ❖ Save file name (ie: LemVal Config 04212011)
     - ❖ Apply
   - Press ESC on laptop
   - Press ..aqm

  - ❖ !01& will appear
- Press ESC
- Press 01aqm
  - ❖ Logger "Home Menu" will appear
- Login (animal password)
- S – Status
- D – Dump Setup
- P – Dump all to Current Port

2) Cold Start Logger
   - ESC to Home Menu
   - Login to the logger with putty (animal password)
   - Login again (password: cold start), you may have to unplug/plug keyboard on 8832)

3) Match IP / Subnet addresses on laptop to logger
   - Home Menu on 8832 > Config Menu > Config Syst Param > Ctl U > Ctl N > Ctl N, this will bring you to the System Configuration Menu where you can view the IP address and gateway numbers
   - Change last # on subnet mask from 255/240 to 0 on the data logger
   - Change laptop IP address and gateway address to match loggers
     - ❖ Start > Settings > Network Connections > LAN > (may need to choose Internet Protocol TCP/IP at this point) Properties > check TCP/IP box only > highlight TCP/IP line > Properties > enter data loggers IP address and gateway addresses (make sure the first three sets of numbers are exactly the same as the data loggers and the last number is only one number and NOT the same as the data logger) (ie: Datalogger ID 192.168.173.1, Gateway # 192.168.173.2 and Laptop IP address 192.168.173.3)

4) Set-up logger for FTP
   - Power cycle logger (Turn off, wait about 15 seconds, then turn back on)
   - From logger Home Menu (version 1)
     - ❖ S (Status Menu) > S (System Maint.) > M (Enter Maint Mode)
   - A warning re-boot message will appear > Y (a cheesy large screen will appear)
   - Password (Animal Password)
   - Maint. Menu will appear
     - ❖ Choose 1) Download
     - ❖ Choose 2) Ethernet Download
     - ❖ A warning message will appear > press Enter
     - ❖ A message asking for the transfer of FTP file will appear
   - From logger Home Menu (version 2 or greater)
     - ❖ S (Status Menu) > S (System Maint.) > D (Download Code)
   - The cheesy screen will NOT appear. The logger will indicate it is ready for the ftp file

5) FTP file from laptop to datalogger
    - Connect Ethernet cable to logger
    - Open DOS
        - Press Start > Run > Open cmd > Ok
    - Make sure the file is where the DOS C prompt is (ie: C:\Documents & Settings\Administrator)
    - FTP session
        - C:\Documnets & Settings\Administrator> **ftp 192.168.173.1** (make sure you use the same ftp address as you assigned the datalogger)
        - User (192.168.173.1: (none)): **das**
        - Password: **“nerothecat”**
        - ftp> **put 8832app.bin.load** (name of the file to be loaded)
        - “File Status Ok” should appear on datalogger
        - Press Enter on datalogger, you should see a progress bar on the datalogger
        - A message stating “requested file action successful” should appear
        - ftp> **bye**
    - Press enter on the logger after sending the file (may have to unplug and plug in the keyboard). If the logger has the Version 2 or greater software before FTP, make sure you press the Enter on the logger IMMEDIATELY after sending the file.
    - Press enter to exit Maint. Mode on the logger (this will load and validate the new file)
    - Help Menu > Press Enter (the version number should change)

6) Re-install the logger program by opening the file captured in Step 1

V.6 Troubleshooting

Refer to the manufacturers’ operation manual for troubleshooting.

Appendix D

Measurement Quality Objectives and Validation Templates

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In June 1998, a workgroup was formed to develop a procedure that could be used by monitoring organizations that would provide for a consistent validation of $PM_{2.5}$ mass concentrations across the US. The workgroup included personnel from the monitoring organizations, EPA Regional Offices, and OAQPS who were involved with assuring the quality of $PM_{2.5}$ mass; additionally, the workgroup was headed by a State and local representative. The workgroup developed a table consisting of three criteria: critical, operational, and systematic criteria, where each criterion had a different degree of implication about the quality of the data. The criteria included on the tables were from 40 CFR Part 50 Appendices L and N, 40 CFR Part 58 Appendix A, and Method 2.12; a few criteria were also added that were neither in CFR nor Method 2.12, but which the workgroup felt should be included. Upon completion and use of the table, it was decided that a "validation template" should be developed for all the criteria pollutants.

To determine the appropriate table for each criterion, the members of the workgroup considered how significantly the criterion impacted the resulting concentration. This was based on experience from workgroup members, experience from non-workgroup members, and feasibility of implementing the criterion.

Criteria that were deemed critical to maintaining the integrity of a sample or group of samples were placed on the first table. Observations that do not meet each and every criterion on the **Critical Criteria** should be invalidated unless there are compelling reason and justification for not doing so. In most cases, this criterion can identify a distinct group of measurements and time period. For example, a flow rate exceedance represents a single sampler for a particular period of time (and therefore distinct number of samples), whereas a field blank or QA collocation exceedance is harder to identify what samples the exceedance may represent. In most cases the requirement, the implementation frequency of the criteria, and the acceptance criteria are found in CFR and are therefore regulatory in nature. The sample or group of samples for which one or more of these criteria are not met is invalid until proven otherwise[1]. The cause of not operating in the acceptable range for each of the violated criteria must be investigated and minimized to reduce the likelihood that additional samples will be invalidated. Typically, EPA Regional Offices will be in the best position to assess whether there are compelling reasons and justification for not deleting the data. The evaluation will be informed by a weight of evidence approach, consider input from States/locals and EPA's national office, and be documented.

Criteria that are important for maintaining and evaluating the quality of the data collection system are included under **Operational Criteria**. Violation of a criterion or a number of criteria may be cause for invalidation. The decision maker should consider other quality control information that may or may not indicate the data are acceptable for the parameter being controlled. Therefore, the sample or group of samples for which one or more of these criteria are not met are suspect unless other quality control information demonstrates otherwise and is documented. The reason for not meeting the criteria MUST be investigated, mitigated or justified.

Finally, those criteria which are important for the correct interpretation of the data but do not usually impact the validity of a sample or group of samples are included on the third table, the **Systematic Criteria**. For example, the data quality objectives are included in this table. If the data quality objectives are not met, this does not invalidate any of the samples but it may impact the uncertainty associated with the attainment/non-attainment decision.

[1] In a number of cases precedence has been set with invalidating data based on failure of critical criteria.

> **NOTE: The designation of quality control checks as Operational or Systematic do not imply that these quality control checks need not be performed.** Not performing an operational or systematic quality control check that is required by regulation (in CFR) can be a basis for invalidation of all associated data. Any time a CFR requirement is identified in the Requirement, Frequency or Acceptance Criteria column it will be identified by ***bold*** and ***italics*** font. Many monitoring organization/PQAOs are using the validation templates and have included them in QAPPs. However, it must be mentioned that diligence must be paid to its use. Data quality findings through data reviews and technical systems audits have identified multiple and concurrent non-compliance with operational criteria that monitoring organization considered valid without any documentation to prove the data validity. The validation templates were meant to be applied to small data sets (single values or a few weeks of information) and should not be construed to allow a criterion to be in non-conformance simple because it is operational or systematic

Following are the tables for all the criteria pollutants. For each criterion, the tables include: (1) the requirement (2) the frequency with which compliance is to be evaluated, (3) acceptance criteria, and (4) information where the requirement can be found or additional guidance on the requirement.

The validation templates have been developed based on the current state of knowledge. The templates should evolve as new information is discovered about the impact of the various criteria on the uncertainty in the resulting mass estimate or concentration. In recent years there has been a number of circumstances where critical criteria and in some cases operational criteria that were in regulation (had a frequency and acceptance criteria) where not met. In these cases, EPA has been consistent in their application of invalidating data not meeting regulations. Interactions of the criteria, whether synergistic or antagonistic, should also be incorporated when the impact of these interactions becomes quantified. Due to the potential misuse of invalid data, data that are invalidated should not be uploaded to AQS, but should be retained on the monitoring organization's local database. This data will be invaluable to the evolution of the validation template.

Use of Bold Italics Font to Identify CFR Requirements.

The criteria listed in the validation templates are either requirements that can be found in the Code of Federal Regulations, guidance found in a variety of guidance documents, or recommendations by the QA Workgroup or EPA. As mentioned above any time a CFR requirement is identified in the Requirement, Frequency or Acceptance Criteria column it will be identified by ***bold and italics*** font and can be used for data invalidation depending on the infraction. The Information/Action column will provide the appropriate references for CFR or guidance documents.

Hyperlink References

Where requirements or guidance documents are found on the web, a hyperlink is created which will lead the user to the closest URL address. Any links to CFR are directed to the electronic CFR document (e-CFR) which is the most up-to-date. E-CFR will not get you to an individual section. Therefore, e-CFR is only hyperlinked once on each page.

Change in Acceptance Criteria

In order to provide more consistent guidance in the use of acceptance criteria we have developed more definitive information on rounding. The acceptance criteria will show more digits than might otherwise be found in regulations or guidance. For example, where in the past the one-point flow rate verification was $\pm$ *4% of transfer standard*, some monitoring organizations equated a flow rate of < $\pm$ 4.5% as acceptable while others considered anything < $\pm$ 4.1% acceptable. Therefore, in order to ensure consistency, EPA has provided more definitive information of these acceptance limits. In this case, the acceptance criteria for the flow rate verification is < $\pm$ 4.1%. In the cases where the CFR lists a requirement (as is the case with the flow rate verification which is listed as $\pm$ 4%), EPA will interpret the acceptance criteria to a level that will provide a more consistent application of the template across the ambient air monitoring network. The rounding policy is included in Appendix L of the QA Handbook.

Truncation

Under no circumstances should quality measurements for comparison to acceptance criteria be truncated, rather than rounded.

PM_{10} Note of Caution

The validation templates for PM_{10} get complicated because PM_{10} is required to be reported at standard temperature and pressure (STP) for comparison to the NAAQS (and follow 40 CFR Part 50 App J) and at local conditions if using it to monitor for $PM_{10-2.5}$ (and follow 40 CFR Part 50 App O). Moreover, PM_{10} can be measured with filter-based sampling techniques as well as with automated methods. The validation templates developed for PM_{10} try to accommodate these differences, but monitoring organizations are cautioned to review the operations manual for the monitors/samplers they use and augment the validation template with QC information specific to their EPA reference or equivalent method designation and instrument. http://www.epa.gov/ttn/amtic/files/ambient/criteria/reference-equivalent-methods-list.pdf

Ozone Validation Template

1) Requirement (O_3)	2) Frequency	3) Acceptance Criteria	Information /Action
CRITICAL CRITERIA-OZONE			
Monitor	NA	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
One Point QC Check Single analyzer	***Every 14 days***	< ±7.1% (percent difference) or < ±1.5 ppb difference whichever is greater	1 and 2) 40 CFR Part 58 App A Sec. 3.1 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.2. QC Check Conc range 0.005 - 0.08 ppm and 05/05/2016 Technical Note on AMTIC
Zero/span check	Every 14 days	Zero drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24hr-14 day) Span drift < ± 7.1 %	1 and 2) QA Handbook Volume 2 Sec. 12.3 3) Recommendation and related to DQO
OPERATIONAL CRITERIA -OZONE			
Shelter Temperature Range	Daily (hourly values)	20.0 to 30.0° C. (Hourly avg) or per manufacturers specifications if designated to a wider temperature range	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2 Generally, the 20-30.0° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance. FRM/FEM list found on AMTIC provides temp. range for given instrument. FRM/FEM monitor testing is required at 20-30° C range per 40 CFR Part 53.32
Shelter Temperature Control	Daily (hourly values)	< 2.1° C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Shelter Temperature Device Check	Every 182 days and 2/ calendar year	<± 2.1° C of standard	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Annual Performance Evaluation Single analyzer	***Every site every 365 days and 1/ calendar year within period of monitor operation,***	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1&2 < ± 1.5 ppb difference or <± 15.1%	1 and 2) 40 CFR Part 58 App A Sec. 3.1.2 3) Recommendation- 3-audit concentrations not including zero. AMTIC guidance 2/17/2011 AMTIC Technical Memo
Federal Audits (NPAP)	***20% of sites audited in calendar year***	Audit levels 1&2 < ± 1.5 ppb difference all other levels percent difference < ± 10.1%	1 and 2) 40 CFR Part 58 App A Sec. 3.1.3 3) NPAP QAPP/SOP
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving and repair and recalibration of standard of higher level Every 182 day and 2/ calendar year if manual zero/span performed biweekly Every 365 day and 1/ calendar year if continuous zero/span performed daily	All points < ± 2.1 % or ≤ ±1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± .05	1) 40 CFR Part 50 App D 2) Recommendation 3) 40 CFR Part 50 App D Sec 4.5.5.6 Multi-point calibration (0 and 4 upscale points) Slope criteria is a recommendation
Zero Air/Zero Air Check	Every 365 days and 1/calendar year	Concentrations below LDL	1) 40 CFR Part 50 App D Sec. 4.1 2 and 3) Recommendation
Ozone Level 2 Standard			

1) Requirement (O_3)	2) Frequency	3) Acceptance Criteria	Information /Action
Certification/recertification to Standard Reference Photometer (Level 1)	Every 365 days and 1/calendar year	single point difference < + 3.1%	1) 40 CFR Part 50 App D Sec. 5.4 2 and 3) Transfer Standard Guidance EPA-454/B-10-001 Level 2 standard (formerly called primary standard) usually transported to EPA Regions SRP for comparison
Level 2 and Greater Transfer Standard Precision	Every 365 days and 1/calendar year	***Standard Deviation less than 0.005 ppm or 3.0% whichever is greater***	1) 40 CFR Part 50 Appendix D Sec. 3.1 2) Recommendation, part of reverification 3) 40 CFR Part 50 Appendix D Sec. 3.1
(if recertified via a transfer standard)	Every 365 days and 1/calendar year	Regression slopes = 1.00 + 0.03 and two intercepts are 0 + 3 ppb	1, 2 and 3) Transfer Standard Guidance EPA-545/B-10-001
Ozone Transfer standard (Level 3 and greater)			
Qualification	Upon receipt of transfer standard	< +4.1% or < +4 ppb (whichever greater)	1, 2 and 3) Transfer Standard Guidance EPA-545/B-10-001
Certification	After qualification and upon receipt/adjustment/repair	RSD of six slopes ≤ 3.7% Std. Dev. of 6 intercepts ≤ 1.5	1, 2 and 3) Transfer Standard Guidance EPA-545/B-10-001 1
Recertification to higher level standard	Beginning and end of O3 season or every 182 days and 2/calendar year whichever less	New slope = + 0.05 of previous and RSD of six slopes ≤3.7% Std. Dev. of 6 intercepts ≤ 1.5	1, 2 and 3) Transfer Standard Guidance EPA-545/B-10-001 recertification test that then gets added to most recent 5 tests. If does not meet acceptability certification fails
Detection (FEM/FRMs) Noise and Lower Detectable Limits (LDL) are part of the FEM/FRM requirements. It is recommended that monitoring organizations perform the LDL test to minimally confirm and establish the LDL of their monitor. Performing the LDL test will provide the noise information.			
Noise	Every 365 days and 1/ calendar year	***≤ 0.0025 ppm (standard range) ≤ 0.001 ppm (lower range)***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation- info can be obtained from LDL 3) 40 CFR Part 53.20 Table B-1
Lower detectable limit	Every 365 days and 1/calendar year	***≤ 0.005 ppm (standard range) ≤ 0.002 ppm (lower range)***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1
SYSTEMATIC CRITERIA-OZONE			
Standard Reporting Units	***All data***	***ppm (final units in AQS)***	1, 2 and 3) 40 CFR Part 50 App U Sec. 3(a)
Rounding convention for design value calculation	***All routine concentration data***	***3 places after decimal with digits to right truncated***	1, 2 and 3) 40 CFR Part 50 App U Sec. 3(a) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual hourly values.
Completeness (seasonal)	***3-Year Comparison***	***≥ 90% (avg) daily max available in ozone season with min of 75% in any one year.***	1,2,3) 40 CFR Part 50 App U Sec 4(b)
	8- hour average	***≥ if at least 6 of the hourly concentrations for the 8-hour period are available***	1) 40 CFR Part 50 App U 2 and 3) 40 CFR Part 50 App U Sec. 3(b)
	Valid Daily Max	***≥ if valid 8-hour averages are available for at least 13 of the 17 consecutive 8-hour periods starting from 7:00 a.m. to 11:00 p.m***	1) 40 CFR Part 50 App U 2,3) 40 CFR Part 50 App U Sec. 3(d)
Sample Residence Time Verification	Every 365 days and 1/calendar year	***≤ 20 Seconds***	1) 40 CFR Part 58 App E, Sec. 9 (c) 2) Recommendation

1) Requirement (O_3)	2) Frequency	3) Acceptance Criteria	Information /Action
			3) 40 CFR Part 58 App E, Sec. 9 (c)
Sample Probe, Inlet, Sampling train	***All sites***	***Borosilicate glass (e.g., Pyrex®) or Teflon®***	1) 40 CFR Part 58 App E, Sec. Sec. 9 (a) 2) Recommendation 3) 40 CFR Part 58 App E, Sec. Sec. 9 (a) FEP and PFA have been accepted as an equivalent material to Teflon. Replacement or cleaning is suggested as 1/year and more frequent if pollutant load or contamination dictate
Siting	Every 365 days and 1/calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-6 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-6
EPA Standard Ozone Reference Photometer (SRP) Recertification (Level 1)	Every 365 days and 1/calendar year	Regression slope = 1.00 ± 0.01 and intercept < 3 ppb	1, 2 and 3) Transfer Standard Guidance EPA-454/B-10-001 This is usually at a Regional Office and is compared against the traveling SRP
Precision (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	**90% CL CV < 7.1%**	1) 40 CFR Part 58 App A 2.3.1.2 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.2
Bias (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	**95% CL < ± 7.1%**	1) 40 CFR Part 58 App A 2.3.1.2 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.3

CO Validation Template

1) Requirement (CO)	2) Frequency	3) Acceptance Criteria	Information /Action
CRITICAL CRITERIA-CO			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
One Point QC Check Single analyzer	***Every 14 days***	< +10.1% (percent difference)	1 and 2) 40 CFR Part 58 App A Sec. 3.1.1 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1. QC Check Conc range 0.5 – 5 ppm
Zero/span check	Every 14 days	Zero drift < + 0.41 ppm (24 hr) < + 0.61 ppm (>24hr-14 day) Span drift < + 10.1 %	1 and 2) QA Handbook Volume 2 Sec. 12.3 3) Recommendation
OPERATIONAL CRITERIA-CO			
Shelter Temperature range	Daily (hourly values)	20.0 to 30.0º C. (Hourly avg) or per manufacturers specifications if designated to a wider temperature range	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2 Generally, the 20-30.0 º C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance. FRM/FEM list found on AMTIC provides temp. range for given instrument. FRM/FEM monitor testing is required at 20-30 º C range per 40 CFR Part 53.32
Shelter Temperature Control	Daily (hourly values)	< 2.1º C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Shelter Temperature Device Check	Every 182 days and 2/ calendar year	< + 2.1º C of standard	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Annual Performance Evaluation Single Analyzer	***Every site every 365 days and 1/ calendar year***	Percent difference of audit levels 3-10 < +15.1% Audit levels 1&2 < + 0.031 ppm difference or < +15.1%	1 and 2) 40 CFR Part 58 App A Sec. 3.1.2 3) Recommendation- 3-audit concentrations not including zero. AMTIC Technical Memo
Federal Audits (NPAP)	***20% of sites audited in a calendar year***	Audit levels 1&2 < + 0.031 ppm difference all other levels percent difference < + 15.1%	1 and 2) 40 CFR Part 58 App A Sec. 3.1.3 3) NPAP QAPP/SOP
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving Every 182 day and 2/ calendar year if manual zero/span performed biweekly Every 365 days and 1/ calendar year if continuous zero/span performed daily	All points < + 2.1 % or ≤ + 0.03 ppm difference of best-fit straight line. whichever is greater and Slope 1 + .05	1) 40 CFR Part 50 Appendix C Sec. 4 2 and 3) Recommendation See details about CO2 sensitive instruments Multi-point calibration (0 and 4 upscale points) Slope criteria is a recommendation

1) Requirement (CO)	2) Frequency	3) Acceptance Criteria	Information /Action
Gaseous Standards	All gas cylinders	**NIST Traceable** (e.g., EPA Protocol Gas)	1) 40 CFR Part 50 Appendix C Sec. 4.3.1 2) NA Green Book 3) 40 CFR Part 50 Appendix C Sec. 4.3.1 See details about CO2 sensitive instruments Gas producer used must participate in EPA Ambient Air Protocol Gas Verification Program 40 CFR Part 58 App A Sec. 2.6.1
Zero Air/Zero Air Check	Every 365 days and 1/ calendar year	***< 0.1 ppm CO***	1) 40 CFR Part 50 App C Sec. 4.3.2 2) Recommendation 3) 40 CFR Part 50 App C Sec. 4.3.2
Gas Dilution Systems	Every 365 days and 1/ calendar year or after failure of 1 point QC check or performance evaluation	Accuracy < ± 2.1 %	1, 2 and 3) Recommendation based on SO2 requirement in 40 CFR Part 50 App A-1 Sec. 4.1.2
Detection (FEM/FRMs) Noise and Lower Detectable Limits (LDL) are part of the FEM/FRM requirements. It is recommended that monitoring organizations perform the LDL test to minimally confirm and establish the LDL of their monitor. Performing the LDL test will provide the noise information.			
Noise	Every 365 days and 1/ calendar year	***≤ 0.2 ppm (standard range)*** ***≤ 0.1 ppm (lower range)***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation- info can be obtained from LDL 3) 40 CFR Part 53.20 Table B-1
Lower detectable level	Every 365 days and 1/ calendar year	***≤ 0.4 ppm (standard range)*** ***≤ 0.2 ppm (lower range)***	1) 40 CFR Part 53.23 (c) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1
SYSTEMATIC CRITERIA-CO			
Standard Reporting Units	***All data***	***ppm (final units in AQS)***	1, 2 and 3) 40 CFR Part 50.8 (a)
Rounding convention for design value calculation	***All routine concentration data***	***1 decimal place***	1, 2 and 3) 40 CFR Part 50.8 (d) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual hourly values.
Completeness	***8-hour standard***	***75% of hourly averages for the 8-hour period***	1) 40 CFR Part 50.8(c) 2) 40 CFR Part 50.8(a-2) 3) 40 CFR Part 50.8(c)
Sample Residence Time Verification	Every 365 days and 1/ calendar year	≤ 20 Seconds	1, 2, and 3) Recommendation. CO not a reactive gas but suggest following same methods other gaseous criteria pollutants.
Sample Probe, Inlet, Sampling train	All Sites	Borosilicate glass (e.g., Pyrex®) or Teflon®	1, 2, and 3) Recommendation. CO not a reactive gas but suggest following same methods other gaseous criteria pollutants. FEP and PFA have been accepted as a equivalent material to Teflon. Replacement/cleaning is suggested as 1/year and more frequent if pollutant load dictate.
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-6 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-6
Precision (using 1-point QC	***Calculated annually and as***	***90% CL CV < 10.1%***	1) 40 CFR part 58 App A Sec. 3.1.1

1) Requirement (CO)	2) Frequency	3) Acceptance Criteria	Information /Action
checks)	***appropriate for design value estimates***		2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.2
Bias (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***95% CL < ± 10.1%***	1) 40 CFR Part 58 App A Sec. 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.3

NO_2, NOx, NO Validation Template

1) Requirement (NO_2)	2) Frequency	3) Acceptance Criteria	Information /Action
CRITICAL CRITERIA- NO_2			
Sampler/Monitor	***NA***	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
One Point QC Check Single analyzer	***Every 14 days***	< ±15.1% (percent difference) or < ± 1.5 ppb difference whichever is greater	1 and 2) 40 CFR Part 58 App A Sec. 3.1.1 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.5 QC Check Conc range 0.005 - 0.08 ppm and 05/05/2016 Technical Note on AMTIC
Zero/span check	Every 14 days	Zero drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24hr-14 day) Span drift < ± 10.1 %	1 and 2) QA Handbook Volume 2 Sec. 12.3 3) Recommendation and related to DQO
Converter Efficiency	During multi-point calibrations, span and audit Every 14 days	***(≥96%)*** 96% – 104.1%	1) 40 CFR Part 50 App F Sec. 1.5.10 and 2.4.10 2) Recommendation 3) 40 CFR Part 50 App F Sec. 1.5.10 and 2.4.10 Regulation states ≥ 96%, 96 – 104.1% is a recommendation.
OPERATIONAL CRITERIA- NO_2			
Shelter Temperature Range	Daily (hourly values)	20.0 to 30.0° C. (Hourly avg) or per manufacturers specifications if designated to a wider temperature range	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2 Generally, the 20-30.0 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance. FRM/FEM list found on AMTIC provides temp. range for given instrument. FRM/FEM monitor testing is required at 20-30 ° C range per 40 CFR Part 53.32
Shelter Temperature Control	Daily (hourly values)	< 2.1° C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Shelter Temperature Device Check	every 182 days and 2/calendar year	< ± 2.1° C of standard	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Annual Performance Evaluation Single Analyzer	***Every site every 365 days and 1/ calendar year***	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1&2 < ± 1.5 ppb difference or < ±15.1%	1) 40 CFR Part 58 App A Sec. 3.1.2 2) 40 CFR Part 58 App A Sec. 3.1.2 3) Recommendation - 3-audit concentrations not including zero. AMTIC Technical Memo
Federal Audits (NPAP)	20% of sites audited in calendar year	Audit levels 1&2 < ± 1.5 ppb difference all other levels percent difference < ± 15.1%	1 & 2) 40 CFR Part 58 App A Sec. 3.1.3 3) NPAP QAPP/SOP

1) Requirement (NO_2)	2) Frequency	3) Acceptance Criteria	Information /Action
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving Every 182 day and 2/ calendar year if manual zero/span performed biweekly Every 365 day and 1/ calendar year if continuous zero/span performed daily	Instrument residence time ≤ 2 min Dynamic parameter ≥ 2.75 ppm-min All points <± 2.1 % or ≤ ± 1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± .05	1) 40 CFR Part 50 App F 2 and 3) Recommendation Multi-point calibration (0 and 4 upscale points) Slope criteria is a recommendation
Gaseous Standards	All gas cylinders	**NIST Traceable** (e.g., EPA Protocol Gas) 50-100 ppm of NO in Nitrogen with < 1 ppm NO_2	1) 40 CFR Part 50 App F Sec. 1.3.1 2) NA Green Book 3) 40 CFR Part 50 App F Sec. 1.3.1. A technical memo may change the concentration requirment. Gas producer used must participate in EPA Ambient Air Protocol Gas Verification Program 40 CFR Part 58 App A Sec. 2.6.1
Zero Air/ Zero Air Check	Every 365 days and 1/ calendar year	Concentrations below LDL	1) 40 CFR Part 50 App F Sec. 1.3.2 2 and 3) Recommendation
Gas Dilution Systems	Every 365 days and 1/ calendar year or after failure of 1 point QC check or performance evaluation	Accuracy < ± 2.1 %	1, 2 and 3) Recommendation based on SO2 requirement in 40 CFR Part 50 App A-1 Sec. 4.1.2
Detection (FEM/FRMs) Noise and Lower Detectable Limits (LDL) are part of the FEM/FRM requirements. It is recommended that monitoring organizations perform the LDL test to minimally confirm and establish the LDL of their monitor. Performing the LDL test will provide the noise information.			
Noise	Every 365 days and 1/ calendar year	***≤ 0.005 ppm***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation- info can be obtained from LDL 3) 40 CFR Part 53.20 Table B-1
Lower detectable level	Every 365 days and 1/ calendar year	***≤ 0.01 ppm***	1) 40 CFR Part 53.23 (c) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1
SYSTEMATIC CRITERIA- NO_2			
Standard Reporting Units	***All data***	***ppb (final units in AQS)***	1, 2 and 3) 40 CFR Part 50 App S Sec. 2 (c)
Rounding convention for data reported to AQ S	***All routine concentration data***	***1 place after decimal with digits to right truncated***	1, 2 and 3) 40 CFR Part 50 App S Sec. 4.2 (a) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual hourly values.
Completeness	***Annual Standard***	***≥ 75% hours in year***	1) 40 CFR Part 50 App S Sec. 3.1(b) 2) 40 CFR Part 50 App S Sec. 3.1(a) 3) 40 CFR Part 50 App S Sec. 3.1(b)
	1-hour standard	***1) 3consecutive calendars years of complete data 2) 4 quarters complete in each year 3) ≥75% sampling days in quarter 4) ≥ 75% of hours in a day***	1) 40 CFR Part 50 App S Sec. 3.2(b) 2) 40 CFR Part 50 App S Sec. 3.2(a) 3) 40 CFR Part 50 App S Sec. 3.2(b) More details in 40 CFR Part 50 App S

1) Requirement (NO_2)	2) Frequency	3) Acceptance Criteria	Information /Action
Sample Residence Time Verification	Every 365 days and 1/ calendar year	***≤ 20 Seconds***	1) 40 CFR Part 58 App E, Sec. 9 (c) 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 9 (c)
Sample Probe, Inlet, Sampling train	***All sites***	***Borosilicate glass (e.g., Pyrex®) or Teflon®***	1, 2 and 3) 40 CFR Part 58 App E Sec. 9 (a) FEP and PFA have been accepted as equivalent material to Teflon. Replacement or cleaning is suggested as 1/year and more frequent if pollutant load or contamination dictate
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Secs 2-6 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-6
Precision (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***90% CL CV < 15.1%***	1) 40 CFR Part 58 App A Sec. 2.3.1.5 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.2
Bias (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***95% CL < ± 15.1%***	1) 40 CFR Part 58 App A Sec. 2.3.1.5 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.3

SO_2 Validation Template

1) Requirement (SO_2)	2) Frequency	3) Acceptance Criteria	Information /Action
CRITICAL CRITERIA- SO_2			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
One Point QC Check Single analyzer	***Every 14 days***	< ±10.1% (percent difference) or < ± 1.5 ppb difference whichever is greater	1 and 2) 40 CFR Part 58 App A Sec. 3.1.1 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.2 QC Check Conc range 0.005 - 0.08 ppm and 05/05/2016 Technical Note on AMTIC
Zero/span check	Every 14 days	Zero drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24hr-14 day) Span drift < ± 10.1 %	1 and 2) QA Handbook Volume 2 Sec. 12.3 3) Recommendation and related to DQO
OPERATIONAL CRITERIA- SO_2			
Shelter Temperature Range	Daily (hourly values)	20.0 to 30.0° C. (Hourly avg) or per manufacturers specifications if designated to a wider temperature range	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2 Generally, the 20-30.0 ° C range will apply but the most restrictive operable range of the instruments in the shelter may also be used as guidance. FRM/FEM list found on AMTIC provides temp. range for given instrument. FRM/FEM monitor testing is required at 20-30 ° C range per 40 CFR Part 53.32
Shelter Temperature Control	Daily (hourly values)	< 2.1° C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Shelter Temperature Device Check	every 180 days and 2/calendar year	< ± 2.1° C of standard	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Annual Performance Evaluation Single Analyzer	***Every site every 365 days and 1/ calendar year***	Percent difference of audit levels 3-10 < ±15.1% Audit levels 1&2 < ± 1.5 ppb difference or < ±15.1%	1 and 2) 40 CFR Part 58 App A Sec. 3.1.2 3) Recommendation - 3-audit concentrations not including zero. AMTIC Technical Memo
Federal Audits (NPAP)	20% of sites audited in calendar year	Audit levels 1&2 < ± 1.5 ppb difference all other levels percent difference < ± 15.1%	1&2) 40 CFR Part 58 App A Sec. 3.1.3 3) NPAP QAPP/SOP
Verification/Calibration	Upon receipt/adjustment/repair/ installation/moving Every 182 day and 2/ calendar year if manual zero/span performed biweekly Every 365 day and 1/ calendar year if continuous zero/span performed daily	All points < ± 2.1 % or < ± 1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 ± .05	1) 40 CFR Part 50 App A-1 Sec. 4 2 and 3) Recommendation Multi-point calibration (0 and 4 upscale points) Slope criteria is a recommendation
Gaseous Standards	***All gas cylinders***	***NIST Traceable*** ***(e.g., EPA Protocol Gas)***	1) 40 CFR Part 50 App A-1 Sec. 4.1.6.1 2) NA Green Book 3) 40 CFR Part 50 App F Sec. 1.3.1 Producers must participate in Ambient Air Protocol Gas

1) Requirement (SO_2)	2) Frequency	3) Acceptance Criteria	Information /Action
			Verification Program 40 CFR Part 58 App A Sec. 2.6.1
Zero Air/ Zero Air Check	Every 365 days and 1/ calendar year	Concentrations below LDL < 0.1 ppm aromatic hydrocarbons	1) 40 CFR Part 50 App A-1 Sec. 4.1.6.2 2) Recommendation 3) Recommendation and 40 CFR Part 50 App A-1 Sec. 4.1.6.2
Gas Dilution Systems	Every 365 days and 1/ calendar year or after failure of 1point QC check or performance evaluation	***Accuracy < ± 2.1 %***	1) 40 CFR Part 50 App A-1Sec. 4.1.2 2) Recommendation 3) 40 CFR Part 50 App A-1 Sec. 4.1.2
Detection (FEM/FRMs) Noise and Lower Detectable Limits (LDL) are part of the FEM/FRM requirements. It is recommended that monitoring organizations perform the LDL test to minimally confirm and establish the LDL of their monitor. Performing the LDL test will provide the noise information.			
Noise	Every 365 days and 1/ calendar year	***≤ 0.001 ppm (standard range)*** ***≤ 0.0005 ppm (lower range)***	1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation- info can be obtained from LDL 3) 40 CFR Part 53.20 Table B-1
Lower detectable level	Every 365 days and 1/ calendar year	***≤ 0.002 ppm (standard range)*** ***≤ 0.001 ppm (lower range)***	1) 40 CFR Part 53.23 (c) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1
SYSTEMATIC CRITERIA- SO_2			
Standard Reporting Units	***All data***	***ppb (final units in AQS)***	1, 2 and 3) 40 CFR Part 50 App T Sec. 2 (c)
Rounding convention for design value calculation	***All routine concentration data***	***1 place after decimal with digits to right truncated***	1, 2 and 3) 40 CFR Part 50 App T Sec. 2 (c) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual hourly values.
Completeness	***1 hour standard***	Hour – 75% of hour ***Day- 75% hourly Conc*** ***Quarter- 75% complete days*** ***Years- 4 complete quarters*** ***5-min value reported only for valid hours***	1, 2 and 3) 40 CFR Part 50 App T Sec. 3 (b), (c) More details in CFR on acceptable completeness. 5-min values or 5-min max value (40 CFR part 58.16(g)) only reported for the valid portion of the hour reported. If the hour is incomplete no 5-min or 5-min max reported.
Sample Residence Time Verification	Every 365 days and 1/ calendar year	***≤ 20 Seconds***	1) 40 CFR Part 58 App E, Sec. 9 (c) 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 9 (c)
Sample Probe, Inlet, Sampling train	***All sites***	***Borosilicate glass (e.g., Pyrex®) or Teflon®***	1, 2 and 3) 40 CFR Part 58 App E Sec. 9 (a) FEP and PFA have been accepted as equivalent material to Teflon. Replacement or cleaning is suggested as 1/year and more frequent if pollutant load or contamination dictate
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-6 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-6
Precision (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***90% CL CV < 10.1%***	1) 40 CFR Part 58 App A Sec. 2.3.1.6 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.2

1) Requirement (SO_2)	2) Frequency	3) Acceptance Criteria	Information /Action
Bias (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***95% CL < $\pm$ 10.1%***	1) 40 CFR Part 58 App A Sec. 2.3.1.6 & 3.1.1 2) 40 CFR Part 58 App A Sec. 4 (b) 3) 40 CFR Part 58 App A Sec. 4.1.3

$PM_{2.5}$ Filter Based Local Conditions Validation Template

1) Criteria (PM2.5 LC)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- $PM_{2.5}$ Filter Based Local Conditions			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Filter Holding Times			
Pre-sampling	***all filters***	***≤ 30 days before sampling***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.5
Sample Recovery	***all filters***	***≤ 7 days 9 hours from sample end date***	1, 2 and 3) 40 CFR Part 50, App. L 10.10
Sampling Period (including multiple power failures)	***all filters***	***1380-1500 minutes, or if value < 1380 and exceedance of NAAQS 1/ midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App L Sec. 3.3 and 40 CFR Part 50 App N Sec. 1 for the midnight to midnight local standard time requirement See details if less than 1380 min sampled
Sampling Instrument			
Average Flow Rate	***every 24 hours of op***	***average within 5% of 16.67 liters/minute***	1, 2 and 3) Part 50 App L Sec. 7.4.3.1
Variability in Flow Rate	***every 24 hours of op***	***CV ≤ 2%***	1, 2 and 3) 40 CFR Part 50, App L Sec. 7.4.3.2
One-point Flow Rate Verification	***every 30 days each seperated by 14 days***	***< ± 4.1% of transfer standard*** < ± 5.1% of flow rate design value	1, 2 and 3) 40 CFR Part 50, App L, Sec. 9.2.5 and 7.4.3.1 and 40 CFR Part 58, Appendix A Sec. 3.2.1
Design Flow Rate Adjustment	***After multi-point calibration or verification***	***< ± 2.1% of design flow rate***	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.6
Individual Flow Rates	***every 24 hours of op***	***no flow rate excursions > ±5% for > 5 min. 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.1
Filter Temp Sensor	***every 24 hours of op***	***no excursions of > 5º C lasting longer than 30 min 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.11.4
External Leak Check	***Before each flow rate verification/calibration*** and before and after $PM_{2.5}$ separator maintenance	***< 80.1 mL/min*** (see comment #1)	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) 40 CFR Part 50 App L Sec. 9.2.3 and Method 2-12 Sec. 7.4.3 3) 40 CFR Part 50, App. L, Sec. 7.4.6.1
Internal Leak Check	If failure of external leak check	***< 80.1 mL/min***	1) 40 CFR Part 50, App. L, Sec. 7.4.6.2 2) Method 2-12, Sec. 7.4.4 3) 40 CFR Part 50, App. L, Sec. 7.4.6.2
Laboratory Activities			

1) Criteria (PM2.5 LC)	2) Frequency	3) Acceptable Range	Information /Action
Post-sampling Weighing	***all filters***	***Protected from exposure to temperatures above 25C from sample retrieval to conditioning*** ***<u><</u>10 days from sample end date if shipped at ambient temp, or*** ***<u><</u> 30 days if shipped below avg ambient (or 4º C or below for avg sampling temps < 4º C) from sample end date***	1, 2 and 3) 40 CFR Part 50 App L Sec. 8.3.6 and L Sec. 10.13. See technical note on holding time requirements at : https://www3.epa.gov/ttn/amtic/pmpolgud.html
Filter Visual Defect Check (unexposed)	***all filters***	***Correct type & size and for pinholes, particles or imperfections***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 10.2
Filter Conditioning Environment			
Equilibration	***all filters***	***24 hours minimum***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.5
Temp. Range	***all filters***	***24-hr mean 20.0-23.0º C***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.1
Temp. Control	***all filters***	***< 2.1º C SD* over 24 hr.***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.2 SD use is a recommendation
Humidity Range	***all filters***	***24-hr mean 30.0% - 40.0% RH or Within <u>+</u>5.0 % sampling RH but <u>></u> 20.0%RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.3
Humidity Control	***all filters***	***< 5.1 % SD* over 24 hr.***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.4 SD use is recommendation
Pre/post Sampling RH	***all filters***	***difference in 24-hr means < <u>+</u> 5.1% RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.3
Balance	***all filters***	***located in filter conditioning environment***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.2
Microbalance Auto-Calibration	***Prior to each weighing session***	Manufacturer's specification	1) 40 CFR Part 50, App. L, Sec. 8.1 2) 40 CFR Part 50, App. L, Sec. 8.1 and Method 2.12 Sec. 10.6 3) NA
OPERATIONAL EVALUATIONS TABLE $PM_{2.5}$ Filter Based Local Conditions			
Field Activities			
One-point Temp Verification	every 30 days	< <u>+</u> 2.1ºC	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec. 7.4.5 and Table 6-1 3) Recommendation
Pressure Verification	every 30 days	< <u>+</u> 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec. 7.4.6 and Table 6-1 3) Recommendation
Annual Multi-point Verifications/Calibrations			
Temperature multi-point Verification/Calibration	on installation, then every 365 days and once a calendar year	< <u>+</u> 2.1ºC	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.4.4 Table 6-1

1) Criteria (PM2.5 LC)	2) Frequency	3) Acceptable Range	Information /Action
Pressure Verification/Calibration	on installation, and on one-point verification failure	< + 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.5 Sampler BP verified against independent standard verified against a lab primary standard that is certified as NIST traceable 1/year
Flow Rate Multi-point Verification/ Calibration	***Electromechanical maintenance or transport*** or every 365 days and once a calendar year	< + 2.1% of transfer standard	1) 40 CFR Part 50, App. L, Sec. 9.2. 2) 40 CFR Part 50, App. L, Sec. 9.1.3, Method 2.12 Sec. 6.3 & Table 6-1 3) Recommendation
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	1, 2 and 3) Recommendation
Precision			
Collocated Samples	***every 12 days for 15% of sites by method designation***	CV < 10.1% of samples > 3.0 µg/m^3	1) and 2) Part 58 App A Sec. 3.2.3 3 Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.1
Accuracy			
Temperature Audit	every 180 days and at time of flow rate audit	< + 2.1ºC	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 180 days and at time of flow rate audit	< +10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and between 5-7 months apart***	< + 4.1% of audit standard < + 5.1% of design flow rate	1 and 2) Part 58, App A, Sec. 3.2.2 3) Method 2.12 Sec. 11.2.1
Monitor Maintenance			
$PM_{2.5}$ Separator (WINs)	every 5 sampling events	cleaned/changed	1, 2, and 3) Method 2.12 Sec. 8.2.2
$PM_{2.5}$ Separator (VSCC)	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3.3
Inlet Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Downtube Cleaning	every 90 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.4
Filter Housing Assembly Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Circulating Fan Filter Cleaning	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
Laboratory Activities			
Filter Checks			
Lot Blanks	9 filters per lot	< +15.1 µg change between weighings	1, 2, 3) Recommendation and used to determine filter stability of the lot of filters received from EPA or vendor. Method 2.12 Sec. 10.5
Exposure Lot Blanks	3 filters per lot	< +15.1 µg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.5 Used for preparing a subset of filters for equilibration
Filter Integrity (exposed)	each filter	no visual defects	1, 2 and 3) Method 2.12 Sec. 10.7 and 10.3
Lab QC Checks			

1) Criteria (PM2.5 LC)	2) Frequency	3) Acceptable Range	Information /Action
Field Filter Blank	10% or 1 per weighing session	<+ 30.1 µg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.1 2 and 3) Method 2.12 Table 7-1 & Sec.10.5
Lab Filter Blank	10% or 1 per weighing session	<+ 15.1 µg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.2 2 and 3) Method 2.12 Sec. 10.5
Balance Check (working standards)	beginning, 10th sample, end	< +3.1 µg from certified value	1, 2 and 3) Method 2.12 Sec. 10.6 Standards used should meet specifications in Method 2.12, Sec. 4.3.7
Routine Filter re-weighing	1 per weighing session	<+ 15.1 µg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.8
Microbalance Audit	every 365 days and once a calendar year	<+ 0.003 mg or manufacturers specs, whichever is tighter	1, 2 and 3) Method 2.12 Sec. 11.2.7
Lab Temp Check	Every 90 days	< + 2.1ºC	1, 2 and 3) Method 2.12 Sec. 10.10
Lab Humidity Check	Every 90 days	< + 2.1%	1, 2 and 3) Method 2.12 Sec. 10.10
Verification/Calibration			
Microbalance Calibration	***At installation*** every 365 days and once a calendar year	Manufacturer's specification	1) 40 CFR Part 50, App. L, Sec. 8.1 2) 40 CFR Part 50, App. L, Sec. 8.1 and Method 2.12 Sec. 10.11 3) NA
Lab Temperature Certification	every 365 days and once a year	< + 2.1ºC	1, 2 and 3) Method 2.12 Sec. 4.3.8 and 9.4
Lab Humidity Certification	every 365 days and once a year	< + 2.1%	1, 2 and 3) Method 2.12 Sec. 4.3.8 and 9.4
Calibration & Check Standards -			
Working Mass Stds. Verification Compared to primary standards	Every 90 days	< + 2.1 ug	1, 2 and 3) Method 2.12 Sec. 9.7
Primary standards certification	every 365 days and once a calendar year	0.025 mg tolerance (Class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7
SYSTEMATIC CRITERIA -PM$_{2.5}$ Filter Based Local Conditions			
Siting	every 365 days and once a calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-5
Data Completeness	***Annual Standard***	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
	24- Hour Standard	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
Reporting Units	***all filters***	***µg/m^3 at ambient temp/pressure (PM$_{2.5}$)***	1, 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b)
Rounding convention for design value calculation	***all filters***	***to one decimal place, with additional digits to the right being truncated***	1, 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.

1) Criteria (PM2.5 LC)	2) Frequency	3) Acceptable Range	Information /Action
Annual 3-yr average	***all concentrations***	***nearest 0.1 µg/m^3*** (> 0.05 round up)	1, 2 and 3) 40 CFR Part 50, App. N Sec. 3 and 4 Rounding convention for data reported to AQS is a recommendation
24-hour, 3-year average	***all concentrations***	***nearest 1 µg/m^3*** (> 0.5 round up)	1, 2 and 3) 40 CFR Part 50, App. N Sec. 3 and 4 Rounding convention for data reported to AQS is a recommendation
Detection Limit			
Lower DL	***all filters***	***< 2 µg/m^3***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 3.1
Upper Conc. Limit	***all filters***	***> 200 µg/m^3***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 3.2
Precision			
Single analyzer (collocated monitors)	every 90 days	Coefficient of variation (CV) < 10.1% for values > 3.0 µg/m^3	1, 2 and 3) Recommendation in order to provide early (quarterly) evaluation of achievement of DQOs.
Primary Quality Assurance Org.	***Annual and 3 year estimates***	***90% CL of CV < 10.1 % for values > 3.0 µg/m^3***	1, 2 and 3) 40 CFR Part 58, App A, Sec. 4.2.1 and 2.3.1.1
Bias			
Performance Evaluation Program (PEP)	***5 audits for PQAOs with < 5 sites 8 audits for PQAOs with > 5 sites***	***< + 10.1% for values > 3.0 µg/m^3***	1, 2 and 3) 40 CFR Part 58, App A, Sec. 3.2.4, 4.2.5 and 2.3.1.1
Field Activities			
Verification/Calibration Standards Recertifications – All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< + 2.1% of NIST Traceable Std.***	1) 40 CFR Part 50, App. L Sec. 9.1 & 9.2 2) Method 2-12 Sec. 4.2.2 & 6.4.3 3) 40 CFR Part 50, App. L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	+ 0.1° C resolution, + 0.5° C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Field Barometer	every 365 days and once a calendar year	+ 1 mm Hg resolution, + 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Clock/timer Verification	Every 30 days	***1 min/mo***	1 and 2) Method 2.12 Sec. 4.2.1 3) 40 CFR Part 50, App. L Sec. 7.4.12
Laboratory Activities			
Microbalance Readability	***At purchase***	***1 µg***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.1
Microbalance Repeatability	At purchase	1 µg	1) Method 2.12 Sec. 4.3.6 2) Recommendation 3) Method 2.12 Sec. 4.3.6
Primary Mass/Working mass Verification/Calibration Standards	At purchase	0.025 mg tolerance (Class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7

1) Criteria (PM2.5 LC)	2) Frequency	3) Acceptable Range	Information /Action
Comment #1 The associated leak test procedure shall require that for successful passage of this test, the difference between the two pressure measurements shall not be greater than the number of mm of Hg specified for the sampler by the manufacturer, based on the actual internal volume of the sampler, that indicates a leak of less than 80 mL/min.			

1/ value must be flagged SD * = standard deviation CV= coefficient of variation

Continuous PM2.5 Local Conditions Validation Template

NOTE: This validation template attempts to provide the critical criteria, annual multipoint verifications/calibrations, and verification/calibration standards recertification frequencies and acceptable ranges for PM2.5 continuous FEMs and ARMs. At the time this validation template was most recently updated (January 2016) there were eleven continuous monitors designated as a Federal Equivalent Method (FEM) and none designated as an Approved Regional Method (ARM). For the most widely used continuous FEMs we have added select method specific operational criteria. However, due to limited available information, we do not have operational criteria for all approved FEMs, especially those methods with just a handful or less of monitors that have been implemented. Where we do list operational criteria for a specific method, we only list the criteria believed to be the most important. More detailed information on operational criteria is available for the most widely used PM2.5 continuous FEMs in Technical System Audit Supplementary Checklists for PM Continuous Monitors. These files are available on the web at: https://www3.epa.gov/ttn/amtic/contmont.html.

Technical Systems Audit Checklists

- PM continuous TSA checklist – Met One BAM – Draft (PDF)
- PM continuous TSA checklist – Thermo TEOM-FDMS – Draft (PDF)

Where appropriate, 40 CFR Part 58 App A and 40 CFR Part 50 App L requirements apply to Continuous PM2.5 FEMs; however, not all criteria may apply to each continuous FEM and ARM due to the nature of the measurement principle and design of the instrument. Also, while this validation template is designed to apply to PM2.5 continuous FEMs and ARMs, it may also apply to PM2.5 continuous methods that are not specifically approved as FEMs or ARMs and used to meet SLAMS monitoring requirements in support of the AQI, but not the NAAQS.

1) Criteria (PM2.5 Cont)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- $PM_{2.5}$ Continuous, Local Conditions			
Sampler/Monitor Designation	NA	***Meets requirements listed in FRM/FEM/ARM designation*** Confirm method designation on front panel or just inside instrument.	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Firmware of monitor	At setup	1. Must be the firmware (or later version) as identified in the published method designation summary. ***2. Firmware settings must be set for flowrate to operate and report at "local conditions" (i.e., not STP).***	40 CFR Part 50 App N. sec. 1 (c)
Data Reporting Period	Report every hour	1. The calculation of an hour of data is dependent on the design of the method. ***2. A 24-hour period is calculated in AQS if 18 or more valid hours are reported for a day [1/].***	See operator's manual. Hourly data are always reported as the start of the hour on local standard time 40 CFR Part 50 App N. Sec 3 (c)

1) Criteria (PM2.5 Cont)	2) Frequency	3) Acceptable Range	Information /Action
Sampling Instrument			
PM10 Inlet (if applicable to method designated)	At Setup	Must be a Louvered PM10 size selective inlet as specified in 40 CFR 50 appendix L, Figures L-2 through L-19	
PM2.5 second stage separator (if applicable to method designated)	At Setup	Must be a BGI Inc. Very Sharp Cut Cyclone (VSCC™) or equivalent second stage separator approved for the method.	The other approved second stage separator option for select FEMs is the Dichot. Only the GRIMM 180 and Teledyne T640 and T640X are known to not have a second stage seperator as part of the method.
Average Flow Rate	***every 24 hours of operation; alternatively, each hour can be checked***	***average within 5% of 16.67 liters/minute at local conditions***	1, 2 and 3) Part 50 App L Sec. 7.4.3.1
Variability in Flow Rate	***every 24 hours of op***	***CV ≤ 2%***	1, 2 and 3) 40 CFR Part 50, App L Sec. 7.4.3.2
One-point Flow Rate Verification	***every 30 days each seperated by 14 days***	***< ± 4.1% of transfer standard*** < ± 5.1% of flow rate design value	1, 2 and 3) 40 CFR Part 50, App.L, Sec. 9.2.5, 40 CFR Part 58, Appendix A Sec. 3.2.3 & 3.3.2
Design Flow Rate Adjustment	***After multi-point calibration or verification***	***< ± 2.1% of design flow rate***	1,2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.6
External Leak Check	***Before each flow rate verification/calibration*** and before and after $PM_{2.5}$ separator maintenance	Method specific. See operator's manual.	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) 40 CFR Part 50 App L Sec.t 9.2.3 and Method 2-12 Sec. 7.4.3 3) 40 CFR Part 50, App. L, Sec. 7.4.6.1
Internal Leak Check	If failure of external leak check	Method specific. See operators manual.	1) 40 CFR Part 50, App. L, Sec. 7.4.6.2 2) Method 2-12 7.4.4 3) 40 CFR Part 50, App. L, Sec. 7.4.6.2
Annual Multi-point Verifications/Calibrations			
Leak Check	every 30 days	< 1.0 lpm BAM (Not Thermo BAMS) ± 0.15 lpm TEOM	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) Recommendation 3) BAM SOP Sec. 10.1.2 TEOM SOP Sec. 10.1.6 Thermo BAM leak check should not be attempted. Foils could be ruptured.
Temperature multi-point Verification/Calibration	on installation, then Every 365 days and 1/ calendar year	< ± 2.1°C	1) 40 CFR Part 50, App.L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.4.4
One-point Temp Verification	every 30 days	< ± 2.1°C	1) 40 CFR Part 50, App.L, Sec. 9.3 2) Method 2.12 Sec. 7.4.5 and Table 6-1 3) Recommendation
Pressure Verification/Calibration	on installation, then Every 365 days and 1/ calendar year	< ± 10.1 mm Hg	1) 40 CFR Part 50, App.L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.5 BP verified against independent standard verified against a lab primary standard that is certified NIST traceable 1/year

1) Criteria (PM2.5 Cont)	2) Frequency	3) Acceptable Range	Information /Action
Flow Rate Multi-point Verification/ Calibration	***Electromechanical maintenance or transport or*** Every 365 days and 1/ calendar year	< $\pm$ 2.1% of transfer standard	1) 40 CFR Part 50, App.L, Sec. 9.2. 2) 40 CFR Part 50, App.L, Sec. 9.1.3, Method 2.12 Sec. 6.3 & Table 6-1 3) Recommendation
Other Monitor Calibrations/checks	per manufacturers' op manual	Annual zero test on Met One BAM 1020 and BAM 1022	per manufacturers' operating manual. Note: more frequent zero tests may be appropriate in areas with seasonal changes in dew-points.
Precision			
Collocated Samples	***every 12 days for 15% of sites by method designation***	CV < 10.1% of samples $\geq$ 3 μg/m^3	1) and 2) Part 58 App A Sec. 3.2.3 3 Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.1
Accuracy			
Temperature Audit	every 180 days and at time of flow rate audit	< $\pm$ 2.1°C	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 180 days and at time of flow rate audit	< $\pm$10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and 5-7 months apart***	< $\pm$ 4.1% of audit standard < $\pm$ 5.1% of design flow rate	1 and 2) Part 58, App A, Sec. 3.3.3 3) Method 2.12 Sec. 11.2.1
Shelter Temperature			
Temperature range	At setup	per operator manual	
Temperature Control	Daily (hourly values)	< 2.1° C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Temperature Device Check	every 180 days and twice a calendar year	< $\pm$ 2.1° C	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Monitor Maintenance			
$PM_{2.5}$ Separator (WINS)	every 5 sampling events	cleaned/changed	1, 2,and 3) Method 2.12 Sec. 8.2.2
$PM_{2.5}$ Separator (VSCC)	every 30 days	cleaned/changed	1,2 and 3) Method 2.12 Sec. 8.3.3
Inlet Cleaning	every 30 days	cleaned	1,2 and 3) Method 2.12 Sec. 8.3
Downtube Cleaning	every 90 days	cleaned	1,2 and 3) Method 2.12 Sec. 8.4
Filter Housing Assembly Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Circulating Fan Filter Cleaning	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
TEOM-FDMS Specific Operational Criteria			
Total Flow Verification	every 30 days	Sum of flow rates from 3 paths equal design flow rate < $\pm$ 5.1%	1,2 and 3) TEOM SOP Sec. 10.1.2
Bypass leak check (TEOM)	every 30 days	$\pm$ 0.60 lpm	1,2 and 3) TEOM SOP Sec. 10.1.6 or TEOM Operating Manual Sec. 5-4
Replace TEOM filters	as needed	Change TEOM filter as filter loading approaches 90%, but must be changed before reaching 100%.	1,2 and 3) TEOM SOP Sec. 10.1.8
Replace the 47-mm FDMS (Purge) filters	every 30 days or any time TEOM filters are replaced	replaced	1,2 and 3) TEOM SOP Sec. 10.1.10

1) Criteria (PM2.5 Cont)	2) Frequency	3) Acceptable Range	Information /Action
Internal/External Data Logger Data	Every 30 days 10 randomly selected values	agree exactly (digital) and ± 1 µg/m^3 (analog). Note: digital is expected and should be used unless there is no capacity to utilize digital in the monitoring agencies' data system.	1, 2 and 3) TEOM SOP Sec. 10.1.24
Replace In-line filters	every 180 days and twice a calendar year	replaced	1, 2 and 3) TEOM SOP Sec. 10.2
Clean cooler assembly	every 365 days and once a calendar year	cleaned	1, 2 and 3) TEOM SOP Sec. 10.3.1
Clean/Maintain switching valve	every 365 days and once a calendar year	cleaned	1, 2 and 3) TEOM SOP Sec. 10.3.2
Clean air inlet system of mass transducer enclosure	every 365 days and once a calendar year	cleaned	1, 2 and 3) TEOM SOP Sec. 10.3.3
Replace the dryers	1/yr or due to poor performance	Review dryer dew point data to determine acceptable performance of dryer	1, 2 and 3) TEOM SOP Sec. 10.3.4
Calibration (KO) constant verification	every 365 days and once a calendar year	Pass or Fail (≤ 2.5%)	1, 2 TEOM SOP Sec. 10.3.6 3) 1405-DF operating guide. Verification software either passes or fails the verification. Acceptance criteria is ≤ 2.5 %
Rebuild sampling pump	18 months	< 66% of local pressure	1, 2 and 3) TEOM SOP Sec. 10.4
GRIMM Specific Operational Criteria			
Internal rinsing air filter	After a few years	Changed	1, 2 and 3) GRIMM SOP Sec. 12.4 May require a trained service staff to change. May only require changing if a message reads "check nozzle and air inlet"
Change Dust Filter	Every 365 days and 1/ calendar year	Changed	1, 2 and 3) GRIMM SOP Sec. 12.3
Relative Humidity Setting	At Setup	Per Operators manual (55%) unless otherwise directed and approved to use at a different value	
Calibration of spectrometer	Yearly	+/- 5% for mass	Operators' Manual section 5.2
Cleaning or changing of the Nafion in inlet	As needed	We are seeking clarification from GRIMM on this	Operators' Manual section 11.4.2
Thermo BAM Specific Operational Criteria			
Cleaning Nozzle and Vane (BAM)	Minimally every 30 days	cleaned	1, 2 and 3) BAM SOP Sec. 10.1.3
Leak Check	every 30 days	≤ 0.42 L/min	1) BAM 5014i Instruction Manual 2) 3) BAM 5014i Instruction Manual
Replace or clean pump muffler	every 180 days and twice a calendar year	Cleaned or changed	

1) Criteria (PM2.5 Cont)	2) Frequency	3) Acceptable Range	Information /Action
Internal/External Data Logger Data (BAM)	Every 30 days 10 randomly selected values	agree exactly (digital) and $\pm$ 1 µg/m^3 (analog). Note: digital is expected and should be used unless there is no capacity to utilize digital in the monitoring agencies' data system.	1, 2 and 3) BAM SOP Sec. 10.1.9
Clean/replace internal debris filter	Every 365 days and 1/ calendar year		
MetOne BAM Specific Operational Criteria			
BAM check of membrane span foil	Daily	Avg. < $\pm$ 5.1% of ABS	1, 2 and 3) BAM SOP Sec. 10.4.3. Applies on the BAM 1020
BAM electrical grounding	At setup	1. Is the chassis of the BAM grounded? Is the downtube grounded to the chassis at the collar (i.e., with setscrews)	Per operator manual
Nozzle cleaning	Every 30 days, or more often as needed	cleaned	Per operator manual
Zero test	Yearly	Standard deviation of the data from a 72-hour zero test < 2.4 µg/m^3	Per operator manual
SYSTEMATIC CRITERIA- $PM_{2.5}$ Continuous, Local Conditions			
Siting	every 365 days and once a calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-5
Data Completeness	***Annual Standard***	***$\geq$ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
	24- Hour Standard	***$\geq$ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
Reporting Units	***all filters***	***µg/m^3 at ambient temp/pressure ($PM_{2.5}$)***	1. 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b)
Rounding convention for data reported to AQS	***all filters***	***to one decimal place or as reported by instrument***	1. 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b)
Annual 3-yr average	***all concentrations***	***nearest 0.1 µg/m^3*** ($\geq$ 0.05 round up)	1,2 and 3) 40 CFR Part 50, App. N Sec. 3 and 4 Rounding convention for data reported to AQS is a recommendation
24-hour, 3-year average	***all concentrations***	***nearest 1 µg/m^3*** ($\geq$ 0.5 round up)	1,2 and 3) 40 CFR Part 50, App. N Sec. 3 and 4 Rounding convention for data reported to AQS is a recommendation
Verification/Calibration Standards Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< $\pm$ 2.1% of NIST Traceable Std.***	1) 40 CFR Part 50, App.L Sec. 9.1 & 9.2 2) Method 2-12 Sec. 4.2.2 & 6.4.3 3) 40 CFR Part 50, App.L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	$\pm$ 0.1° C resolution, $\pm$ 0.5° C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2

1) Criteria (PM2.5 Cont)	2) Frequency	3) Acceptable Range	Information /Action
Field Barometer	every 365 days and once a calendar year	$\underline{+}$ 1 mm Hg resolution, $\underline{+}$ 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Clock/timer Verification	Every 30 days	***1 min/mo*****	1 and 2) Method 2.12 Sec. 4.2.1 3) 40 CFR Part 50, App.L Sec. 7.4.12
Precision			
Single analyzer (collocated monitors)	every 90 days	Coefficient of variation (CV) < 10.1% for values $\geq$ 3.0 µg/m^3	1,2 and 3) Recommendation in order to provide early (quarterly) evaluation of achievement of DQOs.
Primary Quality Assurance Org.	***Annual and 3 year estimates***	***90% CL of CV < 10.1 % for values $\geq$ 3.0 µg/m^3***	1,2 and 3) 40 CFR Part 58, App A, Sec. 4.2.1 and 2.3.1.1
Bias			
Performance Evaluation Program (PEP)	***5 audits for PQAOs with $\leq$ 5 sites 8 audits for PQAOs with > 5 sites***	***< $\underline{+}$10.1% for value > 3 µg/m^3***	1,2 and 3) 40 CFR Part 58, App A, Sec. 3.2.7, 4.3.2 and 2.3.1.1

1/ 24 hour average value must be flagged if not meeting criteria
SD= standard deviation , CV= coefficient of variation

**** = need to ensure data system stamps appropriate time period with reported sample value**

PM10c for $PM_{10-2.5}$ Low –Volume, Filter-Based Local Conditions Validation Template

NOTE: The following validation template was constructed for use of PM_{10} at local conditions where PM_{10c} is used in the calculation of the $PM_{10-2.5}$ measurement or for objectives other than comparison to the PM_{10} NAAQS. Although the PM $_{10-2.5}$ method is found in 40 CFR Part 50 Appendix O, Appendix O references Appendix L (the $PM_{2.5}$ Method) for the QC requirements listed below. Therefore, the information action column, in most cases, will reference 40 CFR Part 50 App L. Monitoring organizations using PM_{10} data for a NAAQS comparison purposes should refer to the PM_{10} validation template for STP (standard temperature and pressure correction). In addition, since the samplers are very similar to the PM2.5 samplers, Guidance Document 2.12 *Monitoring PM2.5 in Ambient Air Using Designated Reference or Class 1 Equivalent Methods* is referred to where appropriate.

1) Criteria (PM10c)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM10c Filter Based Local Conditions			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Filter Holding Times			
Pre-sampling	***all filters***	***< 30 days before sampling***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.5
Sample Recovery	***all filters***	***<7 days 9 hours from sample end date***	1, 2 and 3) 40 CFR Part 50 App L Sec. 10.10
Sampling Period (including multiple power failures)	***all filters***	***1380-1500 minutes, or value if < 1380 and exceedance of NAAQS 1/ midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App L Sec. 3.3 See details if less than 1380 min sampled
Sampling Instrument			
Average Flow Rate	***every 24 hours of op***	***average within 5% of 16.67 liters/minute***	1, 2 and 3) Part 50 App L Sec. 7.4.3.1
Variability in Flow Rate	***every 24 hours of op***	***CV < 2%***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.2
One-point Flow Rate Verification	***every 30 days each seperated by 14 days***	***+ 4% of transfer standard*** + 5% of flow rate design value	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.5, 40 CFR Part 58 App A Sec. 3.3.1
Design Flow Rate Adjustment	***After multi-point calibration or verification***	***< + 2.1% of design flow rate***	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.6
Individual Flow Rates	***every 24 hours of op***	***no flow rate excursions > +5% for > 5 min. 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.1
Filter Temp Sensor	***every 24 hours of op***	***no excursions of > 5° C lasting longer than 30 min 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.11.4
External Leak Check	***Before each flow rate verification/calibration*** and before and after $PM_{2.5}$ separator maintenance	***< 80.1 mL/min*** (see comment #1)	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) 40 CFR Part 50 App L Sec.t 9.2.3 and Method 2-12 Sec. 7.4.3 3) 40 CFR Part 50, App. L, Sec. 7.4.6.1

1) Criteria (PM10c)	2) Frequency	3) Acceptable Range	Information /Action
Internal Leak Check	If failure of external leak check	***< 80.1 mL/min***	1) 40 CFR Part 50, App. L, Sec. 7.4.6.2 2) Method 2-12, Sec. 7.4.4 3) 40 CFR Part 50, App. L, Sec. 7.4.6.2
Laboratory Activities			
Post-sampling Weighing	***all filters***	***Protected from exposure to temperatures above 25C from sample retrieval to conditioning*** ***≤10 days from sample end date if shipped at ambient temp, or*** ***≤30 days if shipped below avg ambient (or 4º C or below for avg sampling temps < 4º C) from sample end date***	1, 2 and 3) 40 CFR Part 50 App L Sec. 8.3.6
Filter Visual Defect Check (unexposed)	***all filters***	***Correct type & size and for pinholes, particles or imperfections***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 10.2
Filter Conditioning Environment			
Equilibration	***all filters***	***24 hours minimum***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.5
Temp. Range	***all filters***	***24-hr mean 20.0-23.0º C***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.1
Temp.Control	***all filters***	***< 2.1º C SD* over 24 hr***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.2 SD use is a recommendation
Humidity Range	***all filters***	***24-hr mean 30.0% - 40.0% RH or within ±5.0% sampling RH but > 20.0%RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.3
Humidity Control	***all filters***	***< 5.1% SD* over 24 hr.***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.4 SD use is recommendation
Pre/post Sampling RH	***all filters***	***difference in 24-hr means ≤ ± 5.1% RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.3
Balance	***all filters***	***located in filter conditioning environment***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.2
OPERATIONAL EVALUATIONS TABLE- PM10c Filter Based Local Conditions			
Field Activities			
Sampling Instrument			
Routine Verifications			
One-point Temp Verification	every 30 days	<± 2.1ºC	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec. 7.4.5 and Table 6-1 3) Recommendation
Pressure Verification	every 30 days	< ± 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec. 7.4.6 and Table 6-1 3) Recommendation
Annual Multi-point Verifications/Calibrations			
Temperature multi-point Verification/Calibration	on installation, then every 365 days and once a calendar year	<± 2.1ºC	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.4.4 Table 6-1

1) Criteria (PM10c)	2) Frequency	3) Acceptable Range	Information /Action
Pressure Verification/Calibration	on installation, then every 365 days and once a calendar year	<+ 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.5 Sampler BP verified against independent standard verified against a lab primary standard that is certified as NIST traceable 1/year
Flow Rate Multi-point Verification/ Calibration	***Electromechanical maintenance or transport or*** every 365 days and once a calendar year	<+ 2.1% of transfer standard	1) 40 CFR Part 50, App. L, Sec. 9.2. 2) 40 CFR Part 50, App. L, Sec. 9.1.3, Method 2.12 Sec. 6.3 & Table 6-1 3) Recommendation
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	1, 2 and 3) Recommendation
Precision			
Collocated Samples	***every 12 days for 15% of sites by method designation***	CV < 10.1% of samples > 3.0 µg/m^3	1) and 2) Part 58 App A Sec. 3.2.3 3 Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1.1
Accuracy			
Temperature Audit	every 180 days and at time of flow rate audit	<+ 2.1ºC	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 180 days and at time of flow rate audit	<+10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and 5-7 months apart***	<+ 4.1% of audit standard <+ 5.1% of design flow rate	1 and 2) Part 58, App A, Sec. 3.2.2 3) Method 2.12 Sec. 11.2.1
Monitor Maintenance			
$PM_{2.5}$ Separator (WINs)	every 5 sampling events	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.2.2
$PM_{2.5}$ Separator (VSCC)	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3.3
Inlet Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Downtube Cleaning	every 90 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.4
Filter Housing Assembly Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Circulating Fan Filter Cleaning	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
Laboratory Activities			
Filter Checks			
Lot Blanks	9 filters per lot	< +15.1 µg change between weighings	1, 2, 3) Recommendation and used to determine filter stability of the lot of filters received from EPA or vendor. Method 2.12 Sec. 10.5
Exposure Lot Blanks	3 filters per lot	< +15.1 µg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.5 Used for preparing a subset of filters for equilibration
Filter Integrity (exposed)	each filter	no visual defects	1, 2 and 3) Method 2.12 Sec. 10.7 and 10.3
Lab QC Checks			

1) Criteria (PM10c)	2) Frequency	3) Acceptable Range	Information /Action
Field Filter Blank	10% or 1 per weighing session	<± 30.1 µg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.1 2 and 3) Method 2.12 Table 7-1 & Sec.10.5
Lab Filter Blank	10% or 1 per weighing session	<± 15.1 µg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.2 2 and 3) Method 2.12 Sec. 10.5
Balance Check (working standards)	beginning, 10th sample, end	< ±3.1 µg from certified value	1, 2 and 3) Method 2.12 Sec. 10.6 Standards used should meet specifications in Method 2.12, Sec. 4.3.7
Routine Filter re-weighing	1 per weighing session	<± 15.1 µg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.8
Microbalance Audit	every 365 days and once a calendar year	<± 0.003 mg or manufacturers specs, whichever is tighter	1, 2 and 3) Method 2.12 Sec. 11.2.7
Lab Temp Check	Every 90 days	< ± 2.1ºC	1, 2 and 3) Method 2.12 Sec. 10.10
Lab Humidity Check	Every 90 days	< ± 2.1%	1, 2 and 3) Method 2.12 Sec. 10.10
Verification/Calibration			
Microbalance Calibration	***At installation*** every 365 days and once a calendar year	Manufacturer's specification	1) 40 CFR Part 50, App. L, Sec. 8.1 2) 40 CFR Part 50, App. L, Sec. 8.1 and Method 2.12 Sec. 10.11 3) NA
Lab Temperature Certification	every 365 days and once a year	< ± 2.1ºC	1, 2 and 3) Method 2.12 Sec. 4.3.8 and 9.4
Lab Humidity Certification	every 365 days and once a year	< ± 2.1%	1, 2 and 3) Method 2.12 Sec. 4.3.8 and 9.4
Calibration & Check Standards -			
Working Mass Stds. Verification Compared to primary standards	Every 90 days	< ± 2.1 ug	1, 2 and 3) Method 2.12 Sec. 9.7
Primary standards certification	every 365 days and once a calendar year	0.025 mg tolerance (Class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7
SYSTEMATIC CRITERIA - PM10c Filter Based Local Conditions			
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-5
Data Completeness	NA	≥ 75% scheduled sampling days in each quarter	1, 2 and 3) Recommendation based on PM2.5 requirements in 40 CFR Part 50, App. N, Sec. 4.1 (b) 4.2 (a)
Reporting Units	***all filters***	***$\mu g/m^3$ at ambient temp/pressure ($PM_{2.5}$)***	1, 2 and 3) 40 CFR Part 50 App N
Rounding convention for design value calculation	***all filters***	***to one decimal place, with additional digits to the right being truncated***	1, 2 and 3) 40 CFR Part 50 App N Sec. 3.0 (b) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Lower DL	***all filters***	***≤ 3 $\mu g/m^3$***	1, 2 and 3) 40 CFR Part 50, App O Sec. 3.1
Upper Conc. Limit	***all filters***	***≥200 $\mu g/m^3$***	1, 2 and 3) 40 CFR Part 50, App O Sec. 3.2

1) Criteria (PM10c)	2) Frequency	3) Acceptable Range	Information /Action
Precision			
Single analyzer (collocated monitors)	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) < 10.1% for values $\geq$ 3 µg/m^3	1, 2 and 3) Recommendation in order to provide early evaluation of achievement of DQOs.
Primary Quality Assurance Org.	***Annual and 3 year estimates***	***90% CL of CV < 10.1% for values $\geq$ 3 µg/m^3***	1, 2 and 3) Recommendation in order to provide early evaluation of achievement of DQOs.
Bias			
Performance Evaluation Program (PEP)	Once every 6-7 years	***< $\pm$10.1% for values $\geq$ 3 µg/m^3***	1, 2 and 3) Recommendation based on pending guidance.
Field Activities			
Verification/Calibration Standards Recertifications – All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< $\pm$ 2.1% of NIST-traceable Std.***	1) 40 CFR Part 50, App. L Sec. 9.1 & 9.2 2) Method 2-12 Sec. 6.3.3 and Table 3-1 3) 40 CFR Part 50, App. L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	$\pm$ 0.1º C resolution, $\pm$ 0.5º C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Field Barometer	every 365 days and once a calendar year	$\pm$ 1 mm Hg resolution, $\pm$ 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Verification/Calibration Clock/timer Verification	every 30 days	***1 min/mo***	1 and 2) Method 2.12 Sec 4.2.1 3) 40 CFR Part 50, App. L, Sec. 7.4.12
Laboratory Activities			
Microbalance Readability	***at purchase***	***1 µg***	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 8.1
Microbalance Repeatability	at purchase	1 µg	1) Method 2.12 Sec. 4.3.6 2) Recommendation 3) Method 2.12 Sec. 4.3.6
Primary Mass. Verification/Calibration Standards	at purchase	0.025 mg tolerance (class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7
Comment #1 The associated leak test procedure shall require that for successful passage of this test, the difference between the two pressure measurements shall not be greater than the number of mm of Hg specified for the sampler by the manufacturer, based on the actual internal volume of the sampler, that indicates a leak of less than 80 mL/min.			

1/ value must be flagged, SD= standard deviation, CV= coefficient of variation

PM_{10} Filter Based Dichot STP Conditions Validation Template

1) Criteria (PM10 Dichot STP)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM_{10} Filter Based Dichot			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Sample Recovery	***all filters***	***ASAP***	1, 2 and 3) 40 CFR Part 50 App J Sec. 9.15
Sampling Period	***all filters***	***1440 minutes ± 60 minutes midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App J Sec. 7.1.5
Sampling Instrument			
Average Flow Rate	every 24 hours of op	average 16.67 liters/minute	1, 2 and 3) Method 2.10 Sec. 2.1
Verification/Calibration			
One-point Flow Rate Verification	***every 30 days each seperated by 14 days***	< ± 7.1% of transfer standard	1, 2 40 CFR Part 58 App A Sec. 3.3.1 and 3) Method 2.10 Table 3-1
Lab Activities			
Filter			
Visual Defect Check (unexposed)	all filters	see reference	1, 2 and 3) Method 2.10 Sec. 4.2
Collection efficiency	***all filters***	***≥ 99 %***	1, 2 and 3) Part 50, App J Sec. 7.2.2
Alkalinity	***all filters***	***< 25.0 microequivalents/gram***	1, 2 and 3) 40 CFR Part 50, App J Sec. 7.2.4
Filter Conditioning Environment			
Equilibration	***all filters***	***24 hours minimum***	1, 2 and 3) 40 CFR Part 50, App. J Sec. 9.3
Temp. Range	***all filters***	***15-30.0º C***	1, 2 and 3) 40 CFR Part 50, App. J Sec. 7.4.1
Temp.Control	***all filters***	***< 3.1º C*** SD* over 24 hr	1, 2 and 3) 40 CFR Part 50, App. J Sec. 7.4.2 SD use is recommendation
Humidity Range	***all filters***	***20% - 45.0% RH***	1, 2 and 3) 40 CFR Part 50, App. J Sec. 7.4.3
Humidity Control	***all filters***	***<5.1% SD**** over 24 hr	1, 2 and 3) 40 CFR Part 50, App. J Sec. 7.4.4 SD use is recommendation
Pre/post Sampling RH	all filters	difference in 24-hr means < ± 5.1% RH	1, 2 and 3) Recommendation based on 40 CFR Part 50, App. L Sec. 8.3.3
Balance	all filters	located in filter conditioning environment	1, 2 and 3) Recommendation based on 40 CFR Part 50, App. L Sec. 8.3.2
OPERATIONAL EVALUATIONS TABLE PM_{10} Filter Based Dichot			
Field Activities			
Verification/Calibration			
System Leak Check	During precalibration check	Vacuum of 10 to 15 in. & rate of decline to 0 in >60 seconds	1, 2 and 3) Method 2.10 Sec. 2.2.1

1) Criteria (PM10 Dichot STP)	2) Frequency	3) Acceptable Range	Information /Action
FR Multi-point Verification/Calibration	every 365 days and once a calendar year	Correlation coefficient of >.990 with no point deviating more than 0.5 L/min for total or 0.05 L/min for coarse	1) 40 CFR Part 50, App. J, Sec. 8.0 2 and 3) Method 2.10 Sec. 2.2.4
Field Temp M-point Verification	on installation, then every 365 days and once a calendar year	< $\pm$ 2.1°C	1, 2 and 3) Recommendation based on Part 50, App. L
Precision			
Collocated Samples	***every 12 days for 15% of sites***	<5.1 ***µg/m³ for concentrations below 80µg/m³ and <7.1% for concentrations above 80µg/m³***	1 and 2) 40 CFR Part 58 App A Sec. 3.3.4 3) Part 50, App J Sec. 4.1
Semi Annual Flow Rate Audit	every 180 days and twice a calendar year	< $\pm$ 10.1% of audit standard	1 and 2) 40 CFR Part 58, App A, Sec. 3.3.3 3) Method 2.10 Sec. 7.1.5
Monitor Maintenance			
Impactor	every 90 days and 4 times a calendar year	cleaned/changed	1, 2 and 3) Method 2.10 Sec. 6.1.2
Inlet/downtube Cleaning	every 90 days and 4 times a calendar year	cleaned	1, 2 and 3) Method 2.10 Sec. 6.1.2
Vacuum pump	every 365 days and once a calendar year	Replace diaphragm and flapper valves	1, 2 and 3) Method 2.10 Sec. 6.1.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
Lab Activities			
Balance Check	beginning, 10th sample, end	< 4.1 µg of true zero < 2.1 µg of 10 mg check weight	1, 2 and 3) Method 2.10 Sec. 4.5
"Standard" filter QC check	10%	< $\pm$ 20.1 µg change from original value	1, 2 and 3) Method 2.10 Sec. 4.5 From standard non-routine filter
"Routine" duplicate weighing	5-7 per weighing session	< $\pm$ 20.1 µg change from original value	1, 2 and 3) Method 2.10 Sec. 4.5 From routine filter set
Integrity- Random sample of test field blank filters	10%	***$\pm$ 5 µg/m³***	1) 40 CFR Part 50 App J Sec. 7.2.3 2 and 2) Recommendation 3) 40 CFR Part 50 App J Sec. 7.2.3
Lab Temperature Calibration	every 180 days and twice a calendar year	$\pm$ 2°C	1, 2 and 3) Recommendation related to 40 CFR Part 50, App .L
Lab Humidity Calibration	every 180 days and twice a calendar year	$\pm$ 2%	1, 2 and 3) Recommendation related to 40 CFR Part 50 App L Sec. 5.8.1
Microbalance Calibration	every 365 days and once a calendar year	Manufacturer's specification	1, 2 and 3) Recommendation related to 40 CFR Part 50 App L
Filter Weighing Audit	every 365 days and once a calendar year	< $\pm$ 20.1 µg change from original value	1, 2 and 3) Method 2.10 Table 7-1
Balance Audit	every 365 days and once a calendar year	Observe weighing technique and check balance with ASTM Class 1 standard	1, 2 and 3) Method 2.10 Table 7-1 Sec. 7.2.2

1) Criteria (PM10 Dichot STP)	2) Frequency	3) Acceptable Range	Information /Action
Primary Mass Stds. (compare to NIST-traceable standards)	every 365 days and once a calendar year	NIST traceable (e.g., ANSI/ASTM Class 1, 1.1 or 2)	1, 2 and 3) Method 2.10 Sec. 9
SYSTEMATIC CRITERIA - PM_{10} Filter Based Dichot			
Siting	Every 365 days and 1/ calendar year	• ***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sections 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sections 2-5
Data Completeness	***24- Hour Standard***	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50 App. K, Sec. 2.3b
Reporting Units	all filters	$\mu g/m^3$ at standard temperature and pressure	1, 2 and 3) 40 CFR Part 50 App K
Rounding convention for design value calculation	***Each routine concentration***	***Nearest 10 $\mu g/m^3$ (≥ 5 µg/m3 round up)***	1, 2 and 3) 40 CFR Part 50 App K Sec. 2. The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Precision			
Single analyzer	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) < 10.1% for values ≥ 3 $\mu g/m^3$	1, 2 and 3) Recommendation 3 $\mu g/m^3$ cut off in 40 CFR part 58 App A Sec. 4
Single analyzer	1/ yr	CV < 10.1% for values ≥ 3 $\mu g/m^3$	1, 2 and 3) Recommendation 3$\mu g/m^3$ cut off in 40 CFR part 58 App A Sec. 4
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV < 10.1% for values ≥ 3 $\mu g/m^3$	1, 2 and 3) Recommendation 3$\mu g/m^3$ cut off in 40 CFR part 58 App A Sec. 4
Field Activities			
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***<± 2.1% of NIST-traceable Std.***	1) 40 CFR Part 50 App J Sec. 7.3 2 Method 2.10 Table 2-1 (1997 version) 3) 40 CFR Part 50 App J Sec. 7.3
Field Thermometer	every 365 days and once a calendar year	± 0.1º C resolution, ± 0.1º C accuracy	1, 2 and 3) Method 2.10 Sec. 1.1.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.10 Sec. 1.1.2
Clock/timer Verification	every 180 days and twice a calendar year	***15 min/day***	1) 40 CFR Part 50 App J Sec. 7.1.5 2) Method 2.10 Sec. 9 3) 40 CFR Part 50 App J Sec. 7.1.5
Lab Activities			
Microbalance	at purchase	Readability 1 µg, Repeatability1 µg	1, 2 and 3) Method 2.10 Sec. 4.4
Primary Mass Stds. (compare to NIST-traceable standards)	at purchase	NIST traceable (e.g., ANSI/ASTM Class 1, 1.1 or 2)	1, 2 and 3) Method 2.10 Sec. 9

***SD= standard deviation CV= coefficient of variation**

PM_{10} Filter Based High Volume (HV) STP Conditions Validation Template

1) Criteria (PM10 Hi-Vol STP)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM_{10} Filter Based Hi-Vol			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Filter Holding Times			
Sample Recovery	***all filters***	***ASAP***	1, 2 and 3) 40 CFR Part 50 App J Sec. 9.15
Sampling Period	***all filters***	***1440 minutes ± 60 minutes midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App J Sec. 7.1.5
Average Flow Rate	every 24 hours of op	~1.13 m^3/min (varies with instrument)	1, 2 and 3) Method 2.11
Verification/Calibration			
One-point Flow Rate Verification	***every 90 days and 4 times a calendar year***	<± 7.1% of transfer standard and <±10.1% from design	1 and 2) 40 CFR Part 58, App A, Sec. 3.3.2 3) Method 2.11 Sec. 3.5.1, Table 2-1
Lab Activities			
Filter			
Visual Defect Check (unexposed)	***all filters***	***see reference***	Method 2.11 Sec. 4.2
Collection efficiency	***all filters***	***99 %***	1, 2 and 3) 40 CFR Part 50, App J Sec. 7.2.2
Alkalinity	***all filters***	***< 25.0 microequivalents/gram***	1, 2 and 3) 40 CFR Part 50, App J Sec. 7.2.4
Filter Conditioning Environment			
Equilibration	***all filters***	***24 hours minimum***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 9.3
Temp. Range	***all filters***	***15.0-30.0° C***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 7.4.1
Temp.Control	***all filters***	***< 3.1° C SD* over 24 hr***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 7.4.2 SD use is recommendation
Humidity Range	***all filters***	***20.0% - 45.0% RH***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 7.4.3
Humidity Control	***all filters***	***< 5.1% SD* over 24 hr***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 7.4.4 SD use is recommendation
Pre/post Sampling RH	all filters	difference in 24-hr means < ± 5.1% RH	1, 2 and 3) Recommendation based on Part 50, App. L Sec. 8.3.3
Balance	all filters	located in filter conditioning environment	1, 2 and 3) Recommendation based on Part 50, App. L Sec. 8.3.2
OPERATIONAL EVALUATIONS TABLE PM_{10} Filter Based Hi-Vol			
Field Activities			
Verification/Calibration			
System Leak Check	During precalibration check	Auditory inspection with faceplate blocked	1, 2 and 3) Method 2.11 Sec. 2.3.2
FR Multi-point Verification/Calibration	every 365 days and once a calendar year	3 of 4 cal points within < ± 10.1% of design	1, 2 and 3) Method 2.11 Sec. 2.3.2
Field Temp M-point Verification	on installation, then every 365 days and once a calendar year	< ± 2.1°C	1, 2 and 3) Recommendation
Precision			

1) Criteria (PM10 Hi-Vol STP)	2) Frequency	3) Acceptable Range	Information /Action
Collocated Samples	***every 12 days for 15% of sites***	CV < 10.1% of samples $\geq$ 15 µg/m^3	1) and 2) 40 CFR Part 58 App A Sec. 3.3.4 3) Recommendation
Semi Annual Flow Rate Audit	***every 180 days and twice a calendar year***	< $\pm$ 7.1% of transfer standard and< $\pm$ 10.1% from design	1 and 2) 40 CFR Part 58, App A, Sec. 3.3.3 3) Method 2.11 Sec. 7 Table 7-1
Monitor Maintenance			
Inlet/downtube Cleaning	every 90 days and 4 times a calendar year	cleaned	1, 2 and 3) Method 2.11 Sec. 6
Motor/housing gaskets	every 90 days and 4 times a calendar year	Inspected replaced	1, 2 and 3) Method 2.11 Sec. 6
Blower motor brushes	600-1000 hours	Replace	1, 2 and 3) Method 2.11 Sec. 6
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	NA
Lab Activities			
Lab QC Checks			
Balance Check (Standard Weight Check and Calibration Check)	beginning, 15th sample, end	< $\pm$ 0.51 mg of true zero and < $\pm$ 0.51 mg 1-5 g check weight	1, 2, and 3) Method 2 .11 Sec. 4.5.1 and 4.5.2
"Routine" duplicate weighing	5-7 per weighing session	< $\pm$ 2.8 mg change from original value	1, 2 and 3) Method 2.11 Sec. 4.5.3 From routine filter set
Integrity- Random sample of test field blank filters	10%	***< $\pm$ 5.1 µg/m^3***	1) 40 CFR Part 50 App J Sec. 7.2.3 2) Recommendation 3) 40 CFR Part 50 App J Sec. 7.2.3
Lab Temperature Calibration	every 180 days and twice a calendar year	< $\pm$ 2.1°C	1, 2 and 3) Recommendation related to 40 CFR Part 50, App. L
Lab Humidity Calibration	every 180 days and twice a calendar year	< $\pm$ 2.1%	1, 2 and 3) Recommendation related to 40 CFR Part 50 App L
Microbalance Calibration	every 365 days and once a calendar year	Manufacturer's specification	
Primary Mass Stds. (compare to NIST-traceable standards)	every 365 days and once a calendar year	NIST traceable (e.g., ANSI/ASTM Class 1, 1.1 or 2)	1, 2 and 3) Method 2.11 Sec. 9
Audits			
Filter Weighing	every 365 days and once a calendar year	< $\pm$ 5.1 mg change from original value	1) Method 2.11 Table 7-1 2) Recommendation 3) Method 2.11 Table 7-1
Balance Audit	every 365 days and once a calendar year	Observe weighing technique and check balance with ASTM Class 1 standard	1) Method 2.11 Table 7-1 2) Recommendation 3) Method 2.11 Table 7-1
SYSTEMATIC CRITERIA - PM_{10} Filter Based Hi-Vol			

1) Criteria (PM10 Hi-Vol STP)	2) Frequency	3) Acceptable Range	Information /Action
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sections 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sections 2-5
Data Completeness	quarterly	$\geq$ 75%	1, 2 and 3) 40 CFR Part 50 App. K, Sec. 2.3b & c
Reporting Units	all filters	μg/m^3 at standard temperature and pressure	1, 2 and 3) 40 CFR Part 50 App K Sec. 1
Rounding convention for design value calculation	***Each routine concentration***	***nearest 10 μg/m^3 ($\geq$ 5 round up)***	1, 2 and 3) 40 CFR Part 50 App K Sec. 1 The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Precision			
Single analyzer	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) $\leq$ 10% $\geq$ 15 μg/m^3	1, 2 and 3) Recommendation
Single analyzer	1/ yr	CV < 10.1% $\geq$ 15 μg/m^3	1, 2 and 3) Recommendation
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV < 10.1% $\geq$ 15 μg/m^3	1, 2 and 3) Recommendation
Field Activities			
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< $\pm$ 2.1% of NIST-traceable Std.***	1) 40 CFR Part 50, App.J Sec. 7.3 2) Method 2.11 Sec. 1.1.3 3) 40 CFR Part 50, App.J Sec. 7.3
Field Thermometer	every 365 days and once a calendar year	$\pm$ 0.1° C resolution, $\pm$ 0.5° C accuracy	1, 2 and 3) Method 2.11 Sec. 1.1.2
Field Barometer	every 365 days and once a calendar year	$\pm$ 1 mm Hg resolution, $\pm$ 5 mm Hg accuracy	1, 2 and 3) Method 2.11 Sec. 1.1.2
Clock/timer Verification	4/year	***15 min/day***	1) 40 CFR Part 50, App.J Sec. 7.1.5 2) Recommendation 3) 40 CFR Part 50, App.J Sec. 7.1.5
Lab Activities			
Microbalance	***at purchase***	Readability 0.1 mg Repeatability0.5 mg (HV)	1 and 2) 40 CFR Part 50, App.J Sec. 7.5 3) Method 2.11 Sec. 4.4
Primary Mass Stds. (compare to NIST-traceable standards)	at purchase	NIST traceable (e.g., ANSI/ASTM Class 1, 1.1 or 2)	1, 2 and 3) Method 2.11 Sec. 9

SD= standard deviation CV= coefficient of variation

Continuos PM10 STP Conditions Validation Template

NOTE: There are a number of continuous PM10 monitors that are designated as FEM. These monitors may have different measurement or sampling attributes that cannot be identified in this validation template. Monitoring organizations should review specific instrument operating manuals and augment the validation template with QC information specific to their EPA reference or equivalent method designation and instrument (https://www3.epa.gov/ttn/amtic/criteria.html). In general, 40 CFR Part 58 App A and 40 CFR Part 50 App J requirements apply to Continuous PM10. Since a guidance document was never developed for continuous PM10, many of the requirements reflect a combination of manual and continuous PM2.5 requirements and are therefore considered recommendations.

1) Criteria (PM_{10} Cont)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM_{10} Continuous			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Sampling Period	**all filters**	**1440 minutes ± 60 minutes midnight to midnight local standard time**	1, 2 and 3) 40 CFR Part 50 App J Sec. 7.1.5
Average Flow Rate	every 24 hours of op	Average within < ± 5.1% of design	recommendation
Verification/Calibration			
One-point Flow Rate Verification	***every 30 days each seperated by 14 days***	< ± 7.1% of transfer standard	1 and 2) 40 CFR Part 58, App A, Sec. 3.3 3) Method 2.10 Table 3-1
OPERATIONAL EVALUATIONS TABLE PM_{10} Continuous			
Verification/Calibration			
System Leak Check	During precalibration check	Auditory inspection with faceplate blocked	1, 2 and 3) Method 2.11 Sec. 2.3.2
FR Multi-point Verification/Calibration	every 365 days and once a calendar year	3 of 4 cal points within < ± 10.1% of design	1) 40 CFR Part 50 App J Sec. 8.0 2 and 3) Method 2.10 Sec. 2.2.4
Audits			
Semi Annual Flow Rate Audit	***Twice a calendar year and 5-7 months apart***	< ± 10.1% of audit standard	1, 2) Part 58, App A, Sec. 3.3.3 3) Method 2.10 Sec. 7.1.5
Monitor Maintenance			
Inlet/downtube Cleaning	every 90 days and 4 times a calendar year	cleaned	1, 2 and 3) Method 2.10 Sec. 6.1.2
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
SYSTEMATIC CRITERIA - PM_{10} Continuous			
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sections 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sections 2-5
Data Completeness	24-hour quarterly	≥ 75%	1, 2 and 3) 40 CFR Part 50 App. K, Sec. 2.3b & c

1) Criteria (PM_{10} Cont)	2) Frequency	3) Acceptable Range	Information /Action
Reporting Units	all filters	µg/m^3 at standard temperature and pressure (STP)	40 CFR Part 50 App K
Rounding convention for design value calculation			
24-hour, 3-year average	***quarterly***	***nearest 10 µg/m^3 (≥ 5 round up)***	1, 2 and 3) 40 CFR Part 50 App K Sec. 1 The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	***< ± 2.1% of NIST-traceable Std.***	1) 40 CFR Part 50, App.J Sec. 7.3 2) Method 2.11 Sec. 1.1.3 3) 40 CFR Part 50, App.J Sec. 7.3
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.1° C accuracy	1, 2 and 3) Method 2.10 Sec. 1.1.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.10 Sec. 1.1.2
Clock/timer Verification	every 180 days and twice a calendar year	***15 min/day***	1) 40 CFR Part 50, App.J Sec. 7.1.5 2) Recommendation 3) 40 CFR Part 50, App.J Sec. 7.1.5

PM_{10} Low Volume STP Filter-Based Local Conditions Validation Template

Monitoring organizations can use low-volume PM instruments for PM_{10} monitoring. However, PM_{10} data collection for NAAQS purposes must be reported in standard temperature and pressure (STP). 40 CFR Part 50 App J describes the reference method for PM_{10} but this method was promulgated for dichot and high volume methods that have improved over the years. Since monitoring organization may be able to use the low volume methods for multiple uses (PM_{10c}, PM_{10}-Pb) it is suggested that the validation criteria for this method follow the method requirements associated with the PM $_{2.5}$ which is Appendix L. Where there are particular requirement directly related to the NAAQS evaluation App J will be used.

1) Criteria (PM10 Lo-Vol STP)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM_{10} Lo-Vol Filter Based STP			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Sample Recovery	***all filters***	***<u><</u>7 days 9 hours from sample end date***	1, 2 and 3) 40 CFR Part 50 App L Sec. 10.10
Pre-sampling	***all filters***	***<u><</u> 30 days before sampling***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.5
Sampling Instrument			
Average Flow Rate	***every 24 hours of op***	***average within < 5.1% of 16.67 liters/minute***	1, 2 and 3) Part 50 App L Sec. 7.4.3.1
Variability in Flow Rate	***every 24 hours of op***	***CV < 2.1%***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.2
One-point Flow Rate Verification	***every 30 days each seperated by 14 days***	***< ± 4.1% of transfer standard*** < ± 5.1% of flow rate design value	1) 40 CFR Part 50, App. L, Sec. 9.2.5, 40 CFR Part 58, App A Sec. 3.3.1 2) Part 58, App A, Sec. 3.3.1 3) 40 CFR Part 50, App. L, Sec. 9.2.5 & 7.4.3.1
Design Flow Rate Adjustment	***at one-point or multi-point verification/calibration***	***< ± 2.1% of design flow rate***	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.6
Individual Flow Rates	***every 24 hours of op***	***no flow rate excursions > ±5.1% for > 5 min. 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.1
Filter Temp Sensor	***every 24 hours of op***	***no excursions of > 5º C lasting longer than 30 min 1/***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.11.4
External Leak Check	***Before each flow rate verification/calibration*** and before and after maintenance	***< 80.1 mL/min*** (see comment #1)	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) 40 CFR Part 50, App. L Sec. 9.2.3 Method 2-12 Sec. Table 8-1 3) 40 CFR Part 50, App. L, Sec. 7.4.6.1
Internal Leak Check	every 5 sampling events	***< 80.1 mL/min***	1) 40 CFR Part 50, App. L, Sec. 7.4.6.2 2) Method 2-12 Table 8-1 3) 40 CFR Part 50, App. L, Sec. 7.4.6.2
Laboratory Activities			

1) Criteria (PM10 Lo-Vol STP)	2) Frequency	3) Acceptable Range	Information /Action
Post-sampling Weighing	***all filters***	***Protected from exposure to temperature $\leq$10 days from sample end date if shipped at ambient temp, or $\leq$30 days if shipped below avg ambient (or 4º C or below for avg sampling temps < 4º C) from sample end date***	1, 2 and 3) 40 CFR Part 50 App L Sec. 8..3.6
Filter Visual Defect Check (unexposed)	***all filters***	***Correct type & size and for pinholes, particles or imperfections***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 10.2
Filter Conditioning Environment			
Equilibration	***all filters***	***24 hours minimum***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.5
Temp. Range	***all filters***	***24-hr mean 20.0-23.0º C***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.1
Temp.Control	***all filters***	***< 2.1º C SD* over 24 hr***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.2 SD use is recommendation
Humidity Range	***all filters***	***24-hr mean 30.0% - 40.0% RH or <5.1% sampling RH but $\geq$ 20.0%RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.3
Humidity Control	***all filters***	***< 5.1% SD* over 24 hr.***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.4 SD use is recommendation
Pre/post Sampling RH	***all filters***	***difference in 24-hr means < $\pm$ 5.1% RH***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.3
Balance	***all filters***	***located in filter conditioning environment***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.2
OPERATIONAL EVALUATIONS TABLE PM_{10} Lo-Vol Filter Based STP			
Field Activities			
Sampling Instrument			
Routine Verifications			
One-point Temp Verification	every 30 days	< $\pm$ 2.1ºC	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec. 7.4.5 and Table 6-1 3) Recommendation
Pressure Verification	every 30 days	< $\pm$ 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Sec 7.4.6 and Table 6-1 3) Recommendation
Annual Multi-point Verifications/Calibrations			
Temperature multi-point Verification/Calibration	on installation, then every 365 days and once a calendar year	< $\pm$ 2.1ºC	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.4.4 and Table 6-1
Pressure Verification/Calibration	on installation, then every 365 days and once a calendar year	< $\pm$ 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.5 Sampler BP verified against independent standard verified against a lab primary standard that is certified as NIST traceable 1/year

1) Criteria (PM10 Lo-Vol STP)	2) Frequency	3) Acceptable Range	Information /Action
Flow Rate Multi-point Verification/ Calibration	***Electromechanical maintenance or transport or*** every 365 days and once a calendar year	< + 2.1% of transfer standard	1) 40 CFR Part 50, App. L, Sec. 9.2. 2) 40 CFR Part 50, App. L, Sec. 9.1.3, Method 2.12 Sec. 6.3 Table 6-1 3) Recommendation
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	1, 2 and 3) Recommendation
Precision			
Collocated Samples	***every 12 days for 15% of sites***	CV < 10.1% of samples > 3.0 μg/m^3	1) and 2) 40 CFR Part 58 App A Sec. 3.3.4 3) Recommendation
Accuracy			
Temperature Audit	every 180 days and at time of flow rate audit	< + 2.1ºC	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 180 days and at time of flow rate audit	< +10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and 5-7 months apart***	< + 4.1% of audit standard < + 5.1% of design flow rate	1 and 2) Part 58, App A, Sec. 3.3.3 3) Method 2.12 Sec. 11.2.1
Monitor Maintenance			
Inlet Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Downtube Cleaning	every 90 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.4
Filter Chamber Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Circulating Fan Filter Cleaning	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
Laboratory Activities			
Filter Checks			
Lot Blanks	9 filters per lot	< +15.1 μg change between weighings	1, 2, 3) Recommendation and used to determine filter stability of the lot of filters received from EPA or vendor. Method 2.12 Sec. 10.5
Exposure Lot Blanks	3 filters per lot	< + 15.1 μg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.5 Used for preparing a subset of filters for equilibration
Filter Integrity (exposed)	each filter	no visual defects	1, 2 and 3) Method 2.12 Sec. 10.3 and 10.7
Lab QC Checks			
Field Filter Blank	10% or 1 per weighing session	< + 30.1 μg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.1 2 and 3) Method 2.12 Table 7-1 & Sec. 10.5
Lab Filter Blank	10% or 1 per weighing session	< + 15.1 μg change between weighings	1) 40 CFR Part 50, App. L Sec. 8.3.7.2 2 and 3) Method 2.12 Sec. 10.5
Balance Check (working standards)	beginning, 10th sample, end	< + 3.1 μg from certified value	1, 2 and 3) Method 2.12 Sec. 10.6 Standards used should meet specifications in Method 2.12, Sec. 4.3.7
Routine Filter re-weighing	1 per weighing session	< + 15.1 μg change between weighings	1, 2 and 3) Method 2.12 Sec. 10.8

1) Criteria (PM10 Lo-Vol STP)	2) Frequency	3) Acceptable Range	Information /Action
Microbalance Audit	every 365 days and once a calendar year	< + 0.003 mg or manufacturers specs, whichever is tighter	1, 2 and 3) Method 2.12 Sec. 11.2.7
Lab Temp Check	Every 90 days	< + 2.1ºC	1, 2 and 3) Method 2.12 Sec. 10.10
Lab Humidity Check	Every 90 days	< + 2.1%	1, 2 and 3) Method 2.12 Sec. 10.10
Verification/Calibration			
Microbalance Calibration	***At installation*** every 365 days and once a calendar year	Manufacturer's specification	1) 40 CFR Part 50, App. L, Sec. 8.1 2) 40 CFR Part 50, App. L, Sec. 8.1 and Method 2.12 Sec. 10.11 3) NA
Lab Temperature Certification	every 365 days and once a year	< + 2.1ºC	1, 2 and 3) Method 2.12 Sec. 4.3.8 and 9.4
Lab Humidity Certification	every 365 days and once a year	< + 2.1%	1, 2 and 3) Method 2.12 Sec.4.3.8 and 9.4
Calibration & Check Standards -			
Working Mass Stds. Verification Compared to primary standards	Every 90 days	< + 2.1 ug	1, 2 and 3) Method 2.12 Sec. 9.7
Primary standards certification	every 365 days and once a calendar year	0.025 mg tolerance (Class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7
SYSTEMATIC CRITERIA - PM_{10} Lo-Vol Filter Based STP			
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sec. 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sec. 2-5
Data Completeness	***24- Hour Standard***	***≥ 75% scheduled sampling days in each quarter***	1, 2 and 3) 40 CFR Part 50 App. K, Sec. 2.3b
Reporting Units	all filters	μg/m^3 at standard temperature and pressure	1, 2 and 3) 40 CFR Part 50 App K Sec. 1
Rounding convention for design value calculation	***Each routine concentration***	***nearest 10 μg/m^3 (≥ 5 round up)***	1, 2 and 3) 40 CFR Part 50 App K Sec. 1 The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Detection Limit			
Lower DL	***all filters***	***≤ 2 μg/m^3***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 3.1
Upper Conc. Limit	***all filters***	***≥200 μg/m^3***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 3.2
Precision			
Single analyzer	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) < 10.1% ≥ 3.0 μg/m^3	1, 2 and 3) Recommendation
Single analyzer	1/ yr	CV < 10.1% ≥ 3.0 μg/m^3	1, 2 and 3) Recommendation
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV < 10.1% ≥ 3 μg/m^3	1, 2 and 3) Recommendation
Field Activities			
Verification/Calibration Standards Recertifications – All standards should have multi-point certifications against NIST Traceable standards			

1) Criteria (PM10 Lo-Vol STP)	2) Frequency	3) Acceptable Range	Information /Action
Flow Rate Transfer Std.	**every 365 days and once a calendar year**	***< ± 2.1% of NIST Traceable Std.***	1) 40 CFR Part 50, App. L Sec. 9.1 & 9.2 2) Method 2.12 Sec.4.2.2 & 6.4.3 3) 40 CFR Part 50, App. L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	± 0.1º C resolution, ± 0.5º C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Clock/timer Verification	every 30 days	***1 min/mo***	1and 2) Method 2.12 Sec. 4.2.1 3) 40 CFR Part 50, App. L Sec. 7.4.12
Laboratory Activities			
Microbalance Readability	***at purchase***	***1 µg***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.1
Microbalance Repeatability	at purchase	1 µg	1) Method 2.12 Sec. 4.3.6 2) Recommendation 3) Method 2.12 Sec. 4.3.6
Primary Mass. Verification/Calibration Standards Recertifications	at purchase	0.025 mg tolerance (Class 2)	1, 2 and 3) Method 2.12 Sec. 4.3.7
Comment #1 The associated leak test procedure shall require that for successful passage of this test, the difference between the two pressure measurements shall not be greater than the number of mm of Hg specified for the sampler by the manufacturer, based on the actual internal volume of the sampler, that indicates a leak of less than 80 mL/min.			

Pb High Volume (TSP) Local Conditions Validation Template

Note: in 2008, the NAAQS was lowered for Pb and new monitoring rules were promulgated which allowed for the use of federal equivalent analytical methods and the use of PM_{10} sampling in certain circumstances. The following information is guidance based on the current FRM which is sampling by TSP and analysis by atomic absorption. Information is this table is derived from the TSP sampling method in 40 CFR Part 50 App B, and QA Handbook Method 2.2 (1977). The analytical requirements/guidance are derived from 40 CFR Part 50, App G and QA Handbook Method 2.8 (1981). Monitoring for Pb based on the new NAAQS requirements will begin in calendar year 2010. **Revised and/or additional Pb validation templates will be included in this Sec. (if published before this version of the Handbook) or posted on AMTIC**

1) Criteria	2) Frequency	3) Acceptable Range	4) Information/Action
CRITICAL CRITERIA- Pb in TSP Local Conditions			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM/ARM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list Also described in 40 CFR Part 50 App B Sec. 7.2
Filter Holding Times			
Sample Recovery	***all filters***	***ASAP***	1, 2 and 3) 40 CFR Part 50 App B Sec. 6.3
Sampling Period	***all filters***	***1440 minutes ± 60 minutes midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App B Sec. 8.15
Sampling Instrument			
Average Flow Rate	***every 24 hours of op***	***1.1-1.70 m^3/min (varies with instrument) in actual condition***	1, 2 and 3) 40 CFR Part 50 App B Sec. 8.8
One-point Flow Rate Verification	***every 90 days and 4 times a calendar year***	< ±7.1% from transfer standard	1 and 2) 40 CFR Part 58 App A Sec. 3.4.2 3) Method 2.2 Sec. 2.6
Lab Activities			
Filter			
Visual Defect Check (unexposed)	***all filters***	***Initial backlight inspection- no pinholes or imperfections. Visual inspection prior to shipping to analytical lab***	1, 2 and 3) 40 CFR Part 50 App B Sec. 8.2
Collection Efficiency	***all filters***	***99 %***	1, 2 and 3) 40 CFR Part 50 App B Sec. 7.1.4
Pressure Drop Range	***all filters***	***42-54 mm Hg***	1, 2 and 3) 40 CFR Part 50 App B Sec. 7.1.5
pH	***all filters***	***6-10***	1, 2 and 3) 40 CFR Part 50, App B Sec. 7.1.6
Pb Content	***all filters pre-sampling batch check***	***< 75 µg/filter***	1, 2 and 3) 40 CFR Part 50, App G Sec. 6.1.1.1 Method 2.8 Sec. 6.2.1. More information relative to whether filters should be corrected for blanks.
Calibration Reproducibility Checks	***Beginning, every 10 samples and end***	***± 5% of value predicted by calibration curve***	1, 2 and 3) 40 CFR Part 50, App G Sec. 9.3 May be FEM dependent
Initial Calibration Blank	***Before first sample***	***< 0.001 µg/mL***	1, 2 and 3) 40 CFR Part 50, App G Sec.8.8

1) Criteria	2) Frequency	3) Acceptable Range	4) Information/Action
Reagent Blank	Every analytical batch	< LDL	1, 2 and 3) Recommendation
Daily Calibration	Daily (on day of analysis)	until good agreement is obtained among replicates	1, 2 and 3) Method 2.8 Sec. 2.8.5
OPERATIONAL EVALUATIONS TABLE Pb in TSP Local Conditions			
Field Activities			
Verification/Calibration			
System Leak Check	During precalibration check	Visual and Auditory inspection with faceplate blocked	1, 2 and 3) Recommendation
FR Multi-point Verification/Calibration	After receipt, after motor maintenance or failure of 1-point check and every 365 days and once a calendar year	5 points over range of 1.1 to 1.7 m^3/min $\leq \pm$ 5.1% limits of linearity	1, 2 and 3) Method 2.2 Sec. 2.6
Precision			
Collocated Samples	***15% of each method code in PQAO Frequency - every 12 days***	CV < 20.1% of samples $\geq$ 0.02 µg/m^3 (cutoff value)	1 and 2) 40 CFR Part 58 App A Sec. 3.3.4.3 3) Recommendation for early evaluation of DQOs
Semi Annual Flow Rate Audit	***every 180 days and twice a calendar year***	$< \pm$ 7.1% of audit standard	1 and 2) 40 CFR Part 58, App A, Sec. 3.4.3 3) Method 2.2 Table 8.2
Monitor Maintenance			
Inlet cleaning	every 90 days and 4 times a calendar year	cleaned	1, 2 and 3) Recommendation
Motor/housing gaskets	~400 hours	Inspected replaced	1, 2 and 3) Method 2.2 Sec. 7
Blower motor brushes	400-500	Replace	1, 2 and 3) Method 2.2 Sec. 7
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	NA
Lab Activities			
Analysis Audits	***6 strips/quarter 3 at each concentration range***	<10.1% (percent difference)	1 and 2) 40 CFR Part 58, App A, Sec. 3.4.6 3) Recommendation
Field Filter Blank	1/quarter	< LDL	1, 2 and 3) Recommendation
Lab Blanks	1/ sample run	< LDL	1, 2 and 3) Recommendation
Control Standards (1 µg Pb/ml and a standard between 1-10 µg Pb/ml)	1st, every 10 samples and last sample.	Deviation of < 5.1% from value predicted by calibration curve	1, 2 and 3) Method 2.8 Sec. 5.7.3
SYSTEMATIC CRITERIA - Pb Filter Based Hi-Vol Local Conditions			
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sections 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sections 2-5
Data Completeness	***3-year standard***	***average of the 3 constituent monthly means $\geq$ 75% .***	1, 2 and 3) 40 CFR Part 50 App. R, Sec. 4. In addition there are substitution tests that can be used for data not meeting completeness criteria.

1) Criteria	2) Frequency	3) Acceptable Range	4) Information/Action
Reporting Units	*all filters*	*μg/m³ at local temperature and pressure.*	1, 2 and 3) 40 CFR Part 50 App R Sec. 3 (b)
Rounding convention for design value calculation (3-month arithmetic mean)	*quarterly*	*Report data to 3 decimal places (data after 3 are truncated.*	1, 2 and 3) 40 CFR Part 50 App R Sec. 3 (b) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Lower Detectable Limit (AA)	*all samples*	*0.07 μg Pb/m³*	1, 2 and 3) 40 CFR Part 50 App G Sec. 2.3
Precision			
Single analyzer	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) < 20.1% ≥0.02 μg/m³	1 and 2) 40 CFR Part 58 App A Sec. 3.4.4 3) Recommendation related to DQO
Primary Quality Assurance Org.	*Annual and 3 year estimates*	*90% CL of CV < 20.1% ≥ 0.02 μg/m³*	1, 2 and 3) 40 CFR Part 58 App A Sec. 3.4.4 and Sec. 2.3.1.3
Bias			
Performance Evaluation Program (PEP)	*5 audits for PQAOs with ≤ 5 sites* *8 audits for PQAOs with > 5 sites*	*95% CL Absolute bias < ±15.1% ≥ 0.02 μg/m³*	1, 2 and 3) 40 CFR Part 58 App A Sec. 3.4.7 and Sec. 2.3.1.3 The PEP include 1 or independent collocated audits and 4 or 6 samples from the monitoring organizations collocated monitor sent to the independent National PEP Laboratory.
Field Activities			
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	every 365 days and once a calendar year	*Resolution 0.02 m³/min* *± 2% reproducibility*	1) 40 CFR Part 50, App. B Sec. 7.8 2) Method 2.2 Sec. 2.5 3) 40 CFR Part 50, App. B Sec. 7.8
Field Thermometer	every 365 days and once a calendar year	*2° C resolution*	1) 40 CFR Part 50, App. B Sec. 7.5 2) Recommendation 3) 40 CFR Part 50, App. B Sec. 7.5
Field Barometer	every 365 days and once a calendar year	*± 5 mm Hg resolution*	1) 40 CFR Part 50, App. B Sec. 7.6 2) Recommendation 3) 40 CFR Part 50, App. B Sec. 7.6
Clock/timer Verification	every 90 days and 4 times a calendar year.	± 2 min/24-hour	R1, 2 and 3) Method 2.2. Sec. 2.3
Lab Activities			
Analytical Standards			
Reagents (HNO_3 and HCL)	*all*	*ACS reagent grade*	1, 2 and 3) 40 CFR Part 50 App G Sec.6.2.1
Pb nitrate Pb $(NO_3)_2$	*all*	*ACS reagent grade (99.0% purity)*	1, 2 and 3) 40 CFR Part 50 App G Sec.6.2.8

SD= standard deviation
CV= coefficient of variation

PM_{10} -Pb Low Volume Filter-Based Local Conditions Validation Template

NOTE: The following validation template was constructed for use of PM_{10}-Pb at local conditions where PM_{10c} method in 40 CFR Part 50 Appendix O is referenced. Although the PM $_{10-2.5}$ method is found in 40 CFR Part 50 Appendix O, Appendix O also references Appendix L (the $PM_{2.5}$ Method) for the QC requirements listed below. Therefore, the information action column, in most cases, will reference 40 CFR Part 50 App L. In addition, since the PM10 samplers are very similar to the PM2.5 samplers, Guidance Document 2.12 *Monitoring PM2.5 in Ambient Air Using Designated Reference or Class 1 Equivalent Methods* is referred to where appropriate. At present the only analytical FRM is XRF. Therefore, quality control criteria are associated with the XRF method which is promulgated in 40 CFR Part 50 Appendix Q.

1) Criteria (PM10-Pb Lo-Vol)	2) Frequency	3) Acceptable Range	Information /Action
CRITICAL CRITERIA- PM10-Pb Filter Based Local Conditions			
Field Activities			
Sampler/Monitor	NA	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58 App C Sec. 2.1 2) NA 3) 40 CFR Part 53 & FRM/FEM method list
Filter Holding Times ***Sample Recovery***	***all filters***	***ASAP***	1, 2 and 3) 40 CFR part 50 App B Sec. 6.3 If filters are used for more than one purpose (i.e.,Pb and PM10) the sample recovery is dictated by the most stringent requirement.
Filter Holding Times ***Pre-sampling***	***all filters***	***≤ 30 days before sampling***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.3.5 Required only if filters will be used for PM10c mass as well as Pb. If only used for Pb then 30 day pre-sampling holding time not required
Sampling Period (including multiple power failures)	***all filters***	***1440 minutes ± 60 minutes midnight to midnight local standard time***	1, 2 and 3) 40 CFR Part 50 App B Sec. 8.15 If filters are used for more than one purpose (i.e.,Pb and PM10) the sample recovery is dictated by the most stringent requirement.
Sampling Instrument			
Average Flow Rate	***every 24 hours of op***	***average within 5% of 16.67 liters/minute***	1, 2 and 3) 40 CFR Part 50 App L Sec. 7.4.3.1
Variability in Flow Rate	***every 24 hours of op***	***CV ≤ 2%***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.2
One-point Flow Rate Verification	every 30 days	***< ± 4.1% of transfer standard*** < ± 5.1% of flow rate design value	1) 40 CFR Part 50, App. L, Sec. 9.2.5, 40 CFR Part 58, Appendix A Sec. 3.4.1 2) Recommendation 3) 40 CFR Part 50, App. L, Sec. 9.2.5
Design Flow Rate Adjustment	***After multi-point calibration or verification***	***< ± 2.1% of design flow rate***	1, 2 and 3) 40 CFR Part 50, App. L, Sec. 9.2.6

1) Criteria (PM10-Pb Lo-Vol)	2) Frequency	3) Acceptable Range	Information /Action
Individual Flow Rates	***every 24 hours of op***	***no flow rate excursions > ±5% for > 5 min.*** [1/]	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.3.1
Filter Temp Sensor	***every 24 hours of op***	***no excursions of > 5º C lasting longer than 30 min*** [1/]	1, 2 and 3) 40 CFR Part 50, App. L Sec. 7.4.11.4
External Leak Check	***Before each flow rate verification/calibration*** and before and after $PM_{2.5}$ separator maintenance	***< 80.1 mL/min*** (see comment #1)	1) 40 CFR Part 50 App L, Sec. 7.4.6.1 2) 40 CFR Part 50 App L Sec. 9.2.3 and Method 2-12 Sec. 7.4.3 3) 40 CFR Part 50, App. L, Sec. 7.4.6.1
Internal Leak Check	If failure of external leak check	***< 80.1 mL/min***	1) 40 CFR Part 50, App. L, Sec. 7.4.6.2 2) Method 2-12 7.4.4 3) 40 CFR Part 50, App. L, Sec. 7.4.6.2
Laboratory Activities (XRF Analysis)			
Filter Visual Defect Check (unexposed)	***all filters***	***Correct type & size and for pinholes, particles or imperfections***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 10.2
Pb blank filter Acceptance Testing	***~ 20 test filters per lot***	***90% of filters < 4.8 ng Pb/cm²***	1, 2 and 3) 40 CFR Part 50 App Q Sec. 6.1.2
OPERATIONAL EVALUATIONS TABLE- PM10-Pb Filter Based Local Conditions			
Field Activities			
Routine Verifications			
One-point Temp Verification	every 30 days	<± 2.1ºC	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Table 6-1 3) Recommendation
Pressure Verification	every 30 days	<± 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2) Method 2.12 Table 6-1 3) Recommendation
Annual Multi-point Verifications/Calibrations			
Temperature multi-point Verification/Calibration	on installation, then every 365 days and once a calendar year	<± 2.1ºC	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.4
Pressure Verification/Calibration	on installation, then every 365 days and once a calendar year	<± 10.1 mm Hg	1) 40 CFR Part 50, App. L, Sec. 9.3 2 and 3) Method 2.12 Sec. 6.5 Sampler BP verified against independent standard verified against a lab primary standard that is certified as NIST traceable 1/year
Flow Rate Multi-point Verification/ Calibration	***Electromechanical maintenance or transport or*** every 365 days and once a calendar year	<± 2.1% of transfer standard	1) 40 CFR Part 50, App. L, Sec. 9.2. 2) 40 CFR Part 50, App. L, Sec. 9.1.3, Method 2.12 Sec. 6.3 and Table 6-1 3) Recommendation
Other Monitor Calibrations	per manufacturers' op manual	per manufacturers' operating manual	1, 2 and 3) Recommendation
Precision			

1) Criteria (PM10-Pb Lo-Vol)	2) Frequency	3) Acceptable Range	Information /Action
Collocated Samples	***15% of each method code in PQAO Frequency - every 12 days***	CV < 20.1% of samples ≥ 0.02 µg/m^3 (cutoff value)	1 and 2) 40 CFR Part 58 App A Sec. 3.4.4 3) Recommendation for early evaluation of DQOs
Accuracy			
Temperature Audit	every 365 days and once a calendar year	<± 2.1ºC	1, 2 and 3) Method 2.12 Sec. 11.2.2
Pressure Audit	every 365 days and once a calendar year	<±10.1 mm Hg	1, 2 and 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and 5-7 months apart***	<± 4.1% of audit standard <± 5.1% of design flow rate	1 and 2) 40 CFR Part 58 App A, Sec. 3.4.3 3) Method 2.12 Sec. 11.2.1
Monitor Maintenance			
Impactor (WINs)	every 5 sampling events	cleaned/changed	1, 2, and 3) Method 2.12 Sec. 8.2.2
Very Sharp Cut Cyclone	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec.8.3.3
Inlet Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Downtube Cleaning	every 90 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.4
Filter Chamber Cleaning	every 30 days	cleaned	1, 2 and 3) Method 2.12 Sec. 8.3
Circulating Fan Filter Cleaning	every 30 days	cleaned/changed	1, 2 and 3) Method 2.12 Sec. 8.3
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	
Laboratory Activities (XRF Analysis)			
Analysis Audits	***6 filters/quarter 3 at each concentration range***	<10.1% (percent difference)	1 and 2) 40 CFR Part 58, App A, Sec. 3.4.6 3) Recommendation
Field Filter Blank	1/quarter	< 0.01 µg/m^3	1) 40 CFR Part 50 App Q Sec. 6.1.2.1 2 and 3) Recommendation
Lab Filter Blank	1/ sample run	<.003 µg/m^3	1 40 CFR part 50 App Q Sec. 6.1.2.1 2 and 3) Recommendation
Thin Film Standards (standard reference materials)	Beginning and end of each analytical run	XRF conc. ± 3x the 1 sigma uncertainty overlaps the NIST certified conc. + 1x its reported uncertainty.	1) 40 CFR Part 50 App Q Sec. 6.2.3 2 and 3) recommendation
Run time quality control standards Checking peak areas, background areas, centroid and FWHM	Beginning and end of each analytical run	Target value 3 SD	1, 2,and 3) Recommendation Target values and SD of QC samples established prior to analysis.
XRF analyzer calibration	***Every 365 days and 1/ calendar year or when significant repairs*** or changes occur or QC limits exceeded	XRF conc. ± 3x the 1 sigma uncertainty overlaps the NIST certified conc. + 1x its reported uncertainty.	1 and 2) 40 CFR Part 50 App Q Sec. 6.2.4 3) Recommendation
Background Measurement and Correction	***20 clean blank filters for each filter lot used***	NA	1 and 2) 40 CFR Part 50 App Q Sec. 6.2.4.2

1) Criteria (PM10-Pb Lo-Vol)	2) Frequency	3) Acceptable Range	Information /Action
SYSTEMATIC CRITERIA - PM10-Pb Filter Based Local Conditions			
Siting	Every 365 days and 1/ calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58 App E, Sections 2-5 2) Recommendation 3) 40 CFR Part 58 App E, Sections 2-5
Data Completeness	***3-year standard***	***average of the 3 constituent monthly means ≥ 75%***	1, 2 and 3) 40 CFR Part 50 App. R, Sec. 4. In addition, there are substitution tests that can be used for data not meeting completeness criteria.
Reporting Units	***all filters***	***μg/m³ at local temperature and pressure.***	1, 2 and 3) 40 CFR Part 50 App R Sec. 3 (b)
Rounding convention for design value calculation (3-monthmean)	***quarterly***	***Report data to 3 decimal places (data after 3 are truncated.***	1, 2 and 3) 40 CFR Part 50 App R Sec. 3 (b) The rounding convention is for averaging values for comparison to NAAQS not for reporting individual values.
Lower DL	***all filters***	***< 0.001 μg/m³***	1, 2 and 3) 40 CFR Part 50 App Q Sec. 2.2
Upper Conc. Limit	***all filters***	***≥200 μg/m³***	1, 2 and 3) 40 CFR Part 50, App.Q Sec. 3.1
Precision			
Single analyzer	every 90 days and 4 times a calendar year.	Coefficient of variation (CV) < 20.1% ≥ 0.02 μg/m³	1 and 2) 40 CFR Part 58 App A Sec. 3.2.4, 4.2.5 and 2.3.1.1 3) Recommendation related to DQO
Primary Quality Assurance Org.	***Annual and 3 year estimates***	***90% CL of CV < 20.1% ≥ 0.02 μg/m³***	1, 2 and 3) 40 CFR Part 58 App A Sec. 3.4.5 and Sec. 2.3.1.3
Bias			
Performance Evaluation Program (PEP)	***5 audits for PQAOs with ≤ 5 sites 8 audits for PQAOs with > 5 sites***	***95% CL Absolute bias <±15% ≥ 0.02 μg/m³***	1, 2 and 3) 40 CFR Part 58 App A Sec. 3.4.7 and Sec. 2.3.1.3 The PEP includes 1 or 2 independent collocated audits and 4 or 6 samples from the monitoring organizations collocated monitor sent to the independent National PEP Laboratory.
Field Activities			
Verification/Calibration Standards Recertifications – All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Std.	**every 365 days and once a calendar year**	***<± 2.1% of NIST-traceable Std.***	1) 40 CFR Part 50, App. L Sec. 9.1 & 9.2 2) Method 2-12 4.2.2 and 6.4.3 3) 40 CFR Part 50, App. L Sec. 9.1 & 9.2
Field Thermometer	every 365 days and once a calendar year	± 0.1° C resolution, ± 0.5° C accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Field Barometer	every 365 days and once a calendar year	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1, 2 and 3) Method 2.12 Sec. 4.2.2
Verification/Calibration Clock/timer Verification	every 30 days	***1 min/mo***	1 and 2) Method 2.12 Sec. 4.2.1 3) 40 CFR Part 50, App. L, Sec. 7.4.12

1) Criteria (PM10-Pb Lo-Vol)	2) Frequency	3) Acceptable Range	Information /Action
Comment #1 The associated leak test procedure shall require that for successful passage of this test, the difference between the two pressure measurements shall not be greater than the number of mm of Hg specified for the sampler by the manufacturer, based on the actual internal volume of the sampler, that indicates a leak of less than 80 mL/min.			

1/ value must be flagged SD= standard deviation CV= coefficient of variation