NORTHERN NEVADA

Public Health

Air Quality

Northern Nevada Public Health Air Quality Monitoring Program

Quality Assurance Project Plan

Version Number 3a

March 11, 2025

NORTHERN NEVADA

Public Health

Serving Reno, Sparks & Washoe County

MISSION

To improve and protect our community's quality of life and increase equitable opportunities for better health.

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

Version Number	Date	Responsible Party	Description of Change
0	12-31-2012	Julie Hunter	1. New Document
1	11-01-2019	Julie Hunter Craig Petersen Brendan Schnieder	1. Changes throughout document due to new guidance and network modifications.
2	12-23-2021	Craig Petersen	1. Updated QA Plan Identification and Approval with staff changes. 2. Updated Distribution List with staff changes. 3. Updated Organizational Chart with staff changes. 4. Updated NPAP and PEP audit frequency in Table 6-1. 5. Revisions to Section 8: Personnel Qualification and Training. 6. Updated quarterly AMP report review staff in Table 21-2. 7. Addition of quarterly AMP report review in Section 21. 8. Revisions to Appendices BB, CC, D, F, G, H, I, J, K, M, N, P, and Q. 9. Addition of Appendix X.
2a	09/13/2024	Craig Petersen	1. Addressed comments in EPA Memo dated August 23, 2024. a. Updated document title from WCHD to NNPH. b. Updated document contents from WCHD to NNPH. c. Added EPA project officer signature line and name to Sec 1, Page 5. d. Added term “Environmental Information Operations (EIO)” to Sec 9, Page 38. e. Changed “Environmental Data Operations to EIO in Table 9-1. f. Added language from and referenced EPA’s “QAPP Standard” in Section 5.1. 2. Updated QA Plan Identification and Approval. 3. Updated QA Plan Distribution List. 4. Updated Organizational Chart.
3	12-16-2024	Craig Petersen Brendan Schnieder Matt McCarthy	1. Updated QA Plan Identification and Approval with staff changes. 2. Updated Distribution List with staff changes.

		Ben McMullen Michael Crawford Jordan Volk	3. Added Roles and Responsibilities for Public Service Intern. 4. Updated Organizational Chart with staff changes. 5. Addition of Example Monitoring Staff Training Log in Section 8. 6. Updated Training Track Sheet in Section 8. 7. Revisions to Table 9-2, Documentation and Record Retention. 8. Revisions to Appendices BB, CC, D, G, H, I, J, K, M, N, O, P, Q, S, U, and X. 9. Addition of Appendices EE and VV.
3a	03-11-2025	Craig Petersen	1. Addressed comments in EPA Memo dated February 25, 2025. a. Updated Monitoring and Analysis Section Manager information in Table 3-1. b. Changed Table 9-3 column label from “EPA Approval Date” to “PQAO Approval Date” and updated dates. c. Removed the last sentence in Section 7.3 referencing Sonoma Tech. d. Added disposition notes for Lab Logbooks in Table 9-2. 2. Updated AQMD Org Chart.

Section 1: Quality Assurance Plan Identification and Approval

Agency: Northern Nevada Public Health, Air Quality Management Division
Title: *Northern Nevada Public Health Air Quality Monitoring Program Quality Assurance Project Plan, Version Number 3a*

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

Francisco Vega Digitally signed by Francisco Vega
Date: 2025.03.12 16:33:11 -07'00'

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Title: Division Director

Craig Petersen Digitally signed by Craig Petersen
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Name: Matt McCarthy
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Acronyms and Abbreviations

AADT	Annual Average Daily Trip
A&WMA	Air & Waste Management Association
AC	Alternating Current
ACV	Alternative Current Voltage
AMTIC	Ambient Monitoring Technology Information Center
ANP	Annual Network Plan
APTI	Air Pollution Training Institute
AQI	Air Quality Index
AQMD	Northern Nevada Public Health Air Quality Management Division
AQMP	Air Quality Monitoring Program
AQS	Air Quality System
ASTM	American Society for Testing and Materials
BAM	Beta Attenuation Monitor
°C	Degrees Celsius
^{14}C	Carbon-14
CAA	Clean Air Act
CARB	California Air Resources Board
CBSA	Core-Based Statistical Area
CCV	Continuing Calibration Verification
CH_4	Methane
CFR	Code of Federal Regulations
CMSA	Consolidated Metropolitan Statistical Area
CO	Carbon Monoxide
CO_2	Carbon Dioxide
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
EIO	Environmental Information Operations
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
FEM	Federal Equivalent Method
FEP	Fluorinated Ethylene Propylene
FRM	Federal Reference Method
FTP	File Transfer Process
GFC	Gas Filter Correlation
HA87	Truckee Meadows Hydrographic Area 87
H_2O	Water vapor
Hg	Mercury

ICV	Initial Calibration Verification
IR	Infrared
$\mu g/m^3$	micrograms per cubic meter
µm	micrometers
L/min	Liters per minute
MARAMA	Mid Atlantic Regional Air Management Association
MDL	Method Detection Limit
MFC	Mass Flow Controllers
mg	milligrams
mm	millimeters
MPO	Metropolitan Planning Organization
MSA	Metropolitan Statistical Area
MQO	Measurement Quality Objective
M/R	Measure/Reference
NAAMC	National Ambient Air Monitoring Conference
NAAQS	National Ambient Air Quality Standards
NACAA	National Association of Clean Air Agencies
NCore	National Core multi-pollutant Monitoring Station
NIST	National Institute of Standards and Technology
N_2	Nitrogen
N_2O	Nitrous oxide
nm	nanometers
NNPH	Northern Nevada Public Health
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_2*	Electronically Excited Nitrogen Dioxide
NOx	Oxides of Nitrogen
NOy	Reactive Oxides of Nitrogen
NPAP	National Performance Audit Program
O_2	Oxygen
O_3	Ozone
ORD	Office of Research and Development
Pb	Lead
PE	Performance Evaluation
PEP	Performance Evaluation Program
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
$PM_{10-2.5}$	PM_{10} minus $PM_{2.5}$
PMT	Photomultiplier Tube
PNA	Poly-nuclear Aromatic
POC	Parameter Occurrence Code
ppm	parts per million
PQAO	Primary Quality Assurance Organization
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
SCC	Sharp Cut Cyclone
SD	Standard Deviation
SIP	State Implementation Plan
SLAMS	State and Local Air Monitoring Station
SO_2	Sulfur Dioxide
SO_2*	Electronically Excited Sulfur Dioxide
SOP	Standard Operating Procedures
SPM	Special Purpose Monitoring
SRP	Standard Reference Photometer
STN	Speciation Trends Network
TAD	Technical Assistance Document
TAPI	Teledyne-Advanced Pollution Instrumentation, Inc.
TSA	Technical Systems Audit
TSP	Total Suspended Particulates
USB	Universal Serial Bus
UV	ultra-violet
VSCC	Very Sharp Cut Cyclone
WCHD	Washoe County Health District
Z/P/S	Zero/Precision/Span

Section 3: Distribution/Notification List

Copies of the Quality Assurance Project Plan (QAPP) for the Northern Nevada Public Health (NNPH) Air Quality Management Division (AQMD) have been distributed to the following individuals listed in Table 3-1. A digital 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@nnph.org (775) 784-7211
Craig Petersen	1001 East 9th Street Reno, NV	Monitoring and Planning Supervisor, AQMD	cpetersen@nnph.org (775) 784-7233
Brendan Schnieder	1001 East 9th Street Reno, NV	Senior Air Quality Specialist, AQMD; QA Manager, AQMD	bschnieder@nnph.org (775) 784-7233
Matt McCarthy	1001 East 9th Street Reno, NV	Senior Air Quality Specialist AQMD	mmccarthy@nnph.org (775) 784-7205
Ben McMullen	1001 East 9th Street Reno, NV	Air Quality Specialist, AQMD; Data Manager, AQMD	bmcmullen@nnph.org (775) 784-7207
Michael Crawford	1001 East 9th Street Reno, NV	Air Quality Specialist, AQMD; Lab Manager, AQMD	mcrawford@nnph.org (775) 784-7221
Jordan Volk	1001 East 9th Street Reno, NV	Air Quality Specialist, AQMD	jvolk@nnph.org (775) 784-7217
Laura Barry, Ph.D.	75 Hawthorne Street San Francisco, CA	Environmental Engineer, Monitoring and Analysis Section, EPA Region 9	barry.laura@epa.gov (415) 947-4180
Dena Vallano	75 Hawthorne Street San Francisco, CA	Manager, Monitoring and Analysis Section, EPA Region 9	vallano.dena@epa.gov (415) 972-3134
Audrey L. Johnson	75 Hawthorne Street San Francisco, CA	Manager, Quality Assurance Branch, EPA Region 9	johnson.audreyl@epa.gov (415) 972-3431

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

Northern Nevada Public Health is organized into six divisions: Administrative Health Services, Air Quality Management, Community & Clinical Health Services, Environmental Health Services, Epidemiology & Public Health Preparedness, and Office of the District Health Officer. 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 Compliance. 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 22 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 2024 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 to the Deputy District Health Officer of NNPH. 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 Deputy District Health Officer or the District 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 Senior Air Quality Specialists.
- primary point of contact with EPA Region 9 Office.
- interacting with the public and media regarding air quality information.
- 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.
- Assign, direct, and review monitoring Air Quality Specialists.
- 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 Annual Network Plan (ANP).
- 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:

- assign, direct, and review planning Environmental Engineer I/II and Air Quality Specialist/Air Quality Specialist Trainee
- 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 approve 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 Senior Air Quality Specialist in planning, 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 Trends Report; and
- review monitoring assessment reports.

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

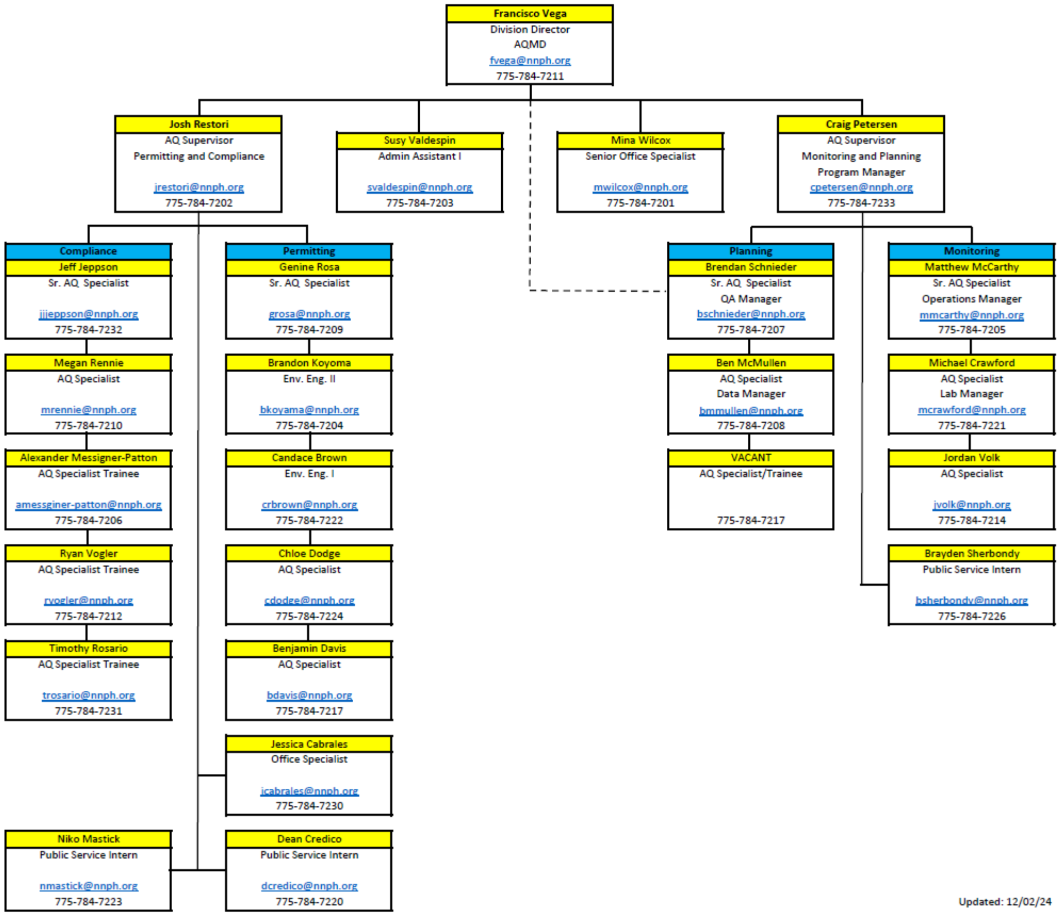
- collecting, calculating, and reviewing air quality data.
- ensuring proper installation, calibration, and adjustment of network instrumentation.
- instrument preventative maintenance.
- authority to stop work and resume work at monitoring sites if needed.

- 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 in monitoring, 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.

Public Service Intern: Under direction of the Senior Air Quality Specialist in monitoring, the Public Service Intern's responsibilities include:
- reviewing and converting field management QC forms to read-only pdf.
- QC of manual method filters.
- routine lab maintenance.
- assisting monitoring staff in any above-mentioned activities on an as-needed basis.

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, except for 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 $PM_{2.5}$, $PM_{10\text{-}2.5}$, SO_2, CO, nitrogen oxide (NO), reactive oxides of nitrogen (NOy), 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 NCore is the use of highly sensitive commercial air pollutant monitors for the characterization of the precursor gases CO, SO_2, 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 Reno4 monitoring station is designated as the network's 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 the 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.

As directed in EPA's *Quality Assurance Project Plan Standard* (*Directive No*: CIO 2105-S-02.1):

> *All EPA organizations performing environmental information operations (EIOs) and non-EPA organizations performing EIOs on behalf of EPA are required to participate in the EPA Agency-wide Quality Program. EPA's Quality Program supports EPA's mission to protect human health and the environment and to ensure EIO products and services are of known and documented quality for their intended use(s).*
>
> *All work performed by or on behalf of EPA involving EIOs shall be implemented in accordance with an approved QAPP.*
>
> *The QAPP is a formal planning document which describes how EIOs are planned, implemented, documented, and assessed during the life cycle of a project. The QAPP describes in comprehensive detail the necessary QA and QC requirements and other technical activities that must be implemented to ensure that the results of the EIOs performed will satisfy the stated performance and acceptance criteria.*

This document presents the AQMD's Monitoring Program's QAPP. The purpose of the QAPP is to describe requirements, procedures, and guidelines for AQMD's Air Quality Monitoring Program. 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		98^{th} percentile of daily max, averaged over 3 years
	Annual	9.0 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		98^{th} 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°: 99^{th} 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 Washoe County Health District (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, the Truckee Meadows Hydrographic Area 87 (HA87) was designated nonattainment 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 if determined to have regulatory significance in accordance with the Exceptional Events Rule.

On August 31, 2023, WCHD changed its name to Northern Nevada Public Health (NNPH).

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

Version 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	12-13-2019
2	QA Manager	12-23-2021	12-23-2021	Staffing updates; addition of quarterly AMP report review; addition of QA Manager SOP; revisions to Section 8; updates to various SOPs	12-23-2021
2a	Air Quality Supervisor	08-23-2024	09-13-2024	Address comments from EPA Memo dated August 23, 2024.	10-03-2024
3	Air Quality Supervisor QA Manager Senior AQ Specialist Data Manager Air Quality Specialist	03-06-2024	12-16-2024	SOP Revisions; styling update; new SOPs (App. EE, VV); addition of training logs for new employees; new maps to reflect current monitoring network; updated contact list; updated responsibilities; updated organizational	---

				chart; updated retention schedule, revisions throughout multiple sections	
3a	Air Quality Supervisor	03-04-2025	03-11-2025	Address comments from EPA Memo dated February 25, 2025.	

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 public in a timely manner.
- Support compliance with ambient air quality standards and emissions strategy development.
- Support for air pollution research studies.

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 Northern Nevada Public Health'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 AQMD's 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:

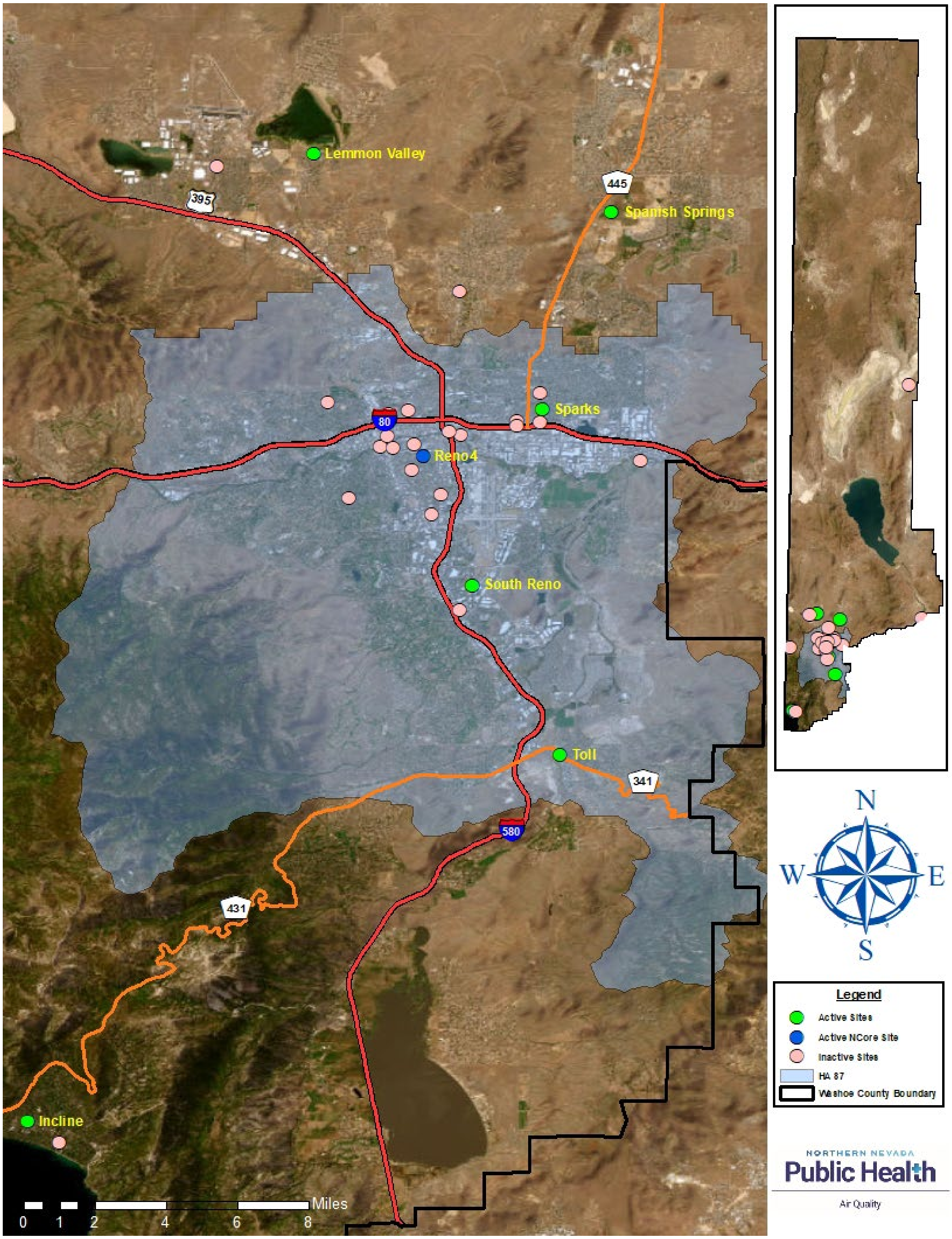
- Criteria Gases (O_3, CO, NO_2, SO_2)
- Non-Criteria Gases (NO, NOx, NOy, NOy-NO)
- Criteria PM (PM_{10}, $PM_{2.5}$)
- Non-Criteria PM ($PM_{2.5}$ Speciation; $PM_{10-2.5}$)
- Meteorology (wind speed, wind direction, ambient temperature, RH)

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 Northern Nevada Public Health 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
QA Quarterly Data Review	AQMD	Quarterly
NPAP Audit	EPA designated contractor	20% of sites audited/year
PEP Audit	EPA designated contractor	5 audits/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 stations 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 episodes.
- 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, Pb, NO_2, PM, O_3 and SO_2 and are all monitored, except for Pb, at the designated SLAMS and NCore stations. 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 $PM_{2.5}$, EPA utilized the formal DQO process (see: *Guidance on Systematic Planning using the Data Quality Objectives Process*) 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 station 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 H
*NO_2, NOx, NO	Appendix I
SO_2	Appendix J
$PM_{2.5}$ Filter Based Local Conditions	Appendix EE Appendix M
Continuous $PM_{2.5}$ Local Conditions	Appendix D
PM_{10} for $PM_{10-2.5}$ Low-Volume, Filter Based Local Conditions	Appendix EE Appendix M
PM_{10} Low Volume STP Filter-Based Local Conditions	Appendix EE Appendix M

*Note: NOy 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.

Section 8: Personnel Qualifications and Training

Ambient air monitoring personnel must have sufficient education, training, and skills to properly operate a variety of complex air sampling instrumentation and associated equipment. Basic knowledge of ambient air monitoring principles, meteorology, chemistry, statistics, and physics are important to ensure competency. Personnel involved in air monitoring activities often interact with the public and staff from federal and state agencies. Therefore, good interpersonal, verbal, and written communication skills are also critical to successfully carrying out assigned duties. The physical ability to travel to and from monitoring sites by vehicle, occasional overnight travel, climbing of ladders, and carrying equipment of up to 50 lbs. are necessary to be an ambient air monitoring station operator.

8.1 Qualifications

All AQMD's air monitoring personnel are hired through a competitive process and must meet minimum qualifications defined by the Washoe County, Nevada Human Resources Department.

To ensure proficiency of its air monitoring personnel, all AQMD air monitoring staff are classified as Air Quality Specialist Trainee or higher. To qualify for these positions, staff must have a bachelor's degree from an accredited college or university in engineering, natural, physical, or environmental sciences, or a closely related field OR an equivalent combination of training and experience.

8.2 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.

8.2.1 Establishing Training Proficiency

AQMD air monitoring personnel are required to complete training that will prepare them for their specific monitoring network job duties. Training may be tailored slightly depending on the specialty area for the position. Below are example training plans for an Air Quality Specialist Trainee, Air Quality Specialist, and Senior Air Quality Specialist. Typically, plans will be completed within the first calendar year and tracked on the AQMD Monitoring Staff Training Log (see Figure 8-1 for an example). The Air Quality Supervisor is responsible for ensuring new air monitoring personnel meet all training requirements and documents required and recommended training during annual performance evaluations.

Air Quality Specialist Training Elements:

- Read and become familiar with the following documents:
    - AQMD's QAPP and instrument SOPs (documented and signed on a required reading form).

  - AQMD’s Annual Network Plan and 5-Year Assessment.
  - 40 CFR Part 58, Appendices A, D, and E.
  - 40 CFR Part 50, Ambient Air Quality Standards for specific pollutants.
  - EPA’s Quality Assurance Handbooks Volumes II and IV, with focus on the Volume II Appendix D Validation Templates.
  - EPA’s Technical Assistance Document (TAD) for NCore.
  - EPA’s TAD for ozone transfer standards.
  - EPA’s Technical Systems Audit (TSA) guidance document.
  - EPA’s Data Validation guidance document.
  - Instrument manufacturer’s User Manuals.
- Job-shadow an Air Quality Specialist and/or Senior Air Quality Specialist. Accompany them on as many trips into the field as it takes to become proficient (with oversight) in all the following tasks:
  - Routine monitoring station site checks.
  - Routine monitoring station BAM checks.
  - Shipping and receiving SASS/URG speciation filter packs.
  - Pulling and installing of manual method FRM and speciation filters.
  - Pulling and installing of RadNet filters.
  - Weekly gas analyzer diagnostic checks.
  - Weekly calibration checks on all NCore gas analyzers.
  - Bi-weekly calibration checks on all SLAMS gas analyzers.
  - Bi-weekly flow verifications on all BAMs.
  - Monthly calibration cylinder pressure checks.
  - Monthly manual method FRM and speciation verifications.
  - Monthly BAM, FRM, and speciation monitor maintenance.
  - Monthly QC of data reports from Data Manager.
  - Hands-on preventative maintenance on all instrumentation.
  - Quarterly audits on all instrumentation.
  - Cross-train with Lab Manager on daily, weekly, monthly, quarterly, semi-annual, and annual lab activities.
  - Cross-train with Senior Air Quality Specialist on ensuring proper traceability of standards.
  - Troubleshooting and repair of failed instrumentation.
  - Corrective Action process.
- Become proficient with AirVision data loggers and data management software:
  - Setup and run daily statistical data reports.
  - Review daily statistical and calibration reports.
  - Disable or put data channels in maintenance mode.
  - Review configurations of data channels.
- Complete the following vendor-based training for new and existing equipment:
  - Teledyne API Level 1 and Level 2.
  - Met One Instruments.
- Complete the following online courses:
  - Air Pollution Training Institute (APTI) SI-470 course, Quality Assurance for Air Pollution Measurement Systems.
- EPA-offered conferences and seminars.

    - National Ambient Air Monitoring and AQS Conference.
- Other pertinent training identified by staff.

Air Quality Specialist Training Elements:
- Able to perform all training elements listed for the Air Quality Specialist Trainee classification without oversight.
- Train Air Quality Specialist Trainees in procedures to ensure that activities are performed within established standards and regulations.

Senior Air Quality Specialist Training Elements:
- Able to perform all training elements listed for the Air Quality Specialist Trainee and Air Quality Specialist classifications.
- Provide lead direction over technical and support staff, direct program activities, schedule, assign, and review work.
- Mentor and train Air Quality Specialists and Air Quality Specialist Trainees in procedures to ensure that activities are performed within established standards and regulations.
- Ensure proper traceability of standards.

In addition to the Air Quality Specialist training elements listed above, 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, conditioning, weighing, and QC of manual method filters.
- Filter concentration calculations.
- Preparation of filters for field use.
- Maintenance of all laboratory equipment.
- Ensuring proper traceability of standards.

The Data Manager will be specifically trained in the following activities before fully executing the responsibilities of the position:
- Managing AQMD's database software.
- Daily data review.
- Raw data editing.
- Manual method data entry.
- QA data entry.
- AQS data submittal.
- Generating AQS reports.
- QA data validation.
- Assessing data quality and flagging.
- Data validation and verifications.
- Data certification.

Figure 8-1 Example Monitoring Staff Training Log

Air Quality Management Division
Monitoring Staff Training Log

Name:	Classification: Air Quality Specialist (Monitoring)
Start Date in Classification:	

Training/Required Reading (See QAPP Section 8.2.1 for all training elements)	Date Completed	Employee Initials	Trainer Initials
Field Training			
Routine monitoring station site checks			
Routine monitoring station BAM checks			
Shipping and receiving SASS/URG speciation filter packs			
Pulling and installing of speciation filters			
Pulling and installing of manual method FRM filters			
Pulling and installing of RadNet filters			
Weekly gas analyzer diagnostic checks			
Bi-weekly calibration checks on all SLAMS gas analyzers			
Bi-weekly flow verifications on all BAMs			
Monthly calibration cylinder pressure checks			
Monthly speciation verifications			
Monthly manual method FRM verifications			
Monthly BAM maintenance			
Monthly speciation maintenance			
Monthly FRM maintenance			
Monthly QC of data reports from Data Manager			
Hands-on preventative maintenance on all instrumentation			
Quarterly audits on all instrumentation			
Cross-train with Lab Manager on daily, weekly, monthly, quarterly, semi-annual, and annual lab activities			
Troubleshooting and repair of failed instrumentation			
Corrective Action process			

Training/Required Reading (See QAPP Section 8.2.1 for all training elements)	Date Completed	Employee Initials	Trainer Initials
Data Management			
Setup and run daily statistical data reports			
Review daily statistical and calibration reports			
Disable or put data channels in maintenance mode			
Review configurations of data channels			
Required Reading			
AQMD QAPP/SOPs			
AQMD Annual Network Plan			
AQMD 5-Year Assessment			
40 CFR 58, Appendices A, D, and E			
40 CFR 50			
EPA's QA Handbook Volume II			
EPA's QA Handbook Volume IV			
EPA's TAD for NCore			
EPA's TAD for Ozone Transfer Standards			
EPA's TSA Guidance Document			
EPA's Data Validation Guidance Document			
Vendor Training			
Teledyne API Level 1			
Teledyne API Level 2			
Met One			
Online Training			
APTI SI-470, QA for Air Pollution Measurement Systems			
EPA Training			

Training/Required Reading (See QAPP Section 8.2.1 for all training elements)	Date Completed	Employee Initials	Trainer Initials
Other Training			

Employee Signature:______________________________ Date: ______________

Supervisor Signature: ______________________________ Date: ______________

8.2.2 Maintaining Training Proficiency

All monitoring staff will be required to maintain training proficiency by periodically refreshing many of the training elements listed above. This may include:

- Annual review of AQMD's instrument SOPs (revised versions of these documents will require documentation on a required reading form).
- Annual review of AQMD's Annual Network Plan.
- 5-year review of AQMD's QAPP (a revised version will require documentation on a required reading form).
- 5-year review of AQMD's 5-year Network Assessment.
- Read and become familiar with any changes to 40 CFR 58, appendices A, D, and E.
- Read and become familiar with any changes to Quality Assurance Handbooks Volumes II and IV, with focus on the Volume II Appendix D Validation Templates.

Additionally, all monitoring staff will be required to attend external training through EPA and other organizations in the form of conference calls, pre-recorded videos, webinars, online presentations, and in-person classroom instruction. This includes:

- Retaking Teledyne Level 2 training every 5 years.
- Attending scheduled monthly monitoring calls with EPA Region 9.
- Attending the Nevada Air Agency's annual conference call with EPA Region 9.
- Attending EPA's National Ambient Air Monitoring and AQS Conference.
- Signing-up to be on the National Association of Clean Air Agencies (NACAA) Monitoring Committee and attend committee meetings.
- Signing-up to be on EPA's Ambient Monitoring Technology Information Center (AMTIC) Listserv.
- As an Air and Waste Management Association (A&WMA) Organizational Member, attending the periodic Air Quality Technology Conferences.
- Other pertinent training identified by staff.

Table 8-1 Training Tracking Sheet

Name/Position	Training	Training Date
Craig Petersen/ Monitoring and Planning Supervisor	EPA Air Sensor Performance Testing Webinar	03/24/21
	EPA AirNow Fire and Smoke Map Webinar	05/19/21
	CARB PQAO Training	10/2021
	EPA AQ Monitoring Grant Webinar	01/11/22
	EPA ORD Air, Climate, and Energy Webinar	03/15/22
	EPA Preparing for Wildfire Smoke Webinar	05/18/22
	EPA Understanding EJ Webinar	06/15/22
	EPA Air Sensor Loan Pilot Program Webinar	07/13/22
	Satellite Remote Sensing Webinar	08/02/22
	NAAMC	08/2022

Name/Position	Training	Training Date
	Wildland Fire Research to Protect Health and the Environment	03/15/23
	EPA Enhanced Air Sensor Guidebook Webinar	04/26/23
	Clarity Wildfires, Smoke, and AQ Webinar	06/01/23
	AirNow Fire and Smoke Map Webinar	08/30/23
	Non-Competitive EPA Grants Webinar	09/19/23
	Clarity Showcase Webinar	11/16/23
	EPA Monitoring and Sensors Grants Webinar	02/28/24
	Clarity BC and PM Measurements Webinar	03/28/24
	EPA Community Air Monitoring Fundamentals Webinar Series	04/2024
Matt McCarthy/ Senior Air Quality Specialist	Internal Monitoring Staff Training	04/08/21
	CARB PQAO Training	10/2021
	Agilaire 8872 Setup and Training	10/15/21
	Teledyne Level 2 Training	05/2022
	Met One Training	10/2022
	Clarity Wildfires, Smoke, and AQ Webinar	06/01/23
Brendan Schnieder/ Senior Air Quality Specialist	Data Certification Webinar	04/2020
	DART Webinar	06/17/20
	Agilaire Training	11/2020
	AirNow Webinar	05/2021
	CSN Data Validation and DART Training	08/2021
	Agilaire On-site 8872 Setup and Training	10/15/21
	Data Certification Webinar	04/2021
	EPA ORD Webinar	06/21/22
	EPA Air Sensor Loan Pilot Programs	07/13/22
	Internal QA Manager Training	09/30/22
	Internal QA Manager Training	02/06/23
	Data Certification Webinar	03/21/23
	Agilaire AirVision Training	03/21/23
	EPA Tools & Resources Webinar	04/26/23
	MARAMA Air Quality Monitoring Training	12/06/23
	Data Certification Webinar	02/15/24
Michael Crawford/ Air Quality Specialist	Met One Training	10/2022
	Teledyne Level 2 Training	02/2024

Name/Position	Training	Training Date
Jordan Volk/ Air Quality Specialist	Teledyne Level 2 Training	05/2022
	Internal Monitoring Staff Training	01/30/23
	AirKnowledge AMBM208-SI Training	03/2023
	Clarity – Wildfires, Smoke, and Air Quality Webinar	06/01/23
	Met One Training	11/2023
Ben McMullen/ Air Quality Specialist	Internal Data Manager Training	02/2023
	Data Certification Webinar	03/21/23
	Agilaire AirVision Training	03/21/23
	MARAMA Air Quality Monitoring Training	12/06/23
	AirKnowledge AMBM206-SI Training	12/19/23
	Data Certification Webinar	02/15/24
	NAAMC	08/2024

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 Information 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 Digital Data

All digital data including ambient air and meteorological parameters are retrieved using an Agilaire AirVision data management system. All digital field forms are stored on the agency LAN on the Monitoring drive. All documents and records will be retained for at least three years in accordance with 2 CFR 200.334. All digital 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 digitally.

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 58.16(b). Data will be submitted no more than 90 days following the end of each calendar quarter. Quarterly data submittal shall contain the following data codes and descriptions:

- state, county, and parameter codes.
- date, time, and duration codes.
- method and unit codes.
- parameter occurrence code (POC).
- all quality assurance data.
    - One-Point Quality Control Checks
    - Annual Performance Evaluations
    - Flow Rate Verifications
    - Semi-Annual Flow Rate Audits
- all ambient air quality and meteorological data; and
- all relevant qualifiers including:
    - Null qualifiers
        - required when submitting a null (i.e., nothing was collected) sample measurement; All Null qualifiers are available for every parameter.
    - QA Qualifiers
        - quality assurance qualifiers are used when data is valid but you want to note something. i.e. measurement was "Below lowest calibration level."
    - Inform Qualifiers
        - informational qualifiers are used in place of a REQuest EXClusion qualifier; use only when an exclusion of the data will not be requested.
    - ReqExc Qualifiers
        - required when submitting data that is affected by an Exceptional Event and for which an exclusion will be requested.

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 by 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 AQS parameter, parameter occurrence, and method codes.
5. The monitoring objective(s)
6. The operating schedules for each monitor.
7. Siting criteria evaluations as described in 40 CFR Part 58 Appendix E.
8. Any proposals to remove or move a monitoring station within a period of 18 months following plan submittal.
9. The monitoring objective and spatial scale of representativeness for each monitor as defined in Appendix D to 40 CFR Part 58.
10. 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.
11. The MSA, CBSA, CSA or other area represented by the monitor.
12. The designation of any Pb monitors as either source-oriented or non-source-oriented according to Section 4.5 of Appendix D to 40 CFR Part 58.
13. 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.
14. 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
15. The identification of required NO_2 monitors as either near-road or area-wide sites in accordance with Section 4.3 of Appendix D to 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 Tracking Sheet (Table 5-2) and SOP Tracking Sheet (Table 9-3) 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 staff. Upon completion of SOP revisions, the QA Manager will review and approve the SOP, with final approval from the Monitoring and Planning Supervisor. Revisions to SOPs are completed when instrumentation is replaced or operation of the instrument changes via vendor manufacturers' recommendations. SOPs for instruments that are no longer in use (greyed out in Table 9-3) are tracked on the tracking sheet 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 digitally 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.

Digital field form cells are "locked" in the calculation cells to avoid altering the equations. After completions of the field form, the form is reviewed and converted to a "secured" 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 digitally, 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 digital 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 instrument logbooks will stay with their respective instruments even if the instrument is relocated to another site. Information recorded in the instrument 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.

9.3 Data Reporting Archiving and Retrieval

All documents will be retained for at least three years in accordance with the statute of limitations stated in 2 CFR 200.334. 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 digital record locations and back-up procedures/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	Digital/LAN
Meteorological Monitoring Data	Permanent	None	Digital/LAN
Data Files for Submittal	Permanent	None	Digital/LAN
Annual Data Certifications	15 years	Delete	Digital/LAN
Quarterly QA Data Review	5 years	Delete	Digital/LAN
Monthly Data Review	5 years	Delete	Digital/LAN
Station Data Exception Logs	5 years	Delete	Digital/LAN
Data Relating to Legal Action	Until Action is Complete	Delete	Digital/LAN
QA/QC			
Quarterly Audits (Gas, PM, Met)	15 years	Delete	Digital/LAN
EPA Audit Reports (PEP and NPAP)	15 years	Delete	Digital/LAN
Calibration Cylinder Certifications	15 years	Delete	Digital/LAN
O_3 Transfer Standard Verifications	15 years	Delete	Digital/LAN
Annual Multi-point QC Checks (NCore Gas)	5 years	Delete	Digital/LAN
Semi-Annual Multi-point QC Checks (Gas)	5 years	Delete	Digital/LAN
Monthly Verifications (PM)	5 years	Delete	Digital/LAN
Bi-weekly QC Checks (Gas, PM)	5 years	Delete	Digital/LAN
Weekly QC Checks (NCore Gas)	5 years	Delete	Digital/LAN
Calibration Records (Gas, PM, Met)	5 years	Delete	Digital/LAN
Control Charts	5 years	Delete	Digital/LAN
Station Log Reports	5 years	Delete	Digital/LAN
Quality Assurance Project Plan (QAPP)	Superseded by revision	Delete	Digital/LAN & Website
Standard Operating Procedures	Superseded by revision	Delete	Digital/LAN
Quality Management Plan (QMP)	Superseded by revision	Delete	Digital/LAN & Website
Corrective Action Requests	15 years	Delete	Digital/LAN

Record Type	Retention Period	Disposition/ Notes	Type/ Location
Equipment			
Instrument Logbooks	15 years	Dispose	Hardcopy/Field Site
Maintenance and Calibration Records	15 years	Delete	Digital/LAN
Work Orders and Repair Orders	15 years	Delete	Digital/LAN
Standard Traceability Certifications	15 years	Delete	Digital/LAN
Requisitions and Purchase Orders	15 years	Delete	Digital/LAN
Manuals	Life of equipment	Delete/ Dispose	Digital and Hardcopy/ LAN and Field Site
Laboratory			
$PM_{2.5}$ STN Custody and Field Sample Forms	5 Years	Dispose	Hardcopy/Data Manager
$PM_{2.5}$ and PM_{10} FRM Field Sample Reports	5 Years	Dispose	Hardcopy/Data Manager
Laboratory Logbooks	15 years	Dispose	Hardcopy/Laboratory
Annual Service/Calibration Records	15 years	Delete	Digital/LAN
Quarterly Audits (Temp, RH)	15 years	Delete	Digital/LAN
PM Weigh Logs	15 years	Delete	Digital/LAN
Mass Standard Verifications	15 years	Delete	Digital/LAN
Mass Standard Traceability Certifications	15 years	Delete/	Digital/LAN
47mm $PM_{2.5}$ and PM_{10} Filters	5 years	Dispose	Refrigerator
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	Refrigerator
Other			
Training Certificates	Permanent	None	Hardcopy/Digital/LAN
Required Reading	Superseded by previous	Delete	Digital/LAN
Lease/Right of Entry Agreements	Permanent	None	Hardcopy/Digital/LAN

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

Appendix	SOP Title	Version	Revision Date	PQAO Approval Date
A *Retired	Anderson Samplers, Inc. High Volume Particulate Matter Sampler – 10 Micron (PM_{10})	1	12/30/10	06/24/13
B *Retired	Met One SASS – Chemical Speciation $PM_{2.5}$	1	12/30/10	06/24/13
BB	Met One SuperSASS – Chemical Speciation $PM_{2.5}$	1	11/05/19	05/11/21
BB	Met One SuperSASS – Chemical Speciation $PM_{2.5}$	2	11/04/21	---
BB	Met One SuperSASS – Chemical Speciation $PM_{2.5}$	3	11/26/24	11/27/24
C *Retired	URG 3000N	1	12/30/10	06/24/13
CC	Sequential URG 3000N	1	11/05/19	05/11/21
CC	Sequential URG 3000N	2	11/04/21	---
CC	Sequential URG 3000N	3	11/13/24	11/26/24
D	Beta Attenuation Monitors – $PM_{2.5}$ and PM_{10}	1	12/21/12	06/24/13
D	Beta Attenuation Monitors – $PM_{2.5}$ and PM_{10}	2	03/31/15	03/25/15
D	Beta Attenuation Monitors – $PM_{2.5}$ and PM_{10}	3	11/05/19	05/11/21
D	Beta Attenuation Monitors – $PM_{2.5}$ and PM_{10}	4	11/03/21	---
D	Beta Attenuation Monitors – $PM_{2.5}$ and PM_{10}	5	12/05/24	12/06/24
E	BGI Particulate Matter Samplers PQ200 – $PM_{2.5}$ and PM_{10}	1	12/30/10	06/24/13
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	---
E *Retired	BGI Particulate Matter Samplers PQ200 – $PM_{2.5}$ and PM_{10}	4	10/10/19	05/11/21
EE	Met One E-SEQ-FRM – $PM_{2.5}$ and PM_{10}	1	11/14/24	11/27/24
F	Carbon Monoxide Analyzers	1	02/28/12	06/24/13
F	Carbon Monoxide Analyzers	2	11/01/19	05/28/21
F *Retired	Carbon Monoxide Analyzers	3	11/04/21	---
G	Ozone Analyzers	1	02/28/12	06/24/13

Appendix	SOP Title	Version	Revision Date	PQAO Approval Date
G	Ozone Analyzers	2	11/01/19	05/28/21
G	Ozone Analyzers	3	11/04/21	---
G	Ozone Analyzers	4	11/07/24	11/26/24
H	Trace Carbon Monoxide Analyzers	1	12/05/12	06/24/13
H	Trace Carbon Monoxide Analyzers	2	11/01/19	05/28/21
H	Trace Carbon Monoxide Analyzers	3	11/04/21	---
H	Trace Carbon Monoxide Analyzers	4	11/19/24	11/27/24
I	Trace Reactive Oxides of Nitrogen Analyzers	1	12/13/12	06/24/13
I	Trace NOx/NOy Analyzers	2	11/01/19	05/28/21
I	Trace NOx/NOy Analyzers	3	11/04/21	---
I	Trace NOx/NOy Analyzers	4	11/22/24	11/27/24
J	Trace Sulfur Dioxide Analyzers	1	12/05/12	06/24/13
J	Trace Sulfur Dioxide Analyzers	2	11/01/19	06/17/21
J	Trace Sulfur Dioxide Analyzers	3	11/04/21	---
J	Trace Sulfur Dioxide Analyzers	4	11/19/24	11/27/24
K	Zero Air Generator	1	12/12/12	06/24/13
K	Zero Air Generator	2	11/01/19	06/17/21
K	Zero Air Generator	3	11/04/21	---
K	Zero Air Generator	4	11/22/24	12/03/24
L *Retired	Environics 6103 Ozone Transfer Standard/Multi-gas Calibrator	1	12/20/12	06/24/13
LL	Teledyne Calibrators (T700, T700U, T750U)	1	10/22/19	06/17/21
LL	Teledyne Calibrators (T700, T700U, T750U)	2	11/27/24	11/27/24
M	Laboratory Procedures	1	12/12/12	06/24/13
M	Laboratory Procedures	2	03/31/15	03/25/15
M	Laboratory Procedures	3	06/30/17	---
M	Laboratory Procedures	4	05/08/19	---
M	Laboratory Procedures	5	10/11/19	06/17/21
M	Laboratory Procedures	6	12/23/21	---
M	Laboratory Procedures	7	11/13/24	11/27/24
N	Meteorology	1	12/20/12	06/24/13
N	Meteorology	2	03/31/15	03/25/15
N	Meteorology	3	10/15/19	06/17/21
N	Meteorology	4	11/30/21	---
N	Meteorology	5	11/27/24	11/27/24
O	RadNet	1	12/06/12	06/24/13
O	RadNet	2	11/05/19	06/17/21
O	RadNet	3	11/06/24	11/26/24
P	Data Retrieval	1	12/05/12	06/24/13

Appendix	SOP Title	Version	Revision Date	PQAO Approval Date
P	Data Retrieval	2	11/05/19	06/30/21
P	Data Retrieval	3	12/01/21	---
P	Data Retrieval	4	11/18/24	11/26/24
Q	Data Validation for Data Management System (Continuous and Manual Monitoring Methods)	1	10/28/10	06/24/13
Q	Data Validation for Data Management System (Continuous and Manual Monitoring Methods)	2	03/31/15	03/25/15
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	06/30/21
Q	Data Validation for Data Management System (Continuous and Manual Monitoring Methods)	6	12/01/21	---
Q	Data Validation for Data Management System (Continuous and Manual Monitoring Methods)	7	11/18/24	11/26/24
R *Combined in App. Q	Data Validation for Manual Monitoring Methods	1	12/17/12	06/24/13
S	File Generation for Continuous Monitoring Methods	1	12/12/12	06/24/13
S	File Generation for Continuous and Manual Monitoring Methods	2	11/05/19	04/29/21
S	File Generation for Continuous and Manual Monitoring Methods	3	11/19/24	11/27/24
T *Combined in App. S	File Generation for Manual Monitoring Methods	1	12/12/12	06/24/13
U	Uploading Ozone and $PM_{2.5}$ data to AirNow	1	12/10/12	06/24/13
U	Uploading Ozone and $PM_{2.5}$ data to AirNow	2	03/31/15	03/25/15
U	Uploading Ozone and $PM_{2.5}$ data to AirNow	3	11/19/24	11/27/24
V	Environmental Systems Corporation (ESC) 8832 Data Loggers	1	12/20/12	06/24/13
V *Retired	Environmental Systems Corporation (ESC) 8832 Data Loggers	2	11/05/19	04/29/21

Appendix	SOP Title	Version	Revision Date	PQAO Approval Date
VV	Agilaire Digital Site Platform 8872	1	12/03/24	12/03/24
W *Combined in App. F, G, H, I, J, & K	Quarterly Gaseous Audits at SLAMS and NCore Stations	1	06/28/12	06/24/13
X	QA Manager Site Inspections	1	12/23/21	10/03/24
X	QA Manager Site Inspections	2	12/02/24	12/03/24

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 kilometers.
- **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** - Usually defines 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 Summary of Probe Siting Criteria

Pollutant	Scale[9]	Height from ground to probe[8] (meters)	Horizontal or vertical distance from supporting structures[8] to probe inlet (meters)	Distance from drip line of trees to probe[8] (meters)	Distance from roadways to probe[8] (meters)
SO_2[2 3 4 5]	Middle, Neighborhood, Urban, and Regional	2.0-15	≥1.0	≥10	N/A.
CO[3 4 6]	Micro [downtown or street canyon sites] Micro [Near-Road sites] Middle and Neighborhood	2.5-3.5 2.0-7.0 2.0-15	 ≥1.0	 ≥10	2.0-10 for downtown areas or street canyon microscale. ≤50 for near-road microscale. *See* Table 10-4 for middle and neighborhood scales.
O_3[2 3 4]	Middle, Neighborhood, Urban, and Regional Micro	2.0-15 2.0-7.0	≥1.0	≥10	*See* Table 10-3. ≤50 for near-road micro-scale.
NO_2[2 3 4]	Middle, Neighborhood, Urban, and Regional	2.0-15	≥1.0	≥10	*See* Table 10-3.
PM[2 3 4 7]	Micro Middle, Neighborhood, Urban and Regional	2.0-7.0 2.0-15	 ≥2.0 (horizontal distance only)	 ≥10	 *See* Figure 10-3.

N/A—Not applicable.

[1] When a probe is located on a rooftop, this separation distance is in reference to walls, parapets, or penthouses located on the roof.

[2] Should be greater than 20 meters from the dripline of tree(s) and must be 10 meters from the dripline.

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

[4] Must have unrestricted airflow in a continuous arc of at least 270 degrees around the probe or sampler; 180 degrees if the probe is on the side of a building or a wall for street canyon monitoring.
[5] The probe or sampler should be away from minor sources, such as furnace or incineration flues. The separation distance is dependent on the height of the minor source emission point(s), the type of fuel or waste burned, and the quality of the fuel (sulfur, ash, or lead content). This criterion is designed to avoid undue influences from minor sources.
[6] For microscale CO monitoring sites, the probe must be ≥10 meters from a street intersection and preferably at a midblock location.
[7] Collocated monitor inlets must be within 4.0 meters of each other and at least 2.0 meters apart for flow rates greater than 200 liters/min or at least 1.0 meter apart for samplers having flow rates less than 200 liters/min to preclude airflow interference, unless a waiver has been granted by the Regional Administrator pursuant to paragraph 3.3.4.2(c) of 40 CFR 58, Appendix A. For $PM_{2.5}$, collocated monitor inlet heights should be within 1.0 meter of each other vertically.
[8] All distances listed are expressed as having 2 significant figures. When rounding is performed to assess compliance with these siting requirements, the distance measurements will be rounded such as to retain at least two significant figures.
[9] See section 1.2 of 40 CFR 58, Appendix D for definitions of monitoring scales.

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 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 operation 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

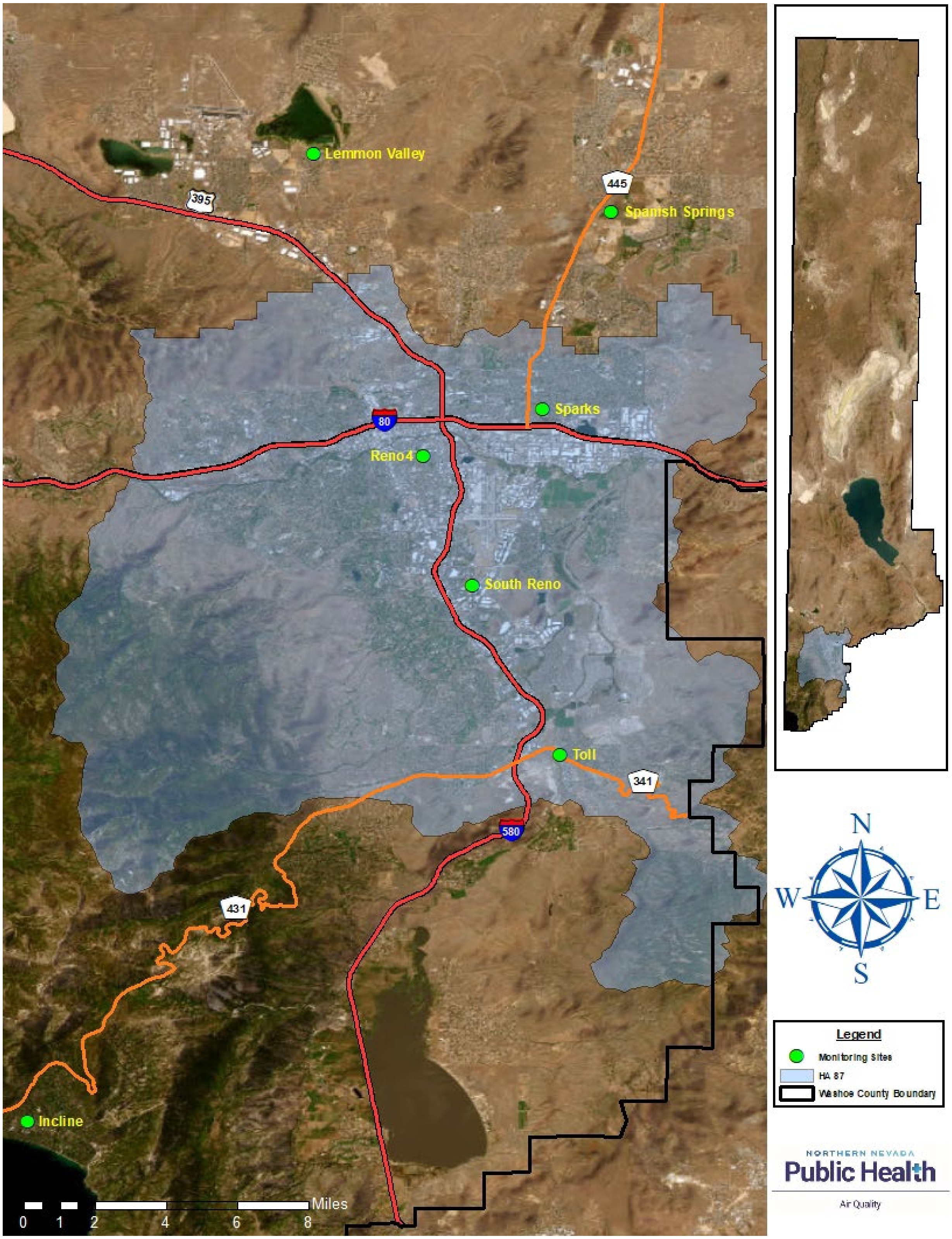
Northern Nevada Public Health's Ambient Air Quality Monitoring Network has seven monitoring stations located throughout Washoe County. The locations of the monitoring stations are identified in Figure 10-1. The AQMD Monitoring Network operates under an approved Annual Network Plan with EPA Region 9. Table 10-6 lists the parameters monitored in 2024 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	NOx	Trace NO	NOy-NO	NOy	Trace SO_2	PM_{10} (manual)	PM_{10} (continuous)	$PM_{2.5}$ (manual)	$PM_{2.5}$ (continuous)	$PM_{10-2.5}$ (manual)	$PM_{10-2.5}$ (continuous)	$PM_{2.5}$ Speciation	Meteorology
SLAMS																		
Incline	✓																	
Lemmon Valley	✓																	
South Reno	✓																	✓
Spanish Springs	✓											✓		✓		✓		✓
Sparks	✓											✓		✓		✓		✓
Toll	✓											✓		✓		✓		✓
NCore																		
Reno4	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
STN																		
Reno4																	✓	
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 $PM_{10-2.5}$ calculation only and is not submitted to AQS for data to be used in comparison to the NAAQS.

Figure 10-1 Northern Nevada Public Health'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 photoconductor. 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, CO_2, N_2O (nitrous oxide) and CH_4 (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 H_2O 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 Measure/Reference (M/R) ratio is only due to CO and not to interfering gases. In this case, Gas Filter Correlation (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 photodetector, 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 downstream 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 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 SO_2 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 SO_2 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 SO_2. 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 they reach the sample chamber.
    - The exact wavelength of light needed to excite a specific non-SO_2 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 Photomultiplier Tube (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 SO_2^* in the sample chamber. The T100 prevents this from occurring by having a very short light path between the area where the SO_2^* fluorescence occurs and the PMT detector. Because the light path is so short, the amount of O_3 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 through 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 SO_2 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 SO_2^* to SO_2 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 SO_2^* 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 (CO_2), water vapor (H_2O) and molecular oxygen (O_2). 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 SO_2 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 SO_2/SO_2^*.

- 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 SO_2) is recorded as the test function OFFSET. This OFFSET value is used during the calculation of the SO_2 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 T200/NOy is a low-level NO/NOy analyzer (0-0.20 ppm range), which operates in virtually the same manner as the Model T200, 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 O_3 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 NO_2*, causing the excited NO_2* 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 H_2O and CO_2 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 CO_2 amounts at low concentrations (less than 0.5%) is negligible.
   - In cases with excessively high CO_2 concentrations (larger than 0.5%), the effect can be calibrated out by using calibration gases with a CO_2 content equal to the measured air.
   - Only very high and highly variable CO_2 concentrations will then cause a measurable interference.
   - Smaller less polar and electronically "harder" molecules such as N_2 and O_2 can cause interference of this type as well, however, the concentrations of N_2 and O_2 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 ensure 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

$A = \varepsilon bc$
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 O_3 is subject to interference from a number of sources including, SO_2, NO_2, NO, H_2O, 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 O_3 scrubber located on the reference path is specifically designed ONLY to remove O_3 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 O_3. 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 O_3 concentration reported by the instrument to become noisy. The average of such noisy readings would still be a relatively accurate representation of the O_3 concentration in the sample gas. Interference from SO_2, NO_2, NO and H_2O 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 O_3. 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 Met One E-SEQ 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 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 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 Carbon-14 (^{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 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 0º C and +50º 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 prefabricated 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, prefabricated enclosures 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 083F sensor is an extremely accurate microprocessor-controlled relative humidity sensor. The relative humidity sensor responds to the full range of 0 to 100% humidity. Response is linear with negligible hysteresis or temperature dependence.

11.1.8.3 Ambient Temperature

Model 063 are precision thermistor temperature sensors. For the most accurate air temperature measurements, the sensors are always mounted in a radiation shield, which minimizes errors caused by solar and terrestrial radiation heating. Sensors produce resistance change inversely proportional to temperature. The 063 sensor is completely sealed in stainless steel housing, filled with silicone oil. The Model 063 has a time constant of 60 seconds.

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 EE of this QAPP.

11.2.2 Digital Data Collection

Digital 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 service and maintain the equipment safely and easily. 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 the 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

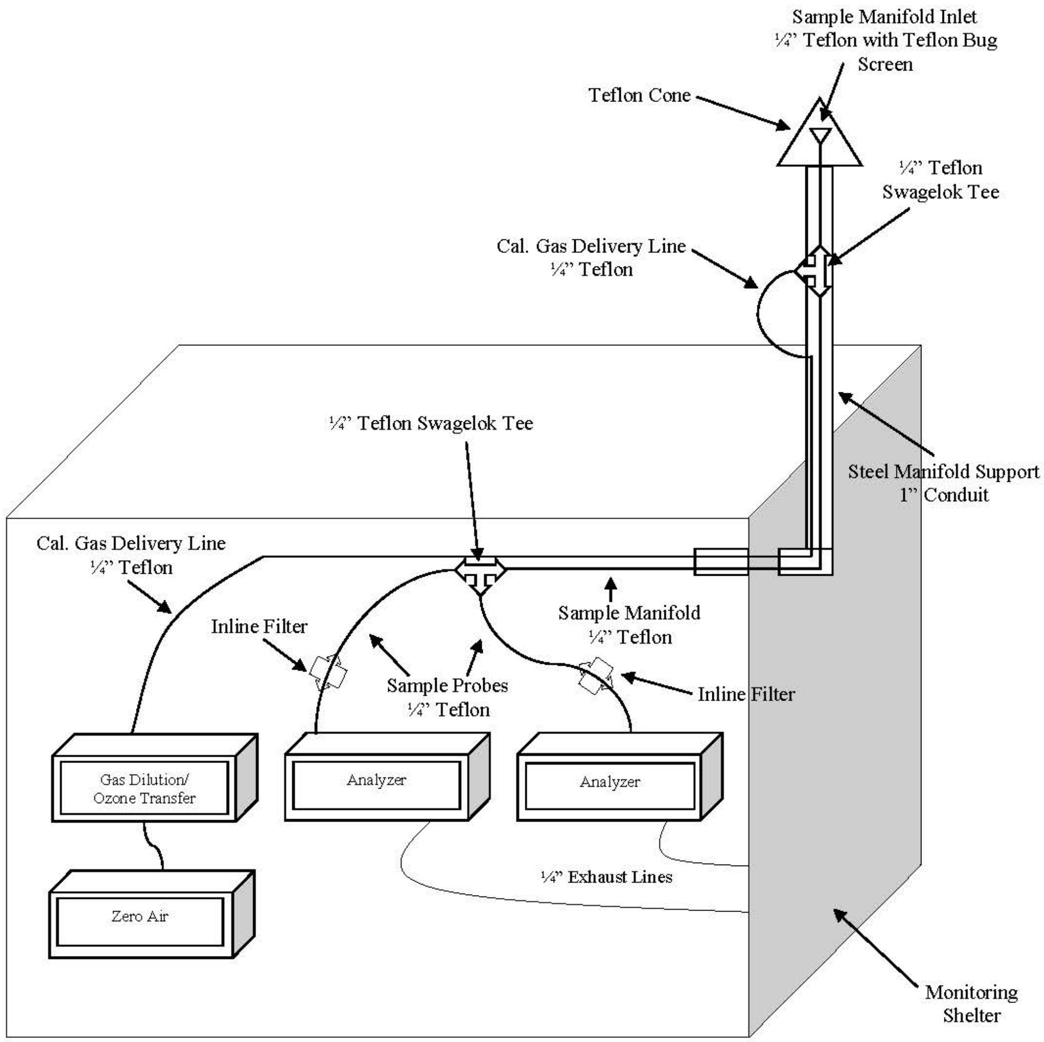
Each of the components of the sampling system must be measured individually. To measure the volume of the components, the following equation will be used:

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

Where:
V = Volume of the component, cm^3
π = 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 Pollutant and NCore Monitors

Pollutant	Model Designation	EPA Reference / Equivalent	SOP
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	Met One E-SEQ-FRM	RFPS-0717-246	Appendix EE
PM_{10} Continuous	Met One BAM 1020	EQPM-0798-122	Appendix D
$PM_{2.5}$ Filter-based	Met One E-SEQ-FRM	RFPS-0717-245	Appendix EE
$PM_{2.5}$ Continuous	Met One BAM 1020	EQPM-0308-170	Appendix D
$PM_{10-2.5}$ Filter-based	Met One E-SEQ-FRM Coarse Pair	RFPS-0717-247	Appendix EE
$PM_{10-2.5}$ 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 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 document storage at the laboratory and any pertinent details such as storage location and conditions. See Figure 12-2 for an example of AQMD's Chain of Custody/Field Sample Report.

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 on a first-in, first-out basis. The filters are inspected by the Lab Manager and placed in a pre-filter conditioning tray following the procedures in Appendix M, Section M.2.1.1. After the initial equilibration, pre-sample filters are pre-weighed by the Lab Manager following the procedures in Appendix M, Section M.2.1.2. As a QC check, the filters are the re-weighed following the procedures in Appendix M, Section M.3. 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-weigh date.

12.1.2 Handling/Transporting Samples to the Field

The Lab Manager prepares filters for a sample run and transports them to the monitoring station following the procedures in Appendix EE, Section EE.4. The sample filters are loaded into the filter cassette magazines and installed into the sampler following procedures in Appendix EE, Section EE.5. All filter identification, pre-conditioning, sample date, and sample installation information is logged on the Chain of Custody/Field Sample Report (Figure 12-2).

12.1.3 Handling/Transporting Samples from the Field

An Air Quality Specialist collects the filters from the samplers within 48 hours after the scheduled run following the procedures in Appendix EE, Section EE.6. A digital download of the run data is also downloaded to a USB drive following the procedures in Appendix EE, Section EE.8. The filter cassettes are placed back in the filter transport case and are transported back to the AQMD office in a temperature-monitored cooler following the procedures in Appendix EE, Section EE.9. Then the filters are either stored in the repair room refrigerator following procedures in Appendix M, Section M.2.2.1, or prepared for post-sample conditioning. Post-sample filters must be weighed within 30 days of refrigerated storage. All sample removal, transport temperature, sample refrigeration, and post-conditioning information is logged on the Chain of Custody/Field Sample Report (Figure 12-2).

12.1.4 Post-Sample Handling and Custody Procedures

Post-sample filters are removed from refrigerated storage, equilibrated in the laboratory, weighed, and concentrations calculated following the procedures in Appendix M, Section M.2.2.2. As a QC check, the filters are then re-weighed following the procedures in Appendix M, Section M.3. After weighing, post-samples are then placed in storage for five years. The hardcopy Chain of Custody/Field Sample Reports are retained by the Data Manager for five years. See Appendix EE for more detailed procedures on $PM_{2.5}$ and PM_{10} sampling.

Figure 12-1 EPA Teflon Filter Memorandum

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

January 30, 2024

MEMORANDUM

SUBJECT: PTFE Filters for Use in Calendar Year (CY) 2024

FROM: Gregory W. Noah
Ambient Air Monitoring Group (C304-06)

RECEIVED
02/07/24

TO: Calendar Year 2024 PTFE Filter Users

This memorandum summarizes characteristics of the polytetrafluorethylene (PTFE) filters which will be used for CY 2024. CY 2024 PTFE filters are supplied by Measurements Technology Laboratory (MTL).

EPA retained a surplus of PTFE filters that were procured for CY 2023. Accordingly, some shipments may contain only filters procured for CY 2023, only filters procured for CY 2024, or a combination of filters procured for both CY 2023 and CY 2024.

The attached tables summarize acceptance testing results for the CY 2023 and CY 2024 PTFE filters.

Please report any problems or other comments concerning the use or quality of the filters to Greg Noah at noah.greg@epa.gov. 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 the EPA.

Attachments:
Table 1. Summary of PTFE Filter Acceptance Testing Results for Filters for Use in Calendar Years (CY) 2023 and 2024
Table 2. Summary of PTFE Filter Acceptance Testing Results for Filters for Use in Calendar Year (CY) 2024
Table 3. Trace Element Acceptance Criteria for PTFE Filters for Use in CY 2023 and CY 2024

cc: Regional Office Air Monitoring Coordinators
Regional Office Quality Assurance Coordinators
Gregory Noah (EPA)
David Elam (TRC)

Number of boxes of PTFE filters ordered for CY 2024	Number of boxes of PTFE filters shipped for CY 2024	Number of Cartons in Shipment
8	8	1

Figure 12-2 Chain of Custody/Field Sample Report

Air Quality Management Division
Chain of Custody / Field Sample Report

Site: *Reno 4*
Sampler: *MET ONE SEQUENTIAL*
Model: *E-SEQ-FRM*

Filter Number:

S/N:	*B13407*	*B13408*	*FB*
ID:	*$PM_{2.5}$*	*PM_{10}*	

Sample Date: ______ Su M T W Th F Sa

Lab Blank:

Weigh by:

Transport:

STAFF	DATE	TIME

Field Fridge Temp: ______ °C
Max Transport Temp: ______ °C

Pre Weighed on:

Post Weighed on:

Chain of Custody

Action	Date	Time (PST)	SEQ RUN	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:

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 5
Reviewed: 11/07/2024

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 is 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.

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 parameter 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 RTI-Research Triangle International, the EPA-contracted laboratory. RTI also provides shipping and sampling schedules. 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 line 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 to be placed in the freezer until the scheduled shipping day. On the shipping day, the samples are removed from the freezer, 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 RTI via UPS. The yellow copies are retained for five years. See Appendices BB and CC for detailed procedures on SuperSASS and URG sampling, respectively.

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 Met One E-SEQ-FRM $PM_{2.5}$ and PM_{10} Particulate Matter Samplers SOP (Appendix EE) 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 47 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 top Petri cover will be left open and the Petri slides placed in a vented and covered tray to allow filter adequate time for off-gassing. 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 Met One E-SEQ-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. A lab blank (initially weighed during Pre-Weigh session batch and the same filter again) used for the Post Weigh session batch and one field blank will be weighed for every 10 samples for the $PM_{2.5}$ filters. The balance will be checked for a zero value between weighing filters. If the balance does not read zero, the balance must be re-zeroed and after every tenth filter weighed 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-weighed 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 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 Met One E-SEQ-FRM SOP located in Appendix EE. 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 choose 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
NO_2	Any range between 0-50 and 0-1000 ppb	0-500 ppb
O_3	Any range between 0-100 and 0-1000 ppb	0-200 ppb
SO_2	Any range between 0-50 and 0-100 ppb	0-100 ppb

14.1.2 Gaseous Analyzer Span/Zero Checks

Nightly O_3 span/zero checks are performed at all monitoring stations and nightly CO and SO_2 checks are performed at the NCore monitoring 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 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.

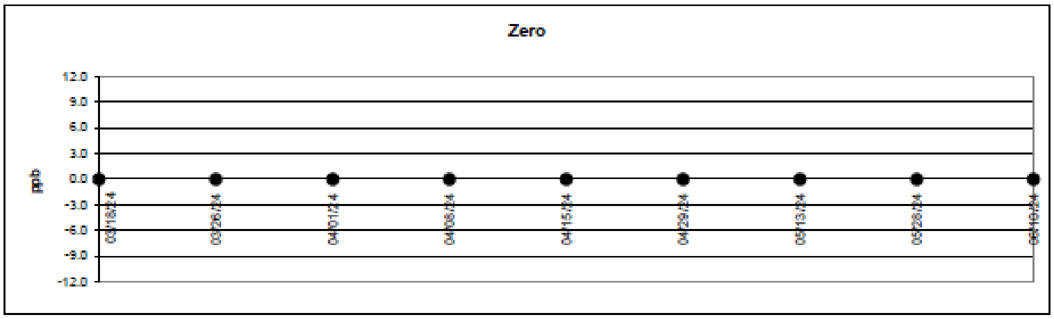
14.1.6 Control Charts

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.

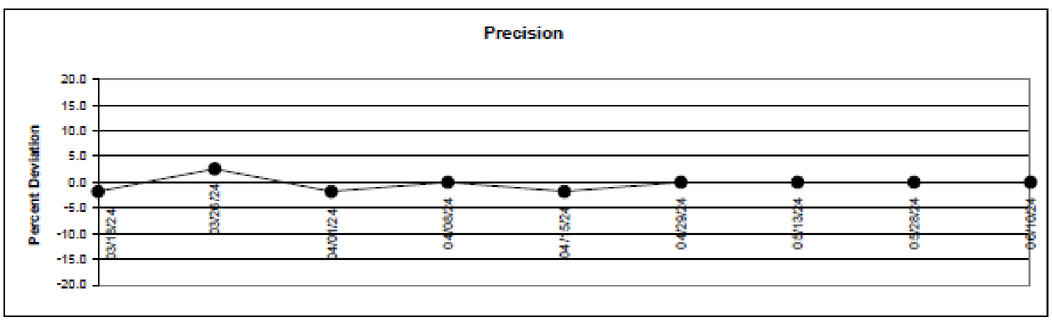
Figure 14-1 Ozone Control Chart

Ozone Control Chart

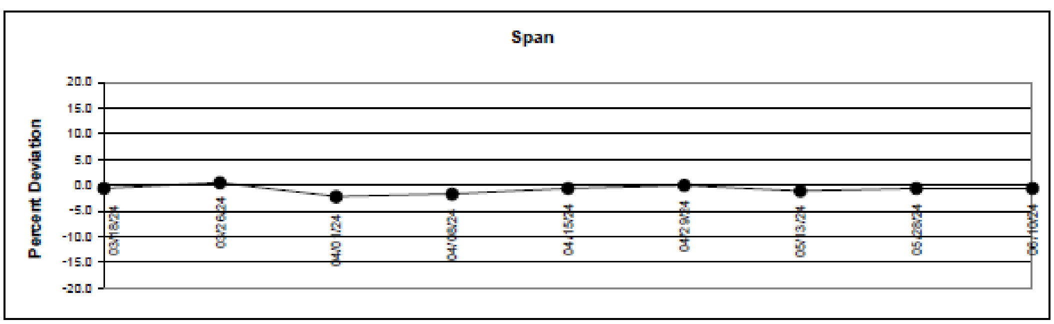
Site:	Spanish Springs	**Instrument:**	TAPI
Year:	2024	**Model:**	T400
Quarter:	2nd	**Serial #:**	2789



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: 6/13/2024- Quarterly Audit- PASS

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 3.2.3 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 3.3.4 requires 15 percent (at least 1) of the manual method PM_{10} samplers be collocated. Being that AQMD only runs one manual method PM_{10} sampler for the calculation of $PM_{10-2.5}$ at the NCore station, and all the primary PM_{10} monitors are continuous methods, there is no collocation requirement.

14.1.9 Field Blanks

AQMD installs one filter, 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

AQMD does not currently run audit points down to two to three times the method detection limit but is 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 AQMD's 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
≤99th 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 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

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_fillable
Last Revision: 08/23/24

14.3 Laboratory QC Checks

14.3.1 Balance Checks

Balance checks are frequent checks of the balance working standards (300 and 500 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 selects a new lab blank from each new lot of filters received. Every pre-weigh batch will have a designated lab blank to be used for the post-weigh session. 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 logbooks, 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 storage facility. AQMD tests all spare instruments prior to deploying in the field and documents the tests in the instrument logbook.

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)
SLAMS O3 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)
FRM PM2.5 (1/3 days)
FRM 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 z/p/s
NCore NOx and NOy multipoint w/ GPT
Weigh pre & post FRM filters
Calculate FRM filter concentrations
QA/QC worksheet review/record creation

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

Monthly
Particulate filters (replace all)
Cal Cylinder pressure checks
FRM PM2.5 verifications
FRM PM10 verifications
Speciation SuperSASS 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
FRM PM10 inlet maintenance (lower)
FRM PM2.5 VSCC maintenance
FRM downtube maintenance
QC raw data
Inspect/condition FRM filters
Sweep shelters
Take out shelter trash (as needed)

Bi-Monthly
Replace BAM filter tape

Quarterly
BAM PM10 inlet maintenance (upper and lower)
FRM PM10 inlet maintenance (upper and lower)
Audits (all)
Speciation SuperSASS cyclone maintenance
Speciation URG down tube maintenance
Speciation URG audit filter rotation
Speciation URG pump box cleaning
Lab working mass standard verifications (Qtrly.)
QA Manager Site Inspections

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

Annually
Gas analyzer multipoint check/calibration
Primary O3 standard recertification (CARB)
Audit calibrator photometer/MFC recertification (CARB)
Calibrator MFC recertifications
Zero air generator scrubber replacement
Zero air generator solenoid valve maintenance
WSP/WDR sensor recertifications
Replace sample manifolds
Standard Traceability (flow, temp, RH)
Monitoring Network Annual Plan
Asset Management Framework
Data Certification
SOP Review
Replace NOx/NOy pump exhaust scrubbers
Replace NOx/NOy ozone dryer DFU
Replace NOx/NOy ozone cleaner chemical
Clean NOx/NOy reaction cell/optical glass
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 internal debris filter/12V battery replacement
BAM pump maintenance
Speciation SuperSASS pump maintenance
Speciation URG cyclone o-ring replacement
Speciation URG audit cassette o-ring and filter media replacement

Other
2-year Speciation URG pump rebuild
2-year Speciation URG pump inline filter replacement
2-year Speciation URG motor timing belt replacement
3-year EPA TSA
5-year Monitoring Network Assessment
5-year QAPP review/revision
5-year QMP review/revision
Cal Cylinder recertification/refilling

Last Reviewed: 11/22/24

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 logbook.

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 logbook.

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, O_3, 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 or at one of the air monitoring sites. 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 is 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 vendor which follows 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 is 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 types 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 Metropolitan Planning Organization (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 demonstration purposes. Other statistical data needed to determine if an event is exceptional like the median, diurnal patterns, seasonal averages, maximums, and minimums are calculated by 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 may use this data for exceptional event demonstrations and research.

18.3 Minimum Monitoring and Siting Data

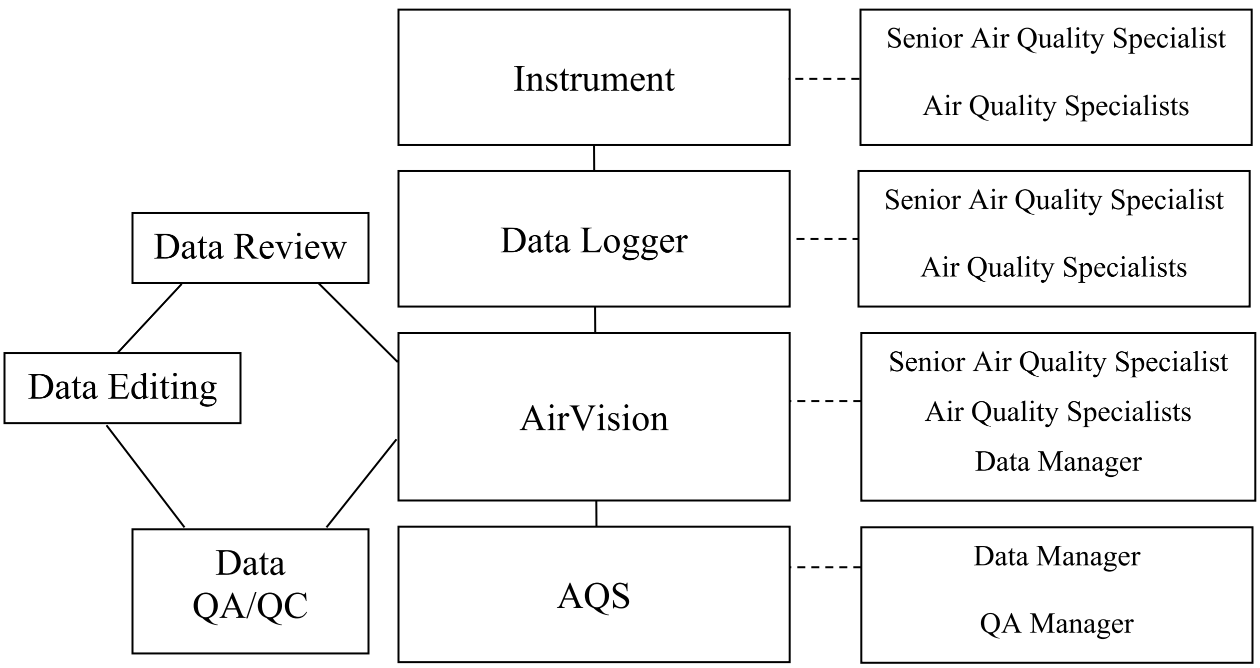
Detailed in the Annual Network Plan (ANP) are the minimum monitoring requirements for all criteria pollutants pursuant to 40 CFR 58, Appendices A, B, C, D, and E where applicable. The Nevada State Demographer's Office population data for the Reno-Sparks Metropolitan Statistical Area (MSA) and the Reno, 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 19-2

Figure 19-1 Data Flow and Responsibilities



19.2 Data Collection, Recording, and Storage

All monitoring data collected in the AQMD network is recorded digitally 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 requires 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 EE. 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 retain sub-hourly data for at least 30 days.

Data is stored on a dedicated server within Washoe County Information Technology Department. Data files generated for submittal are 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 at least 30 days. . All data including manual data forms are stored, deleted, or disposed of 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 undergo 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 digitally 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 QA/QC activities and their corresponding stability 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 is 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.

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 digitally 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 digitally 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

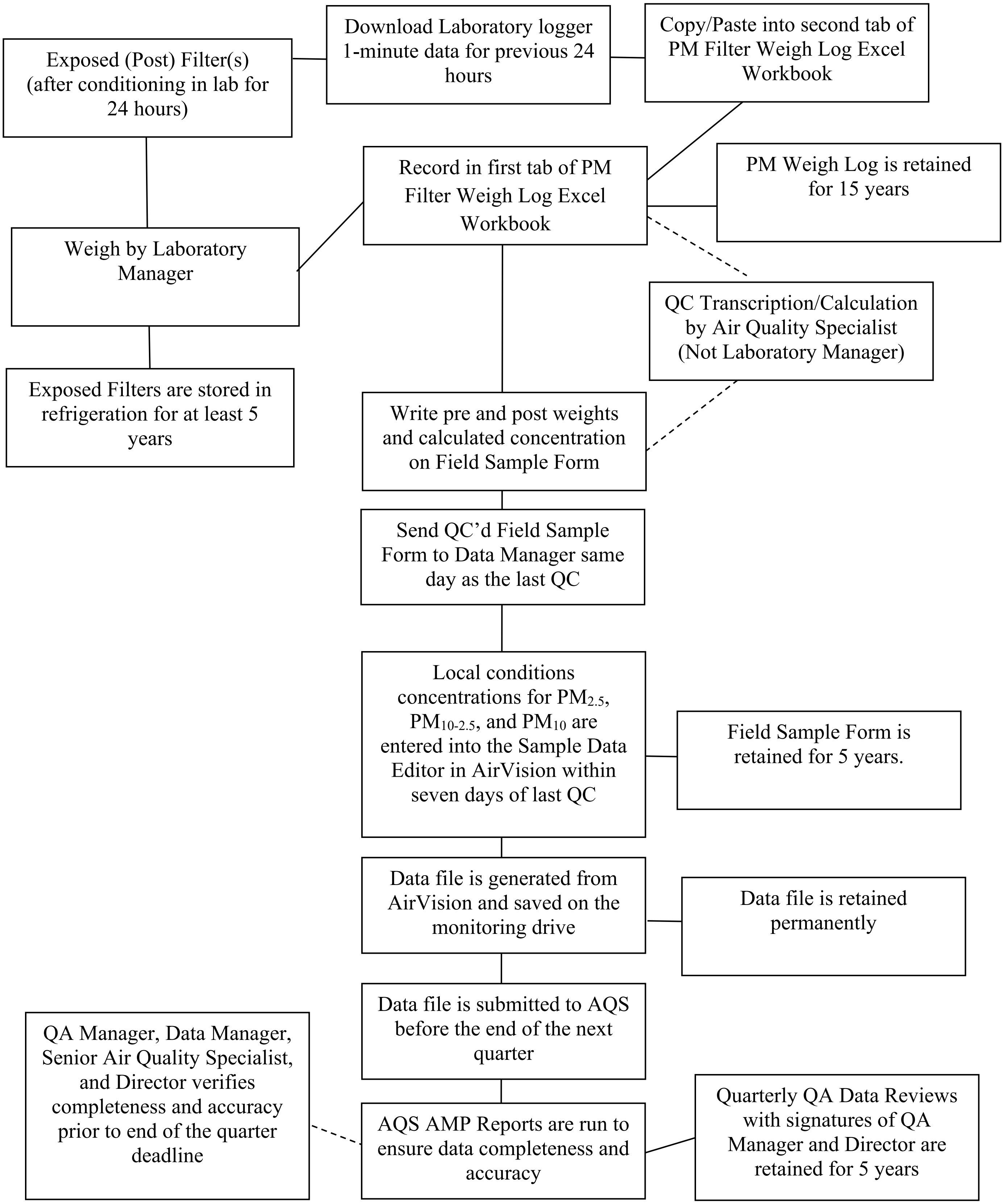
The primary support facility for the $PM_{2.5}$ and PM_{10} network is the filter conditioning and weighing room located in the office of the AQMD. This laboratory is used to conduct pre-exposure weighing and post-exposure weighing of each $PM_{2.5}$ and PM_{10} filter. The laboratory is an environmentally 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 instruments 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 digitally 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 digitally 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 is to be written next to the corrected entry.

Digital field form cells are “locked” in the calculation cells to avoid altering the equations. After completion of the field form, the form is reviewed and 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 digitally, 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 digital data are stored on the agency LAN, that is backed up daily by the Washoe County IT department. All hardcopy data are stored with the Data Manager, in accordance with Section 9.2 Data Reporting Format and Document Control of this QAPP.

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 requirements as set forth in 40 CFR 58.10, beginning July 1, 2007, the AQMD adopted and submitted an Annual Network Plan (ANP) to EPA Region 9. The ANP provides the establishment and maintenance of AQMD's air quality surveillance system that consists of a network of SLAMS, NCore, STN, 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 40 CFR, 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, has made no changes after 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 AQS parameter, parameter occurrence, and method codes.
5. The monitoring objective(s).
6. The operating schedules for each monitor.
7. Siting criteria evaluations as described in 40 CFR Part 58 Appendix E.
8. Any proposals to remove or move a monitoring station within a period of 18 months following plan submittal.
9. The monitoring objective and spatial scale of representativeness for each monitor as defined in Appendix D to 40 CFR Part 58.

10. 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.
11. The MSA, CBSA, CSA or other area represented by the monitor.
12. The designation of any Pb monitors as either source-oriented or non-source-oriented according to Section 4.5 of Appendix D to 40 CFR Part 58.
13. 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.
14. 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
15. The identification of required NO_2 monitors as either near-road or area-wide sites in accordance with Section 4.3 of Appendix D to 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 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

In accordance with 40 CFR Part 58, Appendix A, Section 2.5, technical systems audits (TSAs) of each PQAO shall be conducted at least every 3 years by the appropriate EPA Regional Office and reported to the AQS. A technical systems audit is an onsite 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. The TSA should address and report on the following key areas:

- Planning – network design, monitoring strategy, representativeness, meeting monitoring requirements, funding needs, and resources (staffing, equipment).
- Field Operations – use of approved analyzers and samplers for monitoring objective (FRM, FEM), use of analyzers and samplers according to FRM/FEM requirements, following documented sampling procedures, proper siting of monitoring stations, samplers, and probes, maintenance capacity, cross-training, site housekeeping, age of equipment, and site safety concerns.
- Laboratory Operations – use of appropriate analytical equipment, following documented analytical procedures, cross-training, maintenance capabilities, housekeeping, age of equipment, and sample storage.
- Quality Assurance/Quality Control (QA/QC) – approved and updated QMP and QAPP, consistent with EPA's Quality System, independence, proper collocated sampling, QC checks (zero/precision/span checks, calibrations, etc.) conducted properly, QC checks conducted at the correct frequency, documented QA data reviews, separate instruments and standards for QA, review of electronic traces, and audits.
- Data Management – data acquisition system, data backup, data flow SOP or flowchart, organization, minute data, and archival (paper and electronic).
- Reporting – data in AQS, timely reporting, correct flagging, correct null coding, metadata, certification, and AirNow.

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 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. 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 60 days of acceptance of the audit report.

20.4 Performance Audits

20.4.1 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. At the end of the quarter, after completion of the audits, the QA Manager reviews the audits, then completes and signs the Monitoring Quarterly Audits form (Figure 20-1). When an operator conducts an 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, signed by the requestor, and 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 stored digitally 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 4	TAPI	T300U	704			—	+/- 15%		
Ozone	Incline	TAPI	400E	2133			—	+/- 15%		
	Lemmon Valley	TAPI	T400	1399			—	+/- 15%		
	Reno 4	TAPI	T400	6575			—	+/- 15%		
	South Reno	TAPI	T400	1398			—	+/- 15%		
	Spanish Springs	TAPI	T400	2789			—	+/- 15%		
	Sparks	TAPI	T400	1400			—	+/- 15%		
	Toll	TAPI	T400	7411			—	+/- 15%		
SO_2	Reno 4	TAPI	T100U	514			—	+/- 15%		
NO_2	Reno 4	TAPI	T200U	493			—	+/- 15%		
NO	Reno 4	TAPI	T200U	493			—	+/- 15%		
NOx	Reno 4	TAPI	T200U	493			—	+/- 15%		
NOT	Reno 4	TAPI	T200U	404			—	+/- 15%		
NOy	Reno 4	TAPI	T200U	404			—	+/- 15%		
NO_{2y}	Reno 4	TAPI	T200U	404			—	+/- 15%		
Zero Air	Incline O_3	TAPI	T701	2137		---		< 10 ppb		
	Lemmon Valley O_3	TAPI	T701	2499		---		< 10 ppb		
	Reno 4 CO	TAPI	T701H	1199		---		< 0.1 ppm		
	Reno 4 O_3	TAPI	T701H	1199		---		< 10 ppb		
	Reno 4 SO_2	TAPI	T701H	1199		---		< 1 ppb		
	Reno 4 NO_2	TAPI	T701H	1199		---		< 10 ppb		
	Reno 4 NO_y-NO	TAPI	T701H	1199		---		< 10 ppb		
	South Reno O_3	TAPI	T701	1949		---		< 10 ppb		
	Spanish Springs O_3	TAPI	T701	1948		---		< 10 ppb		
	Sparks O_3	TAPI	701	2498		---		< 10 ppb		
	Toll O_3	TAPI	701	2497		---		< 10 ppb		
Shelt. Temp.	Incline	T Sentry	140-100HVB	91011331		---		+/- 2°C		
	Lemmon Valley	T Sentry	140-100HVB	91011333		---		+/- 2°C		
	Reno 4	T Sentry	140-100HVB	91011335		---		+/- 2°C		
	South Reno	T Sentry	140-100HVB	91011328		---		+/- 2°C		
	Spanish Springs	T Sentry	140-100HVB	91011329		---		+/- 2°C		
	Sparks	T Sentry	140-100HVB	91011332		---		+/- 2°C		
	Toll	T Sentry	140-100HVB	120315641		---		+/- 2°C		
PM_{10}	Reno 4	Met One	E-SEQ	B13408			—	+/- 4%		
	Reno 4	Met One	BAM 1020	C16695			—	+/- 4%		
	Spanish Springs	Met One	BAM 1020	N10986			—	+/- 4%		
	Sparks	Met One	BAM 1020	C16691			—	+/- 4%		
	Toll	Met One	BAM 1020	M7516			—	+/- 4%		
$PM_{2.5}$ (act. flow)	Reno 4	Met One	E-SEQ	B13407			—	+/- 4%		
	Reno 4	Met One	BAM 1020	C16694			—	+/- 4%		
	Spanish Springs	Met One	BAM 1020	N10985			—	+/- 4%		
	Sparks	Met One	BAM 1020	C16684			—	+/- 4%		
	Toll	Met One	BAM 1020	H8579			—	+/- 4%		
Speciation	Reno 4	Met One	SuperSASS	D14378			—	+/- 10%		
	Reno 4	URG	3000N	3N-B1573			—	+/- 10%		
Amb. Temp.	Lab	Dickson	RTRH	1915706		---		+/- 2°C		
	Reno 4	Met One	063-1	W14373		---		+/- 0.5°C		
	South Reno	Met One	063-1	W14372		---		+/- 1.0°C		
	Spanish Springs	Met One	063-1	W14375		---		+/- 1.0°C		
	Sparks	Met One	063-1	W14376		---		+/- 1.0°C		
	Toll	Met One	063-1	W14374		---		+/- 1.0°C		
RH	Balance Room	Dickson	RTRH	1915706		---		+/- 2%		
	Reno 4	Met One	083E	P18243		---		+/- 7%		
WSP/WDR	Reno 4	Met One	50.5H	N11876		---		Ops check		
	South Reno	Met One	50.5H	N11877		---		Ops check		
	Spanish Springs	Met One	50.5H	N12432		---		Ops check		
	Sparks	Met One	50.5H	D5669		---		Ops check		
	Toll	Met One	50.5H	N12434		---		Ops check		
Mass	Lab	Working	500 mg	9QN3		---		+/- 2.0µg		
	Lab	Working	300 mg	9QN5		---		+/- 2.0µg		

= failed audit   = audit not completed

QA Manager Signature: ______________________ Date: ______________

20.4.2 External Audits

EPA conducts AQMD's 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. Each calendar year, at least 20% of the eligible monitoring sites within each PQAO are selected for audit such that 100% of the monitoring sites within the PQAO (and therefore within the Region) are audited within the six-year period. Following the 20% requirement, all sites could be covered in a five-year period, but the six-year period allows for sites with special interest to be audited as needed during the six-year period

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 $\mu g/m^3$. 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 Air Monitoring Data Certification

At least one month prior to the May 1st deadline as described in 40 CFR 58.15, 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 which the AQMD Director 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
Quarterly QA Data Review	Data Manager	Supervisor Senior AQS QA Manager Division Director	Quarterly	Division Director QA Manager
Internal Performance Audits	QA Manager	Senior AQS	Quarterly	Senior AQS
Corrective Action Request	Senior AQS	QA Manager	As Needed	Division Director Supervisor QA Manager
Technical Systems Audits	EPA	Supervisor Senior AQS	Triennially	Supervisor

		AQS Data Manager QA Manager		

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 21-2. 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 for keeping 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
AMP504	Extract QA Data	Data Manager	Quarterly	Division Director 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	Division Director 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	Division Director QA Manager
AMP256	QA Data Quality Indicator Report	Data Manager	Quarterly	Division Director QA Manager
AMP 251	Raw Assessment Report	Data Manager	Quarterly	Division Director 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 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 the 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. All Corrective Action Request forms are stored digitally on the agencies LAN.

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 Monitors used in Evaluations of National Ambient Air Quality Standards.
- 40 CFR Part 58, Appendix D - Network Design Criteria for Ambient Air Quality Monitoring
- 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 digital 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 AQS 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	Qualifier Code	Qualifier Description
REQEXC	RA	African Dust.
REQEXC	RB	Asian Dust.
REQEXC	RC	Chemical Spills & Industrial Accidents.
REQEXC	RD	Cleanup After a Major Disaster.
REQEXC	RE	Demolition.
REQEXC	RF	Fire - Canadian.
REQEXC	RG	Fire - Mexico/Central America.
REQEXC	RH	Fireworks.
REQEXC	RI	High Pollen Count.
REQEXC	RJ	High Winds.
REQEXC	RK	Infrequent Large Gatherings.
REQEXC	RL	Other.
REQEXC	RM	Prescribed Fire.
REQEXC	RN	Seismic Activity.
REQEXC	RO	Stratospheric Ozone Intrusion.
REQEXC	RP	Structural Fire.
REQEXC	RQ	Terrorist Act.
REQEXC	RR	Unique Traffic Disruption.
REQEXC	RS	Volcanic Eruptions.
REQEXC	RT	Wildfire-U. S.
QA	1	Deviation from a CFR/Critical Criteria Requirement.
QA	1V	Data reviewed and validated.
QA	2	Operational Deviation.
QA	3	Field Issue.
QA	4	Lab Issue.
QA	5	Outlier.
QA	6	QAPP Issue.
QA	7	Below Lowest Calibration Level.
QA	9	Negative value detected - zero reported.
QA	CB	Values have been Blank Corrected.
QA	CC	Clean Canister Residue.
QA	CF	Canister Bias: NATTS/UATMP Data for compounds that have failed certification for the canister.
QA	CL	Surrogate Recoveries Outside Control Limits.
QA	DI	Sample was diluted for analysis.
QA	DN	DNPH peak less than NATTS TAD requirement, reported value should be considered an estimate.
QA	EH	Estimated; Exceeds Upper Range.

Type	Qualifier Code	Qualifier Description
QA	FB	Field Blank Value Above Acceptable Limit.
QA	FX	Filter Integrity Issue.
QA	HT	Sample pick-up hold time exceeded.
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	MS	Value reported is 1/2 MDL substituted.
QA	MX	Matrix Effect.
QA	ND	No Value Detected, Zero Reported.
QA	NS	Influenced by nearby source.
QA	QP	Pressure Sensor Questionable.
QA	QT	Temperature Sensor Questionable.
QA	QX	Does not meet QC criteria.
QA	SB	Sampler Bias: NATTS/UATMP Data for compounds that have failed certification for the sampler.
QA	SP	NATTS/UATMP data with Spike Recovery outside acceptance limits.
QA	SQ	Values Between SQL and MDL.
QA	SS	Value substituted from secondary monitor.
QA	SX	Does Not Meet Siting Criteria.
QA	TB	Trip Blank Value Above Acceptable Limit.
QA	TT	Transport Temperature is Out of Specs.
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 or Average out of Spec.
QA	XC	Canister certification expired
QA	Y	Elapsed Sample Time out of Spec.
NULL	AA	Sample Pressure out of Limits.
NULL	AB	Technician Unavailable.
NULL	AC	Construction/Repairs in Area.
NULL	AD	Shelter Storm Damage.
NULL	AE	Shelter Temperature Outside Limits.
NULL	AF	Scheduled but not Collected.
NULL	AG	Sample Time out of Limits.
NULL	AH	Sample Flow Rate or CV out of Limits.
NULL	AI	Insufficient Data (cannot calculate).

Type	Qualifier Code	Qualifier Description
NULL	AJ	Filter Damage.
NULL	AK	Filter Leak.
NULL	AL	Voided by Operator.
NULL	AM	Miscellaneous Void.
NULL	AN	Machine Malfunction.
NULL	AO	Bad Weather.
NULL	AP	Vandalism.
NULL	AQ	Collection Error.
NULL	AR	Lab Error.
NULL	AS	Poor Quality Assurance Results.
NULL	AT	Calibration.
NULL	AU	Monitoring Waived.
NULL	AV	Power Failure.
NULL	AW	Wildlife Damage.
NULL	AX	Precision Check.
NULL	AY	Q C Control Points (zero/span).
NULL	AZ	Q C Audit.
NULL	BA	Maintenance/Routine Repairs.
NULL	BB	Unable to Reach Site.
NULL	BC	Multi-point Calibration.
NULL	BD	Auto Calibration.
NULL	BE	Building/Site Repair.
NULL	BF	Precision/Zero/Span.
NULL	BG	Missing ozone data not likely to exceed level of standard.
NULL	BH	Interference/co-elution/misidentification.
NULL	BI	Lost or damaged in transit.
NULL	BJ	Operator Error.
NULL	BK	Site computer/data logger down.
NULL	BL	QA Audit.
NULL	BM	Accuracy check.
NULL	BN	Sample Value Exceeds Media Limit.
NULL	BR	Sample Value Below Acceptable Range.
NULL	CS	Laboratory Calibration Standard.
NULL	DA	Aberrant Data (Corrupt Files, Aberrant Chromatography, Spikes, Shifts).
NULL	DL	Detection Limit Analyses.
NULL	EC	Exceeds Critical Criteria.
NULL	FI	Filter Inspection Flag.
NULL	MB	Method Blank (Analytical).
NULL	MC	Module End Cap Missing.

Type	Qualifier Code	Qualifier Description
NULL	QV	Quality Control Multi-point Verification.
NULL	SA	Storm Approaching.
NULL	SC	Sampler Contamination.
NULL	ST	Calibration Verification Standard.
NULL	SV	Sample Volume out of limits.
NULL	TC	Component Check & Retention Time Standard.
NULL	TS	Holding Time Or Transport Temperature Is Out Of Specs.
NULL	XX	Experimental Data.
NULL QC	1C	A 1-Point QC check exceeds acceptance criteria but there is compelling evidence that the analyzer data is valid.
NULL QC	1F	No 1 Point QC but need to count for completeness
INFORM	IA	African Dust.
INFORM	IB	Asian Dust.
INFORM	IC	Chem. Spills & Indust Accidents.
INFORM	ID	Cleanup After a Major Disaster.
INFORM	IE	Demolition.
INFORM	IF	Fire - Canadian.
INFORM	IG	Fire - Mexico/Central America.
INFORM	IH	Fireworks.
INFORM	II	High Pollen Count.
INFORM	IJ	High Winds.
INFORM	IK	Infrequent Large Gatherings.
INFORM	IL	Other.
INFORM	IM	Prescribed Fire.
INFORM	IN	Seismic Activity.
INFORM	IO	Stratospheric Ozone Intrusion.
INFORM	IP	Structural Fire.
INFORM	IQ	Terrorist Act.
INFORM	IR	Unique Traffic Disruption.
INFORM	IS	Volcanic Eruptions.
INFORM	IT	Wildfire-U. S.
INFORM	J	Construction.
REQEXC	E	Forest Fire.
REQEXC	RU	Wildland Fire Use Fire-U. S.
QA	8*	QA/QC Unknown.
QA	PQ*	Values Between PQL And MDL.
QA	T*	Multiple PM2.5 Validity Flags.
INFORM	A*	High Winds.
INFORM	B*	Stratospheric Ozone Intrusion.
INFORM	C*	Volcanic Eruption.

Type	Qualifier Code	Qualifier Description
INFORM	D*	Sandblasting.
INFORM	F*	Structural Fire.
INFORM	G*	High Pollen Count.
INFORM	H*	Chem. Spills & Indust. Accidents.
INFORM	I*	Unusual Traffic Congestion.
INFORM	IU*	Wildland Fire Use Fire-U. S.
INFORM	K*	Agricultural Tilling.
INFORM	L*	Highway Construction.
INFORM	M*	Rerouting of Traffic.
INFORM	N*	Sanding/Salting of Streets.
INFORM	O*	Infrequent Large Gatherings.
INFORM	P*	Roofing Operations.
INFORM	Q*	Prescribed Burning.
INFORM	R*	Cleanup After a Major Disaster.
INFORM	S*	Seismic Activity.
INFORM	U*	Sahara Dust.
INFORM	Z*	Other event.

* Indicates the flag is no longer active

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 digital 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 digital evaluation of criteria pollutant concentrations shall be validated and verified utilizing both manual and digital methods. Specific criteria listed on Table 22-2 are used to 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	087	T	Parts per million
Carbon monoxide (COT)	-0.4	50.0	42101	593	R	Parts per million
Sulfur dioxide (SO_2T)	-4.0	1500.0	42401	600	T	Parts per billion
Oxides of nitrogen (NOx)	-5.0	1200.0	42603	099	T	Parts per billion
Nitric oxide (NO)	-5.0	1200.0	42601	099	T	Parts per billion
Nitrogen dioxide (NO_2)	-5.0	400.0	42602	099	T	Parts per billion
NOy – NOtrace (NO_2y)	-5.0	200.0	42612	699	T	Parts per billion
Reactive oxides of nitrogen (NOy)	-5.0	520.0	42600	699	T	Parts per billion
Nitric oxide (NOT)	-5.0	1000.0	42601	699	T	Parts per billion
PM_{10} – LC (PM10LC)	0	5000	85101	246	T	Micrograms/cubic meter (LC)
$PM_{2.5}$- Local Conditions ($PM_{2.5}$)	0	5000	88101	545	T	Micrograms/cubic meter (LC)
$PM_{10\text{-}2.5}$ - Local Conditions (PMC)	-3	5000	86101	247	T	Micrograms/cubic meter (LC)
PM_{10} Total 0-10 µm 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)
$PM_{10\text{-}2.5}$ - 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	040	R	Degrees Centigrade
Relative Humidity (RELHUM)	0	100	62201	071	R	Percent relative humidity
Wind Direction – Resultant (RWDR)	0	360	61104	071	R	Degrees Compass
Wind Direction – Scalar (WDR)	0	360	61102	071	R	Degrees Compass
Wind Speed – Resultant (RWSP)	0	60	61103	071	R	m/s
Wind Speed – Scalar (WSP)	0	60	61101	071	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 are 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 Data Verification and Data 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 fails 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 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 check (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 check 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 by indicating the name of the event in AQS and in AirVision.

Table 23-1 AirVision 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 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 are 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 9.0 µg/m^3).
- Developing limits on decision errors.

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 with 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 is 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 higher. The AMP504, AMP430, and AMP256 reports 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 Manager 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.

NORTHERN NEVADA

Public Health

Air Quality

Please contact Francisco Vega for
questions and comments at,
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Appendix BB: Met One Super Speciation Air Sampling System (SASS) - Chemical Speciation $PM_{2.5}$

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Jordan Volk

Title of Author: Air Quality Specialist

Signature: Jordan Volk Digitally signed by Jordan Volk Date: 2024.11.27 11:55:33 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.26 13:43:50 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.27 10:32:50 -08'00' 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

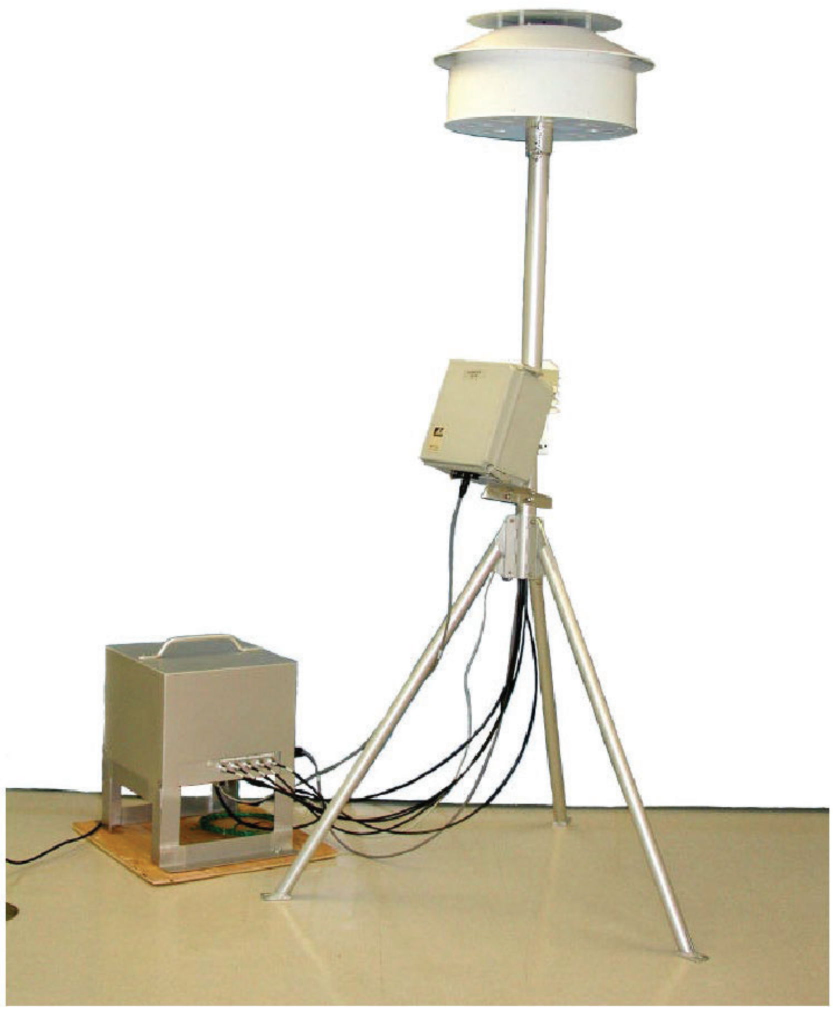
AQMD	Northern Nevada Public Health, Air Quality Management Division
AT	Ambient Temperature
BP	Barometric Pressure
ºC	Degrees Celsius
CSN	Chemical Speciation Network
CV	Coefficient of Variation
EPA	U.S. Environmental Protection Agency
FB	Field Blank
FiSH	Filter Shipping and Handling
FT	Filter Temperature
L/min	Liters per minute
µm	micrometer
mm	millimeters
mmHg	millimeters of Mercury
PDF	Portable Document Format
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
QAPP	Quality Assurance Project Plan
QC	Quality Control
RTI	Research Triangle Institute International
SASS	Speciation Air Sampling System
SCC	Sharp Cut Cyclone
S/N	Serial Number
SOP	Standard Operating Procedures
STD	Standard Deviation
STN	Speciation Trends Network
USB	Universal Serial Bus

List of Figures

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).

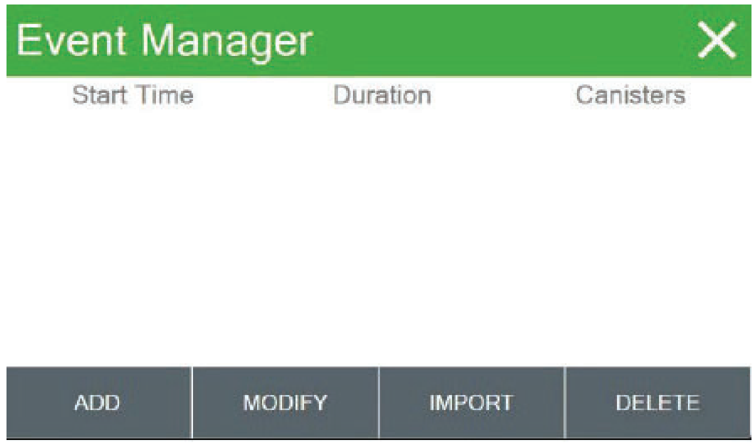
Equipment Needed
- New sampling canisters
- 4 sharp cut cyclones
- $PM_{2.5}$ CSN Custody and Field Data Form
- Field Sampling Null Value and Validity Coding Form
- Instrument logbook
- Filter transport cooler bag
- 6-8 Blue Ice packs

BB.4.1.1 Installing Sampling Canisters

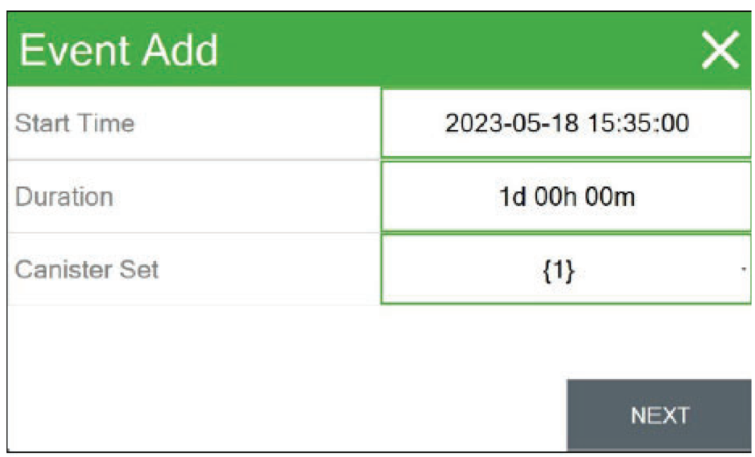
1. Collect the new sampling canisters shipped from RTI with the $PM_{2.5}$ CSN Custody and Field Data Form (Figure 3) included (see section BB.6.1 for receiving shipment procedures).

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 BB.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. Tap the touchscreen to activate the display screen.
13. Press  icon on the home screen to bring up the drop-down menu. Next, press OPERATE. Then, press the EVENT MANAGER option.

14. From the Event Manager screen press the ADD button on the bottom left of the screen.



15. From the Event Add screen, set the start time by pressing on the green outlined box next to "Start Time". Change this to reflect the date of the sample run on the Custody Form and set the time to 00:00:00. Follow this with setting the length of the run by pressing the box next to "Duration" outlined in green. Set this to 1d 00hr 00min. Finally, select which canister set will run by pressing on the box next to "Canister Set" outlined in green. Using the scroll bar on the bottom right pick option [1,2] for the first run. Once you have verified that the date, duration and canisters set are correct click the NEXT button on the bottom right of the screen.

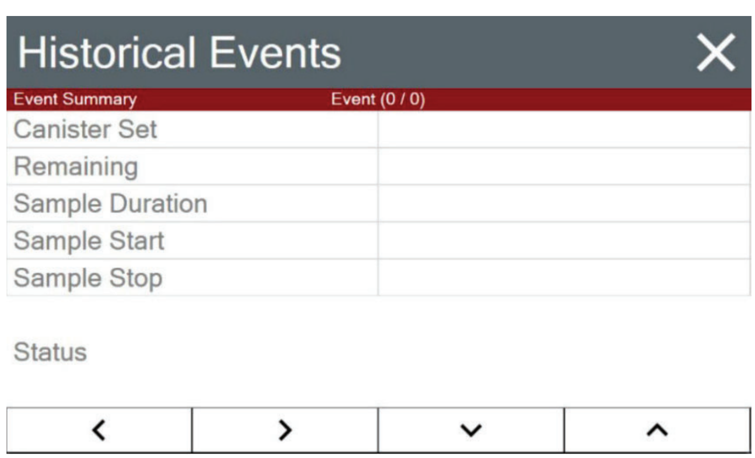


16. Next fill in the Canister ID numbers provided on the CSN Chain of Custody Form provided by RTI and press SAVE.
17. You will be back on the Event Manager screen. Verify that the Start Date, Duration and Canisters chosen are correct. If so, proceed with programing the second run using steps 14-16 choosing "Canister Set" [3,4] for the second run.
18. Fill out the date of sampler setup and operator's name on both Chain of Custody and Field Data Forms.
19. 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.
20. Record the time, date, and Sequential run numbers in the instrument logbook.

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 counterclockwise.
3. Remove the canister from position 1 by rotating it counterclockwise 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. Tap the touchscreen to activate the screen.
7. Press icon on the home screen to bring up the drop-down menu. Next, press OPERATE. Then, press HISTORICAL EVENTS.

8. The HISTORICAL EVENTS menu is comprised of nine screens. Each screen provides information for the following event subjects: Event Summary, Volume Summary, Min/Max, Max Delta- T, Warnings, Real Time Value and 5 Min- Averages. The most recent run will load first. Use the left arrow at the bottom of the screen to navigate to the first run.



9. From the first 1st screen record the Start Time and Date, End Time and Date, Retrieval Time and Date, and Run Time on the field form.
10. Using the arrow pointing downward navigate between each screen to get the values for the run. On the 2nd screen record the Volume (m3), Flow (LPM), and CV (%). On the 3rd screen record the Filters Temperatures Max, Avg, and Min. On the 4th screen record the Ambient Temperatures Max, Avg, and Min as well as the Barometric Pressures Max, Avg, and Min. The 5th screen displays Delta T which is not recorded. Warnings are displayed on the 6th screen. If any are shown record what the warning was and the date and time of the warning in the comment section of the CSN Chain of Custody Form if there are no Run Time or Delta- T Flags record "None" in the appropriate box on the Field Data Form. The 8th screen displays power interruptions if any have occurred record it in the comment section of field form. The 8th and 9th screens display the instruments Real Time Statistics and the runs 5-Minute Averages, neither of these are recorded.
11. After cycling through the 9th screen, the instrument will be displaying the 1st screen again. Use the right arrow at the bottom of the screen to display the second run. Record everything from steps 9-10 for the 2nd run.
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 X in the top right corner 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.

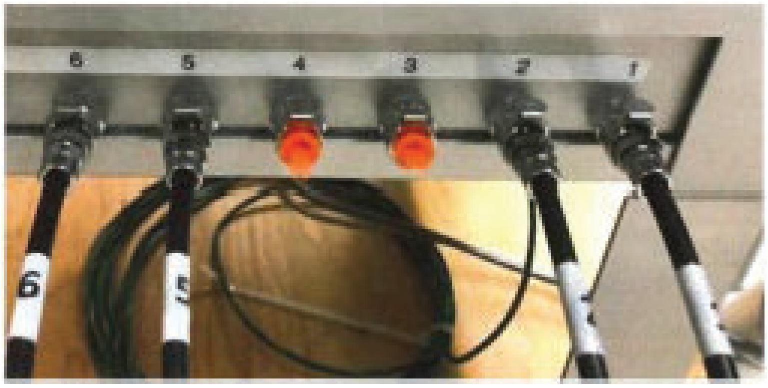
BB.4.1.3 Installation of Field Blank Canisters

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.

3. Cap the corresponding ports on the pump box.



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.
2. Install the nylon 8QFB canister (labeled with a red dot) onto channel 4.

3. As an additional safeguard, program the sampler to only collect samples on channels 1 and 2.
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.

BB.4.2 Post Run Data Retrieval

The Met One SuperSASS has the ability to download and transfer data using a USB drive. Data transfer will save a .BIN file containing event records and a .DAT file containing data log records. These files can be viewed and converted to .CSV with the FSCommAQ software. This function allows AQMD to digitally store filter runs statistical summaries on AQMD's network for future reference and troubleshooting purposes.

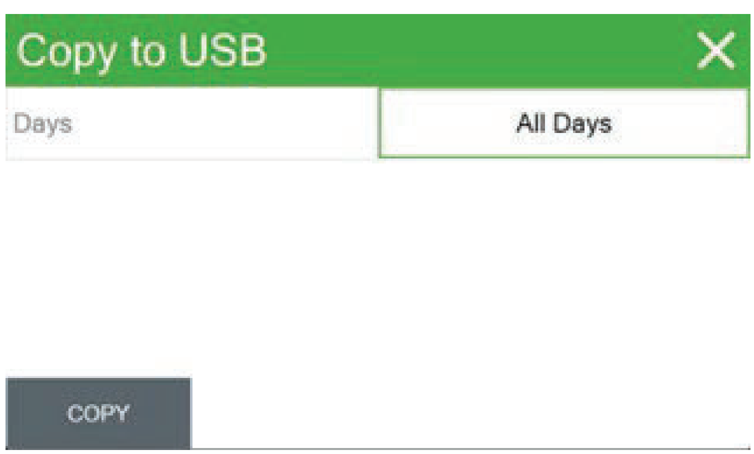
BB.4.2.1 Data Download

Equipment Needed

- SASS USB Drive
- Field Laptop
- FSComm Software

1. Locate the USB drive labeled SASS from inside the monitoring shelter. This stick should be located with the SASS Instrument Logbook.
2. After the removal of the previous filter run canisters and installation of the next filter run canisters have been completed, insert the USB drive into the SASS.
3. Tap the touchscreen display to activate the screen.
4. Press icon on the home screen to bring up the drop-down menu. Next, press OPERATE. Then, choose TRANSFER DATA.

5. Set the "Days" to 7 by pressing the box outlined in green. If the previous run had not had its data transferred, choose a longer timeframe such as 14 days to capture all missing data.



6. Once 7 days has been chosen, press the COPY at the bottom left of the screen. This will initiate the data transfer. After a couple of seconds the screen will indicate if the data was transferred successfully or if it encountered an error.
7. If the data transfer was successful, remove the USB drive from the SASS. If an error was encountered, try copying the data a second time. If it fails again contact Met One technical service for guidance.
8. After the USB drive has been removed from the SASS. Press the X button in the top right corner twice to exit back to the home screen. Take the USB drive inside the shelter.

BB.4.2.2 Data storage and Conversion

1. To convert the data file, begin by inserting the USB drive containing the SASS data into the field laptop.
2. Navigate to the USB drive file folder on the laptop and cut the file .BIN and .DAT files that had been created.
3. Navigate to the current year SASS raw data folder using the following pathway: \\wcadmin\aqmonitoring$\Field Mgmt Functions\QA-QC\Speciation QA-QC\SASS Data Download
4. Paste the .BIN and .DAT files.
5. To convert the files into a .CSV file, open FSComm software.
6. Click on IMPORT FILES.
7. Choose the .BIN file that was added to the SASS Raw Data folder
8. FSComm will generate a file for each of the runs contained on the .BIN file that was imported. New files will show up in blue font.
9. Select the EXPORT CSV.
10. Click the check mark for all the newly created files. Choose the month of the run for the output file pathway. **NOTE: Every file selected here will be exported to the same file location. If runs happen on different months, either export them in different batches to the correct month file folder or go into the month file folder and cut the file from the different month and move it to its correct month.**
11. Open the SASS data file folder and verify the .CSV file exported correctly.
12. If everything exported properly exit out of the file folders and FSComm software.

Figure 2 EPA Sampling Schedule

Figure 3 PM2.5 CSN Custody and Field Form

Q413701T	PM 2.5 CSN CUSTODY AND FIELD DATA FORM	c. White (return to lab) c. Yellow (site retains)

A. CUSTODY RECORD (Name, Date) **Container ID:** C6678G **Set:** 2Q

1. Laboratory, Out ~~fer~~ fwoo 5/14/24
2. Site, In JRV 05/15/24
3. Site, Out ____________________
4. Lab, In ____________________

B. SITE AND SAMPLER INFORMATION

1. Site AIRS Code 32-031-0031
2. SASS/URG S/N
3. Sampler Type SASS URG
4. Sampler POC 5
5. Site Name Reno (Libby Booth Elementary School)
6. Intended date of use Tuesday, May 21, 2024
7. Date of Sampler set-up ____________________
8. Operator's name ____________________

C. SAMPLER CHANNEL COMPONENT

Channel/ Position No.	Component ID No.	Component Description
5 -- SASS	I3169I	Teflon Module ID
6 -- SASS	I3170B	Nylon Module ID
2 -- URG	I122923	Quartz Cartridge ID

D. START, END, AND RETRIEVAL TIMES

Channel/ Position No.	Start date	Start time	End date	End time	Retrieval date	Retrieval time
5 -- SASS						
6 -- SASS						
2 -- URG						

E. SAMPLER CHANNEL INFORMATION (Post-Sampling)

Channel/ Position	Run Time	Run Time, Flag	Elapsed Time (Total)	Elapsed Time (After)	Sample Volume (m3)	Avg. flow (L/min)	Avg. flow CV (%)
5 -- SASS							
6 -- SASS							
2 -- URG							

Channel/ Position	Avg. ambient T (° C)	Max. ambient T (° C)	Min. ambient T (° C)	Δ T Flag	Avg. Filter T (° C)	Max. Filter T (° C)	Min. Filter T (° C)
5 -- SASS							
6 -- SASS							
2 -- URG							

Channel/ Position	Avg. BP (mm Hg)	Max. BP (mm Hg)	Min. BP (mm Hg)
5 -- SASS			
6 -- SASS			
2 -- URG			

F. Comments ____________________

Figure 4 Field Sampling Null Value and Validity Coding Form

Chemical Speciation Network
Field Sampling Null Value and Validity Coding Form

c. White (return to lab)
c. Yellow (site retains)

Chain of Custody Sampling Request ID: Q4172398 **Sampling Date:** 7/17/24

Date Received in SHAL: _______________

Instructions to Field Sampling Operator: For the sampling event identified by the Chain of Custody Sampling Request ID indicated above, please place checkmark next to all applicable flags in the tables below. If a flag is applicable to the Teflon filter sample place a checkmark in the T box, if a flag is applicable to the Nylon filter sample place a checkmark in the N box, if a flag is applicable to the quartz filter sample place a checkmark in the Q box, if a flag is applicable to all samples place a checkmark in the "all" box. If no flags apply to this sampling event, please check the box below the tables. ***Please note: additional codes and flags may be applied by the lab or during data processing and review.***

Table A. Null Value Codes

*** selection of any flag in this table will invalidate the sample**

FLAG	DESCRIPTION	T	N	Q	All
AB	Technician unavailable				
AC	Construction/repairs in area				
AD	Shelter storm damage				
AF	Scheduled but not collected				
AG	Sample time out of limits				
AH	Sample flow rate or CV out of limits				
AJ	Filter damage				
AK	Filter leak				
AL	Voided by operator				
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 (corrupt files)				
SA	Storm approaching				

Table B. Validity Flags

*** samples marked with any of these flags will be analyzed and reported with flags noted**

FLAG	DESCRIPTION	T	N	Q	All
2	Operational Deviation				
3	Field Issue				
4	Lab Issue				
IA	African Dust				
IB	Asian Dust				
IC	Chem spill and industrial accidents				
ID	Cleanup after 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-us				
J	Construction				
QP	Pressure sensor questionable				
QT	Temperature sensor questionable				
W	Flow average out of spec				
X	Filter temperature difference out of spec				
Y	Elapsed time out of spec				
FX	Filter Integrity Issue				

☐ **No flags assigned to this sampling event.** ______________________ ________________

Signature Date

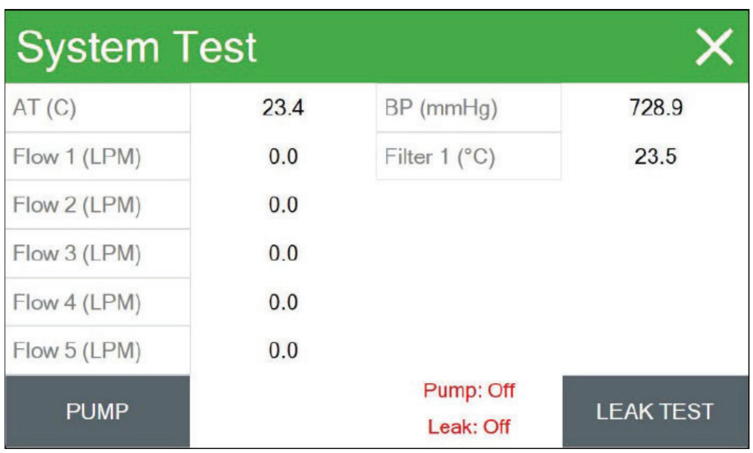
BB.4.2 Quality Control

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

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. Tap the touchscreen to activate the screen.
4. Press icon on the home screen to bring up the drop-down menu. Next, press TEST. Then press SYSTEM TEST.



5. The SYSTEM TEST screen displays the current ambient readings along with flow and leak test. With no canisters installed place the Alicat FP-25 temperature probe in the sampling head on channel 1. This is where the filter temperature sensors are located. Allow the FP-25 temperature probe to stabilize. Once stable, record the filter temperature from the touchscreen and the Alicat FP-25 on the QA/QC sheet.
6. Repeat the process for Channels 2, 3, and 4. Record the filter temperatures on the QA/QC form. The sampler's filter temperatures must be within +/-2° C of the verification temperature. If it is outside +/- 2° C, the sampler's temperature must be recalibrated. See section BB.5 for Calibration Procedures. However, continue with the rest of the verification steps below before calibrating. A flow verification is to be done before calibrating filter temperatures to record an "as found" flow for the instrument.

7. 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.
8. Repeat for canister 2 or 4 (The same canister will be used for channels 2 and 4).
9. 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.
10. 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 BB.5 for Calibration Procedures.
11. Record the sampler's barometric pressure (BP) and Alicat FP-25 barometric pressure on the QA/QC form. The sampler's barometric pressure must be within +/- 10mmHg of the Alicat FP-25 barometric pressure. If it is outside +/- 10mmHg, the barometric pressure must be recalibrated. See section BB.5 for Calibration Procedures.
12. 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 (AT). 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 BB.5 for Calibration Procedures.
13. 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 LEAK CHECK button to turn the leak check on.
14. 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 BB.8 for troubleshooting a leak.
15. Remove canisters from Channels 1 and 2 and install in Channels 3 and 4. Repeat step 14 for Channels 3 and 4. After leak checking all the channels turn off LEAK CHECK but allow the pump to continue running.
16. Met One Technical Services advises that the pump is allowed to run for a minimum of 20 minutes before attempting to take any flow readings. This allows the pump to warm up and flows to stabilize. After 20 minutes verify that the flows for all four channels have stabilized. Once they have you may proceed with the flow verification.
17. 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. Record the reading for flow one and the flow reading provided by the Alicat flow meter.
18. The sampler flow must be within +/- 10% STD of the Alicat reference flow. Repeat for Channel 2.
19. Remove canisters from Channels 1 and 2 and install them in Channels 3 and 4. Repeat steps 17 and 18 for Channels 3 and 4.

20. AQMD uses +/- 5% as an in-house action level. If any flows are outside of +/- 5% then that flow must be calibrated; see section BB.5 for Calibration Procedures.
21. Press PUMP, to turn the pump off and press the X in the top right corner to exit from the system test and return to the home screen.
22. Detach the flow equipment and place the verification canisters in the cooler. Raise the radiation shield back into position and lock in place. Press X in the top right corner to return to the main screen.
23. Record the time, date, and verification result in the instrument logbook.
24. If a paper QA/QC form was used, transcribe the information onto the digital SASS QA/QC excel worksheet located on the AQMonitoring drive in the QA/QC folder. After the worksheet has been checked by the QC person and finalized, give a copy to the Data Manager for QA data entry.

BB.4.2.2 Quarterly Checks

Quarterly audits are performed once per quarter.

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

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 23 in section BB.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.
3. If a paper QA/QC form was used, transcribe the information onto the digital SASS QA/QC excel worksheet located on the AQMonitoring drive in the QA/QC folder. After the worksheet has been checked by the QA Manager and finalized, give a copy to the Data Manager for QA data entry, and file a copy in the Quarterly Audit folder made by the monitoring Senior Air Quality Specialist.

BB.4.2.3 QA/QC Worksheet Review and PDF Finalization

After completing the QA/QC worksheet, it needs to be reviewed by an Air Quality Specialist and then saved as a read only PDF to lock the worksheet from editing, creating the official record.

1. Once a QA/QC worksheet is completed, the dedicated QC person will review and PDF the worksheet. For verifications, the Senior Air Quality Specialist and the Air Quality Specialists have each been assigned sites that they are not the normal site operator of to review and PDF. The QA Manager will be responsible for reviewing and creating a PDF for all audit QA/QC worksheets.

2. It is the responsibility of the dedicated QC person to monitor the QA/QC folder on the AQMonitoring drive for new QA/QC worksheets to review and PDF. When a new worksheet is completed, the QC person will review the worksheet for errors, including content and calculations.
    a. If an error is found, contact should be made to the operator to get the issue fixed.
3. After completing the review, click the Acrobat tab on the top ribbon. Click Create PDF. Click Convert to PDF, Yes, and Save. Save the PDF with the same naming convention, and notating "_RECORD" at the end of the file name.
4. The PDF will now be opened in Adobe. On the toolbar on the right, click the Fill & Sign option. On the top of the page, click Sign yourself.
5. If initials have not already been created, click Add Initials, and save your initials. If your initials have been saved, click on them in the dropdown menu and place them on the QC Check/PDF line at the bottom of the worksheet.
6. To create a read only copy, the QC person needs open Adobe Acrobat Pro DC with the Adobe Sign Add-In. After placing the initials, the QC person will click Next on the right of the Fill and Sign ribbon. Click Save as a Read Only. Save the record with the same naming convention and click yes to replace existing file with the Read Only version.

Figure 5 QA/QC Form for SASS

Air Quality Management Division
QA/QC Form for SASS

Verification: ______ Audit: ______

Sampler: *Met One* Model: *SuperSASS* S/N: ______ Site: Reno 4

Operator: ______ Date: ______

Date / Time

Standard: ______ Model: ______ S/N: ______

	Display	Reference	Difference		Pass? Yes	No
Date:			0		X	
Time (PST):			0	+ / - 5min?	X	

Pressure

Standard: ______ Model: ______ S/N: ______

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

Temperature

Standard: ______ Model: ______ S/N: ______

	Display (^oC)	Reference (^oC)	Difference (^oC)		Yes	No
Ambient:			0.0	+ / - 2^oC?	X	
Filter 1			0	+ / - 2^oC?	X	
2			0	+ / - 2^oC?	X	
3			0	+ / - 2^oC?	X	
4			0	+ / - 2^oC?	X	

Leak Check

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

Flow

Standard: ______ Model: ______ S/N: ______

		I_A (Sampler Display)	M_A (Transfer Standard)	I_A vs. M_A % Dev.		Yes	No
Local Flow Actual LPM	Ch. 1			#DIV/0!	+ / - 10%?	#DIV/0!	#DIV/0!
	Ch. 2			#DIV/0!	+ / - 10%?	#DIV/0!	#DIV/0!
	Ch. 3			#DIV/0!	+ / - 10%?	#DIV/0!	#DIV/0!
	Ch. 4			#DIV/0!	+ / - 10%?	#DIV/0!	#DIV/0!
			Avg. % Dev.	#DIV/0!	+ / - 10%?	#DIV/0!	#DIV/0!

	Yes	No
Monthly Maintenance Completed?		
Quarterly Maintenance Completed?		

Comments: ______________________________

File Name: SASS_Verif_Audit_Blank
Reviewed: 07/19/2024

QC Check/PDF:__________

Figure 6 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 07/19/2024

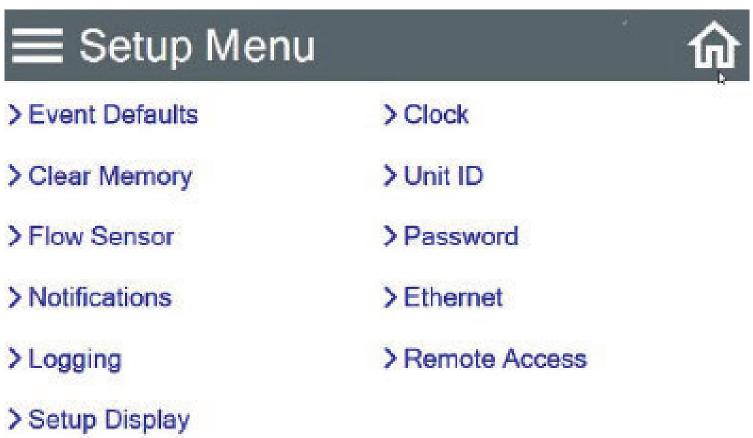
BB.5 Calibration Procedures

The operator will refer to this document as well as the manufacturer's operation manual to perform calibrations. When doing an Ambient Temperature (AT) or Barometric Pressure Calibration (BP) it is required that all 4 flows be rechecked and that the "Post Cal Flow Verification" section of the SASS Calibration Form (Figure 7) be filled out. Refer to Section BB.4.2.1 Monthly Checks, Steps 17-21 for how to set up and perform a flow verification.

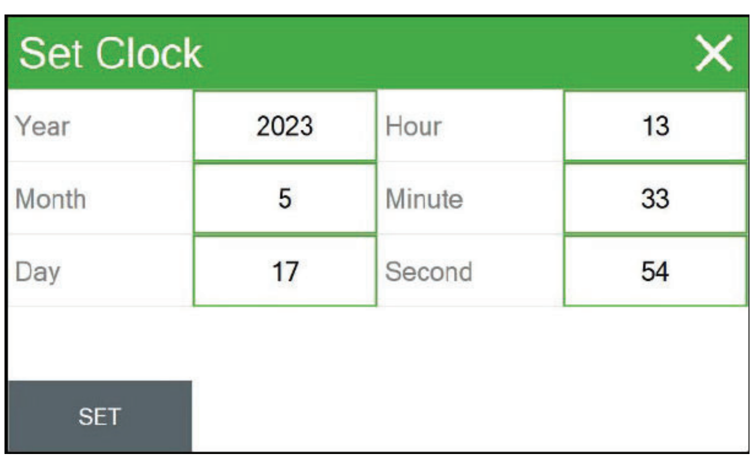
BB.5.1 Time and Date Calibration

If the time is over +/- 5 minutes or if the date is incorrect, a calibration must be performed before the next scheduled sample run.

1. Tap the touchscreen to activate the screen.
2. Press icon on the home screen to bring up the drop-down menu. Next, press the Test button. From here press setup.
3. Next, choose Clock.



4. To set the time and date press the outlined box of the parameter that needs to be changed. Enter the correct numerical value needed.



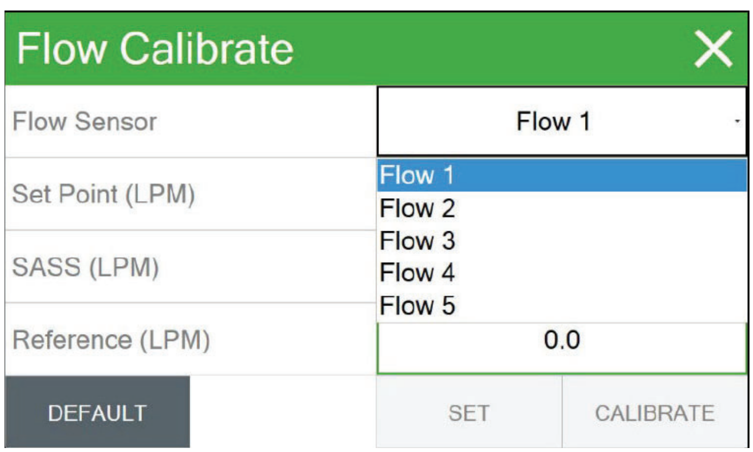
5. Once the date and time have been properly set pressure the set button on the bottom left corner of the screen.
6. Click the X in the right corner twice to return to the home screen.
7. Verify that the date and time is correct. If so, note that the time and/or date was changed on the comments section of the QC sheet and how much it was changed and the Instrument Log

BB.5.2 Flow Calibration

Equipment Needed

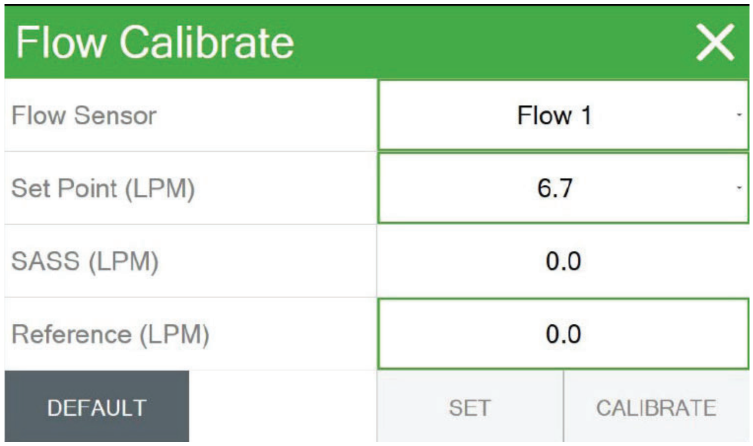
- Verification Reference Standard (Alicat FP-25BT)
- Verification Filter Canisters (4)
- Flow Standard Adaptor/Attachment Hose
- SASS Calibration Form

1. Begin any calibration by filling out the start time, date, S/N number and operator on the SASS Calibration Form (Figure 7).
2. Tap the touchscreen to activate the screen.
3. Press icon on the home screen to bring up the drop-down menu. Next, press the TEST button. From here, press FLOW CALIBRATE.
4. The pump will automatically start upon entering this screen.
5. Touch the green outlined box to the right of "Flow Sensor" on the touch screen to bring up a drop-down menu. Choose the channel that needs calibration.



6. Install the verification canister with the SCC to the channel that is being calibrated and attach the Alicat FP-25BT to the canister using the same method discussed in Section BB.4.2.1 Monthly Checks, Step 17.
7. Leave the "Set Point" at 6.7 LPM and allow the SASS and Alicat flow readings to stabilize.
8. Once the flows have stabilized record the SASS flow display reading and the Alicat reading onto the SASS Calibration Form.

9. Next, enter the reading from the Alicat into the box outlined in green to the right of "Reference (LPM)" on the SASS touch screen display. Once entered press SET at the bottom of the screen and next press CALIBRATE.



7. The SASS flow should be calibrated and the reading on the Alicat should reflect the instruments flow.
8. Repeat steps 5-7 for each channel in need of calibration.
9. After every channel has been calibrated recheck, the flows using the Alicat. Record the SASS display flow and the Alicat flow on the SASS Calibration Form in the section labeled "Post Cal Flow Verification".
10. If every channel that has been calibrated is within +/- 5% for the "Post Cal Flow Verification", you may leave the calibration screen by pressing the X in the upper right corner of the touch screen display.
11. Record the end time of the calibration on the SASS Calibration Form.

BB.5.3 Temperature Calibration

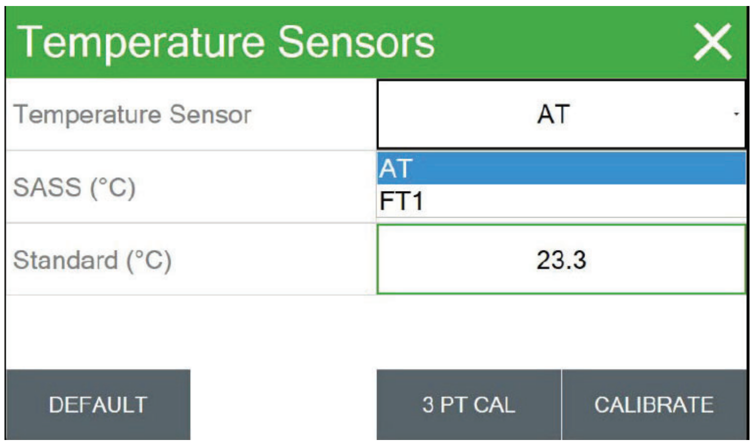
Equipment Needed

- Verification Reference Standard (Alicat FP-25BT)
- SASS Calibration Form

Although the SuperSASS has the ability to perform a 3-point temperature calibration Met One Technical Services does not recommend this being performed by agencies in the field. Instead, it is recommended that if you are unable to get a passable temperature from a 1-point calibration, that agencies replace the sensor with a new one and ship the sensor to Met One for recalibration. The procedure below is for a 1-point temperature calibration. If you are attempting the 3-point calibration refer to the SuperSASS manual and contact Met One Technical Service for guidance.

1. Begin any calibration by filling out the start time, date, S/N number and operator on the SASS Calibration Form (Figure 7).
2. Tap the touchscreen to activate the display screen.
3. Press  icon on the home screen to bring up the drop-down menu. Next, press the TEST button. From here press TEMPERATURE CALIBRATE.

4. Connect the Alicat FP-25BT temperature probe to the filter sensor you are calibrating based upon the results of the previous verification testing or to the radiation shield if calibrating ambient temperature. The set-up process is explained in Section BB.4.2.1 Monthly Checks, Steps 5-6.
5. The display will show the Ambient Temperature (AT) first. The reference and AT readings should be within ± 2 °C of each other. To choose the sensor you need to calibrate, start by pressing the green box to the right of "Temperature Sensor". This will activate a dropdown menu giving you the Filter Temperature (FT 1-4) options for each filter run. The reference and FTs readings should be within ± 2 °C of each other as well.



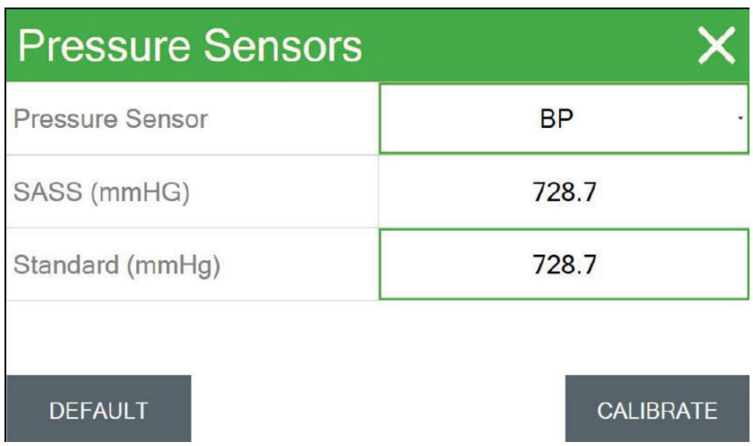
6. Once temperature readings are stable for the AT/FTs and the Alicat, press the green box next to "Standard (°C)" on the touch screen and enter the reading that the Alicat is measuring.
7. Repeat steps 3-5 for each filter sensor and ambient temperature that you need to calibrate.
8. Once each temperature sensor has been set to the reference standard press CALIBRATE at the bottom of the screen.
9. Each sensor should have calibrated to the set reference points. To verify this, recheck each temperature reading with the Alicat by cycling back through them using the "Temperature Sensor" dropdown menu. If each filter has held the calibration you are finished and can exit back to the home screen using the X in the top right corner.
10. If upon recheck the temperature reading is outside ± 2 °C, then click the DEFAULT button in the bottom left of the screen and repeat steps 3-7. If the sensors don't hold the calibration after defaulting and recalibrating, then replacement/repairs of the sensor maybe necessary. Consult the manual and contact Met One Technical Service for guidance.
11. If AT was calibrated, perform a Post Cal Flow Verification for all Channels according to Section BB4.2.1 Monthly Checks, Steps 17-21. If only FTs were calibrated, then only the specific channels that were calibrated need a Post Cal Flow Verification. The Post Cal Flow Verification must be +/- 10% of the reference standard. If they are not, then a Flow Calibration is required (see Section BB.5.2 Flow Calibration).
12. Once the "Post Cal Flow Verification" section of the SASS Calibration Form is filled out record the end time of the calibration on the form and fill out all calibrations performed in the Instrument Log.

BB.5.4 Barometric Pressure Calibration

Equipment Needed
- Verification Reference Standard (Alicat FP-25BT)
- SASS Calibration Form

The SuperSASS barometric pressure (BP) value must be within ±10 mmHg of the reference sampler to pass a verification. NNPH uses ±5 mmHg as the in-house action limit. If during a verification a reading is higher than ±5 mmHg of the reference standard proceed with the following calibration procedure:

1. Begin any calibration by filling out the start time, date, S/N number and operator on the SASS Calibration Form (Figure 7).
2. Tap the touchscreen to activate the display screen.
3. Press icon on the home screen to bring up the drop-down menu. Next, press the TEST button. Then, press PRESSURE CALIBRATE.
4. The display screen will now show the BP.



5. Check the displayed BP against the Alicat FP-25BT's BP. Fill out the SASS display reading and the reference readings on the SASS Calibration Form.
6. If its above ±5 mmHg, touch the green out lined box to the right of "Standard (mmHg)".
7. From here enter the reference BP.
8. Now hit CALIBRATE in the bottom right corner.
9. The "SASS (mmHG)" pressure in the middle of the screen should now reflect the standard pressure that was previously entered. If the reading does not change to within ±5 mmHg of the reference standard, press the DEFAULT button in the bottom left corner and repeat steps 4-6. If the "SASS (mmHG)" reading still isn't within ±5 mmHg of the reference standard repairs/replacement of the sensor maybe required. Contact Met One Technical Service for guidance.
10. Once the "SASS (mmHG)" BP is properly calibrated you may exit out of the calibration screen by pressing the X in the top right corner.
11. After BP has been calibrated perform a Post Cal Flow Verification for all Channels according to Section BB4.2.1 Monthly Checks, Steps 17-21. The Post Cal Flow

Verification must be +/- 10% of the reference standard. If they are not, then a Flow Calibration is required see Section BB.5.2 Flow Calibration.

12. Once the "Post Cal Flow Verification" section of the SASS Calibration Form is filled out record the end time of the calibration on the form and fill out all calibrations performed in the Instrument Log.

Figure 7. SASS Calibration Form

Air Quality Management Division
URG Flow Calibration

Sampler: SASS Model: SuperSASS S/N: Site: Reno 4

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

Flow Standard: Model: S/N:

Temperature Cal

	Display (°C)	Standard (°C)	Difference (°C)		Yes	No
Ambient:			0.0	+/-2°C?	X	
Filter 1:			0.0	+/-2°C?	X	
Filter 2:			0.0	+/-2°C?	X	
Filter 3:			0.0	+/-2°C?	X	
Filter 4:			0.0	+/-2°C?	X	

Barometric Pressure Cal

	Display (mmHg)	Standard (mmHg)	Diffrerence (mmHg)		Yes	No
Pressure:			0.0	+/-10mmHg	X	

Flow (6.7 L/min)

	I_A (Sampler Display L/Min)	M_A (Transfer Standard L/Min)	I_A vs. M_A % Dev.		Yes	No
Channel 1:			#DIV/0!	+ / - 10%?	#DIV/0!	#DIV/0!
Channel 2:			#DIV/0!		#DIV/0!	#DIV/0!
Channel 3:			#DIV/0!		#DIV/0!	#DIV/0!
Channel 4:			#DIV/0!		#DIV/0!	#DIV/0!

Post Cal Flow Verification (6.7 L/min)

	I_A (Sampler Display L/Min)	M_A (Transfer Standard L/Min)	I_A vs. M_A % Dev.		Yes	No
Channel 1:			#DIV/0!	+ / - 10%?	#DIV/0!	#DIV/0!
Channel 2:			#DIV/0!		#DIV/0!	#DIV/0!
Channel 3:			#DIV/0!		#DIV/0!	#DIV/0!
Channel 4:			#DIV/0!		#DIV/0!	#DIV/0!

Comments: ______________________________

File Name: SASS_Cal_Master_Template
Last Revision: 11/13/2024

QC:_______

BB.6 Shipping/Receiving Procedures

BB.6.1 Receiving Procedures

1. Sampling Canisters will be received on the days specified by RTI shipping schedule (Figure 8). Shipping schedules are emailed to all Speciation operators from the Region 9 contact person. Email Shal@RTI or Melinda Beaver at EPA 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. Place the plastic bag containing the canisters in the cooler bag inside the repair room.
3. Unpack the paperwork from inside the shipping box. Sign and date "Site In" on the $PM_{2.5}$ STN Custody and Field Data Form. Stable the white and yellow Custody and Field Data Forms together to avoid them ripping apart from one another in the event of inclement weather.
4. Place the Custody and Field Data Forms and the Null Code Forms into the plastic bag with the canisters.
5. Remove the ice packs from around the canisters and place in boxes in the freezer.
6. Create a label 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 a piece of paper. Tape the label 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.
7. Place the box in the filter archive/shipping/repair room until the ship date.
8. 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 9 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.

9. At the end of each calendar year, remove the yellow copies of the $PM_{2.5}$ STN Custody and Field Data forms and the Field Sampling Null Value and Validity forms from the binder, transfer them to a large-pocket file folder, and file in the appropriate file cabinet in the Data Manager's office to be retained for five years per Table 9-2 of the QAPP.

Figure 8 Chemical Speciation 1/3 Sequential Sampling Schedule

Chemical Speciation Network

Sequential Schedule December 2023
Through December 2024

October 2024

Shipping, Receiving, and Sampling Schedule for CSN Sites using 1-in-3 Sequential Day Sampling							
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Date			Oct 1	Oct 2	Oct 3	Oct 4	Oct 5
Shipped from RTI					7Q8QFB		
Received by State						7Q8QFB	
Sampling					**5Q**		
Shipped from State				3Q4Q			
Received by RTI					3Q4Q		
Date	Oct 6	Oct 7	Oct 8	Oct 9	Oct 10	Oct 11	Oct 12
Shipped from RTI			1Q2Q				
Received by State				1Q2Q			
Sampling	**6Q**			**7Q8QFB**			**1Q**
Shipped from State			5Q6Q				
Received by RTI				5Q6Q			
Date	Oct 13	Oct 14	Oct 15	Oct 16	Oct 17	Oct 18	Oct 19
Shipped from RTI		3Q4Q			5Q6Q		
Received by State			3Q4Q			5Q6Q	
Sampling			**2Q**			**3Q**	
Shipped from State		7Q8FB			1Q2Q		
Received by RTI			7Q8FB			1Q2Q	
Date	Oct 20	Oct 21	Oct 22	Oct 23	Oct 24	Oct 25	Oct 26
Shipped from RTI					7Q		
Received by State						7Q	
Sampling		**4Q**			**5Q**		
Shipped from State				3Q4Q			
Received by RTI					3Q4Q		
Date	Oct 27	Oct 28	Oct 29	Oct 30	Oct 31		
Shipped from RTI			1Q2Q				
Received by State				1Q2Q			
Sampling	**6Q**			**7Q**			
Shipped from State			5Q6Q				
Received by RTI				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
Direct +1 (352) 333 6621
Mobile: +1 (720) 883 2390
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Fax + 1 352 333 6622

www.amecfw.com

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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.7.3. Annual Maintenance

Annual rebuild of the vacuum pump using rebuild kit provided by Met One. See rebuild kit for instructions.

BB.8 Troubleshooting

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

Appendix CC: Sequential URG 3000N

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Jordan Volk

Title of Author: Air Quality Specialist

Signature: Jordan Volk Digitally signed by Jordan Volk Date: 2024.11.27 07:28:56 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.26 13:51:12 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.26 14:01:53 -08'00' 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
URG	URG-3000N Sequential Particulate Speciation System

List of Figures

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 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

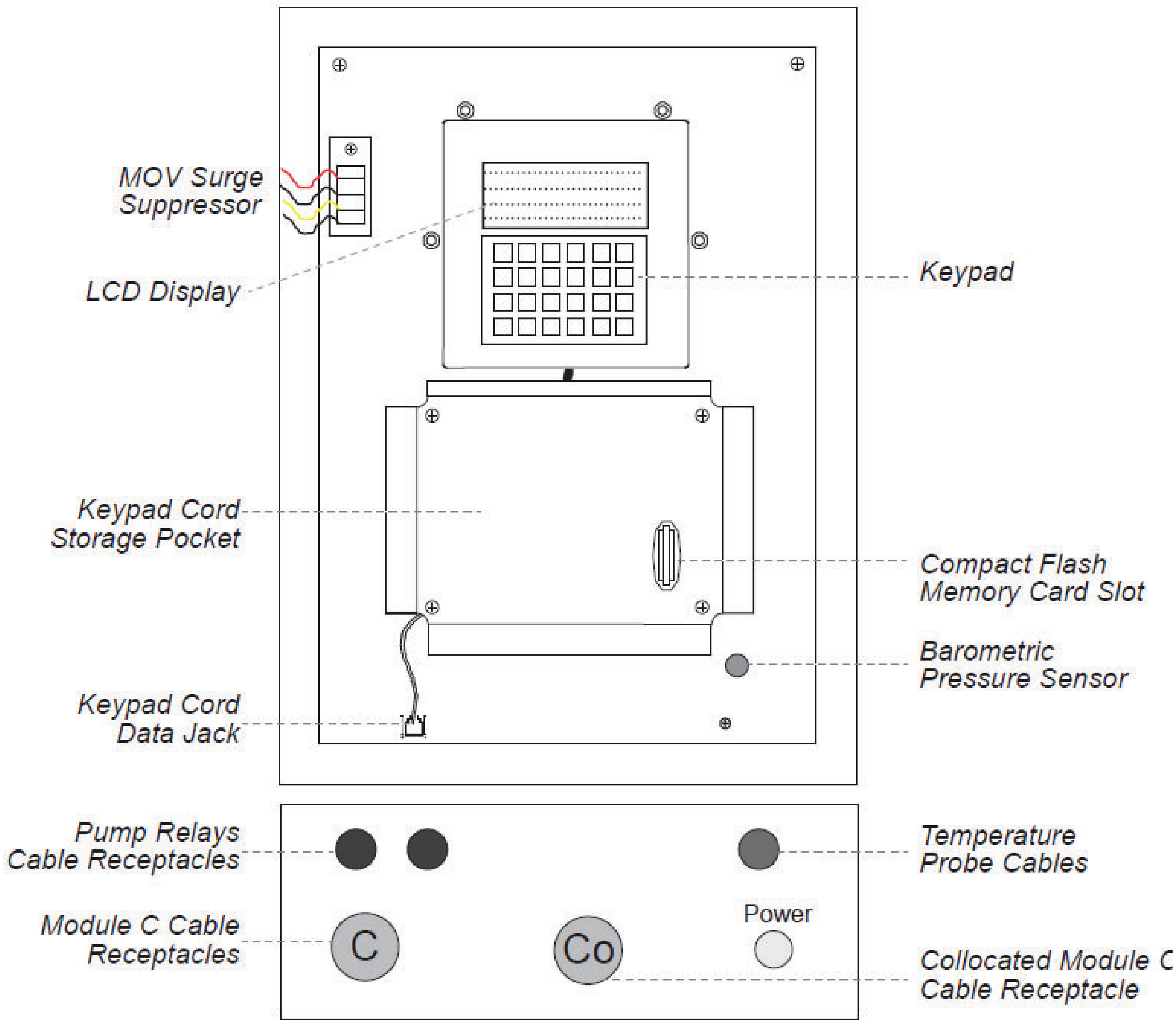
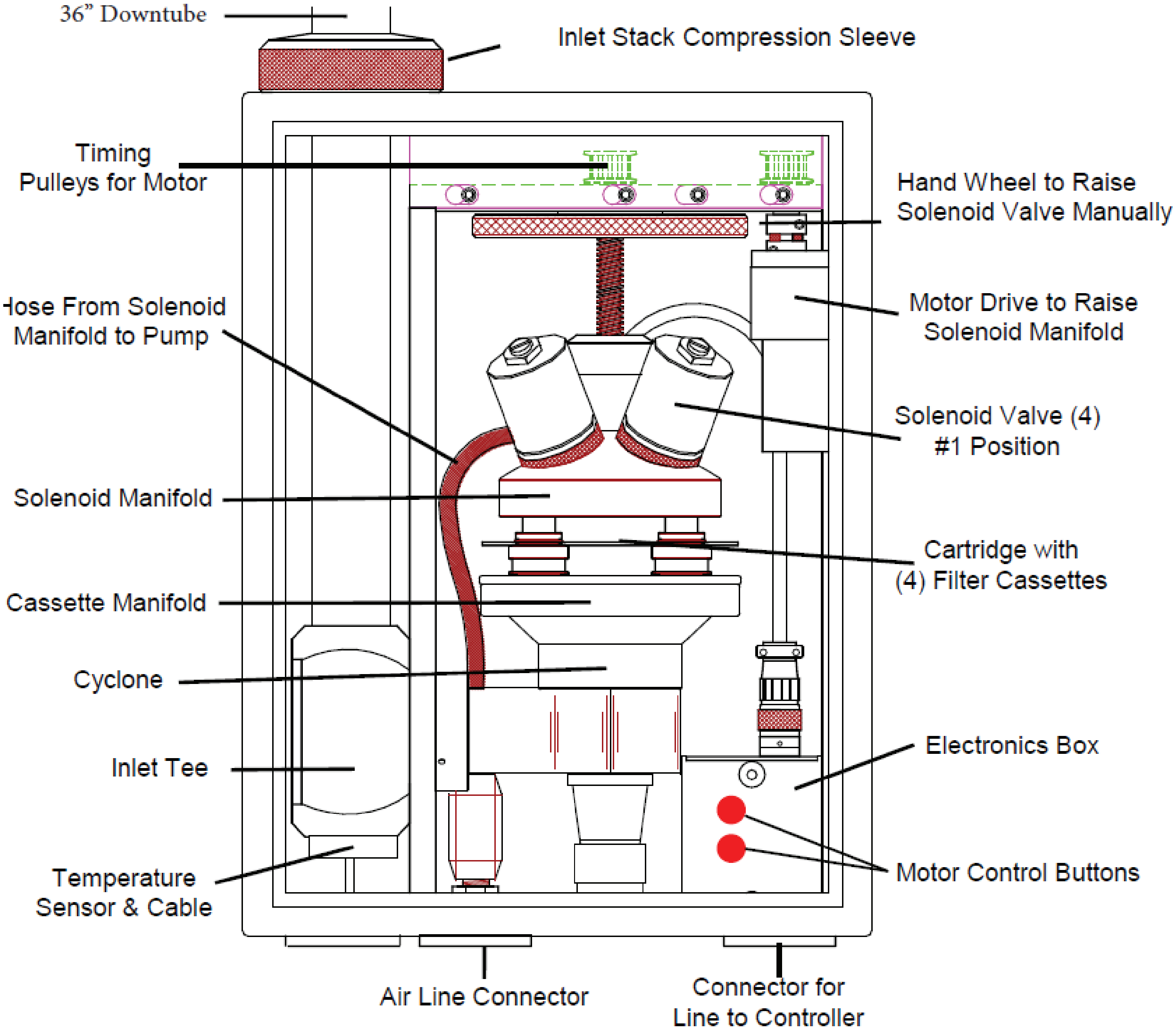


Figure 1b Sample Module C



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 RTI 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 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

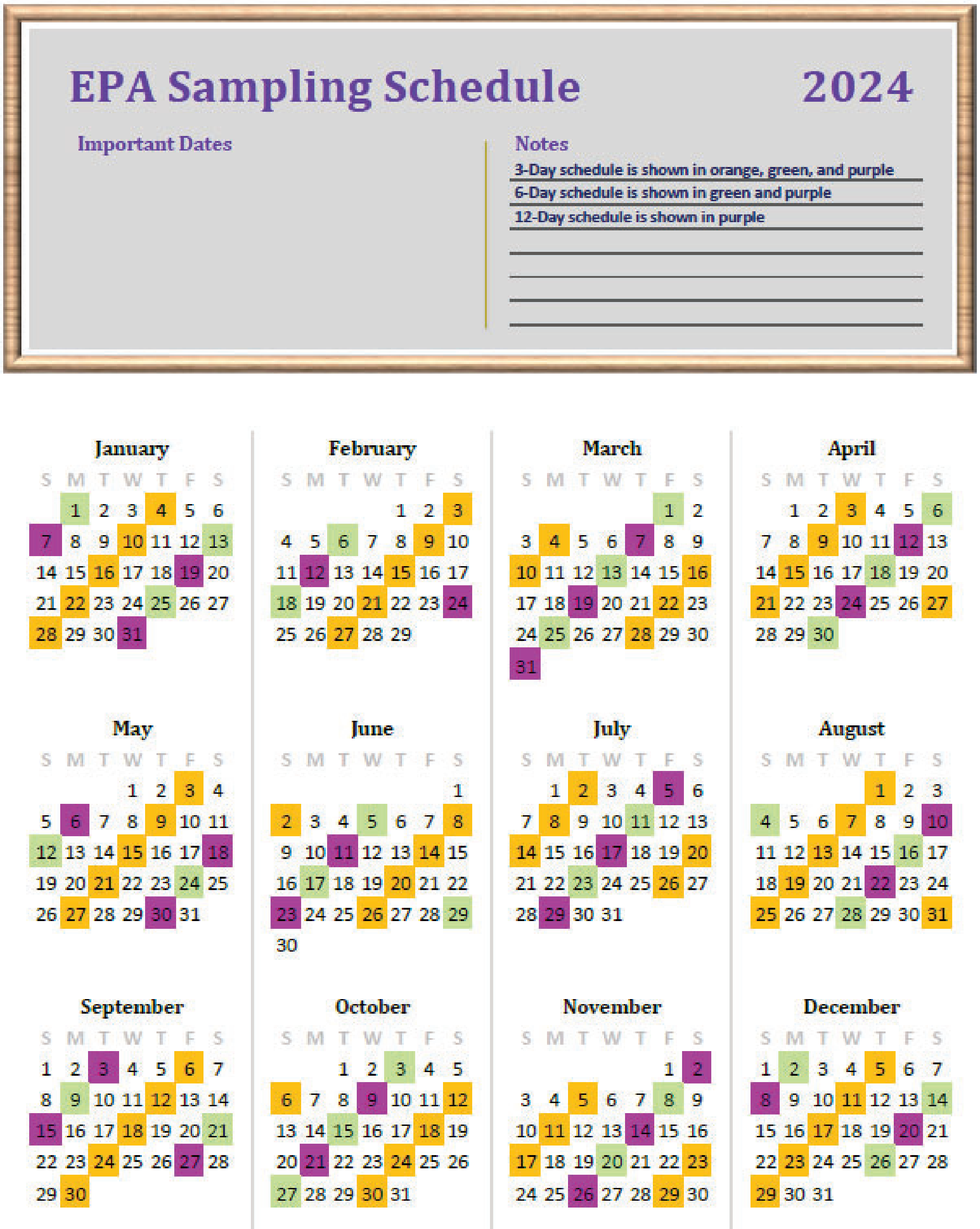


Figure 3 PM2.5 CSN Custody and Field Form

Q413701T

PM 2.5 CSN CUSTODY AND FIELD DATA FORM

c. White (return to lab)
c. Yellow (site retains)

A. CUSTODY RECORD (Name, Date) **Container ID:** C6678G **Set:** 2Q

1. Laboratory, Out [illegible] 05/14/24
2. Site, In JRV 05/15/24
3. Site, Out
4. Lab, In

B. SITE AND SAMPLER INFORMATION

1. Site AIRS Code 32-031-0031
2. SASS/URG S/N
3. Sampler Type SASS URG
4. Sampler POC 5
5. Site Name Reno (Libby Booth Elementary School)
6. Intended date of use Tuesday, May 21, 2024
7. Date of Sampler set-up
8. Operator's name

C. SAMPLER CHANNEL COMPONENT

Channel/ Position No.	Component ID No.	Component Description
5 -- SASS	I3169I	Teflon Module ID
6 -- SASS	I3170B	Nylon Module ID
2 -- URG	I122923	Quartz Cartridge ID

D. START, END, AND RETRIEVAL TIMES

Channel/ Position No.	Start date	Start time	End date	End time	Retrieval date	Retrieval time
5 -- SASS						
6 -- SASS						
2 -- URG						

E. SAMPLER CHANNEL INFORMATION (Post-Sampling)

Channel/ Position	Run Time	Run Time, Flag	Elapsed Time (Total)	Elapsed Time (After)	Sample Volume (m3)	Avg. flow (L/min)	Avg. flow CV (%)
5 -- SASS							
6 -- SASS							
2 -- URG							

Channel/ Position	Avg. ambient T (° C)	Max. ambient T (° C)	Min. ambient T (° C)	Δ T Flag	Avg. Filter T (° C)	Max. Filter T (° C)	Min. Filter T (° C)
5 -- SASS							
6 -- SASS							
2 -- URG							

Channel/ Position	Avg. BP (mm Hg)	Max. BP (mm Hg)	Min. BP (mm Hg)
5 -- SASS			
6 -- SASS			
2 -- URG			

F. Comments

Figure 4 Field Sampling Null Value and Validity Coding Form

Chemical Speciation Network
Field Sampling Null Value and Validity Coding Form

c. White (return to lab)
c. Yellow (site retains)

Chain of Custody Sampling Request ID: Q4172398 **Sampling Date:** 7/17/24

Date Received in SHAL: ________________

Instructions to Field Sampling Operator: For the sampling event identified by the Chain of Custody Sampling Request ID indicated above, please place checkmark next to all applicable flags in the tables below. If a flag is applicable to the Teflon filter sample place a checkmark in the T box, if a flag is applicable to the Nylon filter sample place a checkmark in the N box, if a flag is applicable to the quartz filter sample place a checkmark in the Q box, if a flag is applicable to all samples place a checkmark in the "all" box. If no flags apply to this sampling event, please check the box below the tables. ***Please note: additional codes and flags may be applied by the lab or during data processing and review.***

Table A. Null Value Codes

*** selection of any flag in this table will invalidate the sample**

FLAG	DESCRIPTION	T	N	Q	All
AB	Technician unavailable				
AC	Construction/repairs in area				
AD	Shelter storm damage				
AF	Scheduled but not collected				
AG	Sample time out of limits				
AH	Sample flow rate or CV out of limits				
AJ	Filter damage				
AK	Filter leak				
AL	Voided by operator				
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 (corrupt files)				
SA	Storm approaching				

Table B. Validity Flags

*** samples marked with any of these flags will be analyzed and reported with flags noted**

FLAG	DESCRIPTION	T	N	Q	All
2	Operational Deviation				
3	Field Issue				
4	Lab Issue				
IA	African Dust				
IB	Asian Dust				
IC	Chem spill and industrial accidents				
ID	Cleanup after 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-us				
J	Construction				
QP	Pressure sensor questionable				
QT	Temperature sensor questionable				
W	Flow average out of spec				
X	Filter temperature difference out of spec				
Y	Elapsed time out of spec				
FX	Filter Integrity Issue				

☐ **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

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.
47. Record the time, date, and verification result in the instrument logbook.
48. If a paper QA/QC form was used, transcribe the information onto the digital URG QA/QC excel worksheet located on the AQMonitoring drive in the QA/QC folder. After

the worksheet has been checked by the QC person and finalized, give a copy to the Data Manager for QA data entry.

Figure 5 QA/QC Form for URG

Air Quality Management Division
QA/QC Form for URG

Verification: ______ Audit: ______

Sampler: *URG* Model: *3000N* S/N: ______ Site: Reno 4

Operator: ______ Date: ______

Date / Time

Standard: ______ Model: ______ S/N: ______

	Display	Reference	Difference		Pass? Yes	No
Date:			0		X	
Time (PST):			0	+ / - 5min?	X	

Pressure

Standard: ______ Model: ______ S/N: ______

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

Temperature

Standard: ______ Model: ______ S/N: ______

	Display (^{o}C)	Reference (^{o}C)	Difference (^{o}C)		Yes	No
Ambient:			0	+ / - 2^{o}C?	X	

Leak Check

	Max	Min	Diff		Yes	No
Standard: Stopcock			0	< 225?	X	

Flow

Standard: ______ Model: ______ S/N: ______

	I_A (Sampler Display)	M_A (Transfer Standard)	I_A vs. M_A % Dev.		Yes	No
Local (Act.) Flow (L/min):			#DIV/0!	+ / - 10%?	#DIV/0!	#DIV/0!

	Yes	No
Monthly Maintenance Completed?		
Quarterly Maintenance Completed?		

Comments: ____________________

File Name: URG_Verif_Audit_Blank - Copy
Reviewed: 07/19/2024

QC Check/PDF:__________

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

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.
47. Record the time, date, and verification result in the instrument log book.
48. If a paper QA/QC form was used, transcribe the information onto the digital URG QA/QC excel worksheet located on the AQMonitoring drive in the QA/QC folder. After the worksheet has been checked by the QA Manager and finalized, give a copy to the Data Manager for QA data entry, and file a copy in the Quarterly Audit folder made by the monitoring Senior Air Quality Specialist.

CC.4.2.3 QA/QC Worksheet Review and PDF Finalization

After completing the QA/QC worksheet, it needs to be reviewed by an Air Quality Specialist and then saved as a read only PDF to lock the worksheet from editing, creating the official record.

1. Once a QA/QC worksheet is completed, the dedicated QC person will review and PDF the worksheet. For verifications, the Senior Air Quality Specialist and the Air Quality Specialists have each been assigned sites that they are not the normal site operator of to review and PDF. The QA Manager will be responsible for reviewing and creating a PDF for all audit QA/QC worksheets.
2. It is the responsibility of the dedicated QC person to monitor the QA/QC folder on the AQMonitoring drive for new QA/QC worksheets to review and PDF. When a new worksheet is completed, the QC person will review the worksheet for errors, including content and calculations.
    a. If an error is found, contact should be made to the operator to get the issue fixed.
3. After completing the review, click the Acrobat tab on the top ribbon. Click Create PDF. Click Convert to PDF, Yes, and Save. Save the PDF with the same naming convention, and notating "_RECORD" at the end of the file name.
4. The PDF will now be opened in Adobe. On the toolbar on the right, click the Fill & Sign option. On the top of the page, click Sign yourself.
5. If initials have not already been created, click Add Initials, and save your initials. If your initials have been saved, click on them in the dropdown menu and place them on the QC Check/PDF line at the bottom of the worksheet.
6. To create a read only copy, the QC person needs open Adobe Acrobat Pro DC with the Adobe Sign Add-In. After placing the initials, the QC person will click Next on the right of the Fill and Sign ribbon. Click Save as a Read Only. Save the record with the same naming convention and click yes to replace existing file with the Read Only version.

Figure 6 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 07/19/2024

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

Sampler:	URG	Model:	3000N	S/N:		Site:	Reno 4

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

Flow Standard:		Model:		S/N:	

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

Barometric Pressure Cal	Display (mmHg)	Standard (mmHg)	Diffrerence (mmHg)		Yes	No
Pressure:			0.0	+/-10mmHg	X	

Flow (22.0 L/min)

	IA (Sampler Display L/Min)	MA (Transfer Standard L/Min)	IA vs. MA % Dev.		Yes	No
Local (Act.) Flow:			#DIV/0!	+ / - 10%?	#DIV/0!	#DIV/0!

Post Cal Flow Verification (22.0 L/min)

	IA (Sampler Display L/Min)	MA (Transfer Standard L/Min)	IA vs. MA % Dev.		Yes	No
Local (Act.) Flow:			#DIV/0!	+ / - 10%?	#DIV/0!	#DIV/0!

Comments: ____

____

____

File Name: URG_Cal_Master_Template
Last Revision: 10/23/2024

QC:________

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 RTI shipping schedule (Figure 8). Shipping schedules are emailed to all Speciation operators from the Region 9 contact person. Contact Eric Poitras at RTI 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 $PM_{2.5}$ 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 a piece of blank paper and tape it 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 $PM_{2.5}$ CSN Custody and Field Data Form. Separate the yellow and white copies of both field forms. Staple the corresponding white Custody Forms to the white Coding/Null Value Form and do the same to the yellow 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 $PM_{2.5}$ 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.
9. At the end of each calendar year, remove the yellow copies of the $PM_{2.5}$ CSN Custody and Field Data forms and the Field Sampling Null Value and Validity forms from the binder, transfer them to a large-pocket file folder, and file in the appropriate file cabinet in the Data Manager's office to be retained for five years per Table 9-2 of the QAPP.

Figure 8 Chemical Speciation 1/3 Sequential Sampling Schedule

Chemical Speciation Network

Sequential Schedule December 2023
Through December 2024

October 2024

Shipping, Receiving, and Sampling Schedule for CSN Sites using 1-in-3 Sequential Day Sampling							
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Date			Oct 1	Oct 2	Oct 3	Oct 4	Oct 5
Shipped from RTI					7Q8QFB		
Received by State						7Q8QFB	
Sampling					**5Q**		
Shipped from State				3Q4Q			
Received by RTI					3Q4Q		
Date	Oct 6	Oct 7	Oct 8	Oct 9	Oct 10	Oct 11	Oct 12
Shipped from RTI			1Q2Q				
Received by State				1Q2Q			
Sampling	**6Q**			**7Q8QFB**			**1Q**
Shipped from State			5Q6Q				
Received by RTI				5Q6Q			
Date	Oct 13	Oct 14	Oct 15	Oct 16	Oct 17	Oct 18	Oct 19
Shipped from RTI		3Q4Q			5Q6Q		
Received by State			3Q4Q			5Q6Q	
Sampling			**2Q**			**3Q**	
Shipped from State		7Q8FB			1Q2Q		
Received by RTI			7Q8FB			1Q2Q	
Date	Oct 20	Oct 21	Oct 22	Oct 23	Oct 24	Oct 25	Oct 26
Shipped from RTI					7Q		
Received by State						7Q	
Sampling		**4Q**			**5Q**		
Shipped from State				3Q4Q			
Received by RTI					3Q4Q		
Date	Oct 27	Oct 28	Oct 29	Oct 30	Oct 31		
Shipped from RTI			1Q2Q				
Received by State				1Q2Q			
Sampling	**6Q**			**7Q**			
Shipped from State			5Q6Q				
Received by RTI				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

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Program Manager CSN FiSH Unit
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USA 32669-3000
Tel + 1 352 332 3318
Fax + 1 352 333 6622

www.amecfw.com

Page 1 of 1

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

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Michael Crawford

Title of Author: Air Quality Specialist

Signature: MICHAEL CRAWFORD Digitally signed by MICHAEL CRAWFORD Date: 2024.12.06 14:15:18 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.12.06 14:10:08 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.12.06 14:53:54 -08'00' 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
BKGD	Background
BP	Barometric Pressure
ºC	Degrees Celsius
^{14}C	Carbon-14
DAS	Data Acquisition System
EMI	Electromagnetic Interference
EPA	U.S. Environmental Protection Agency
HEPA	High Efficiency Particulate Air
IP	Internet Protocol
K	Kelvin
L/min	Liters per minute
µg	Micrograms
mmHg	millimeters of Mercury
NAAQS	National Ambient Air Quality Standards
NIST	National Institute of Standards and Technology
PDF	Portable Document Format
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 $PM_{2.5}$
PN	Part Number
PST	Pacific Standard Time
QA	Quality Assurance
QC	Quality Control
RH	Relative Humidity
RFI	Radio Frequency Interference
SOP	Standard Operating Procedures
VSCC	Very Sharp Cut Cyclone

List of Tables and Figures

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 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.

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 two 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 are also noted in the Station Log Report.

Figure 1 BAM Routine Check Form

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 ($\mu g/m^3$)										
Instrument Flow (act. L/min)										
Tape Condition										
Trouble Lights/ Error Codes										
Last Calibration Factor										

Comments: ____________________

File Name: BAM routine check form_2024
Last Revision: 07/19/2024

Figure 2 Station Log Report

Air Quality Management Division
Station Log Report

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_Master_Template.xlsx
Last Revision: 11/07/2024

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 PM_{10} 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. Record the "Start Time" in PST on the BAM Worksheet (Preferred time to start a verification would be at the start of the hour).
3. Complete the required information on the BAM Worksheet, including the instrument's displayed flow in actual L/min.
4. 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.
5. Record ambient pressure from instrument display (OPERATE>NORMAL screen) and pressure standard (in mmHg). Enter values into worksheet and verify acceptance criteria are +/- 10 mmHg. If not within specification, see section D.5.2 for pressure calibration.
6. 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 and allow enough time to equilibrate. Enter values into worksheet and verify acceptance criteria are +/- 2°C. If not within specification, see section D.5.3 for temperature calibration.
7. 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.
8. Allow the reading to stabilize and hit Start Avg., then take the 5 second average off the Alicat. Record measured flow on BAM Worksheet.
9. Calculate percent deviation between indicated and measured flow. Acceptance criteria are +/- 4%. If not within specification, see section D.5.4 for flow calibration.
10. 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.
11. In the TEST > TAPE menu, advance the tape forward to a fresh, unused spot.
12. 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.

13. 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.
14. Turn the pump off, remove the leak test valve, and re-install the inlet heads if monthly maintenance is already complete.
15. **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.
16. Complete the monthly inlet head maintenance and VSCC if on 2.5 unit (if due) before placing the inlet head back on the downtube (see section D.6 for Routine Maintenance).
17. Replace the inlet on the downtube and press Tape on the front of the instrument.
18. Press Self-Test to engage the sampler in the self-test procedure.
19. 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.
20. Note the end time on the field form.
21. Record the Date, Start Time, End Time, and Parameter on the respective digital Data Exception Log (Figure 4). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.

Figure 3 BAM Worksheet

Air Quality Management Division
BAM Worksheet

Flow Check: ____ Calibration: ____ Audit: ____

Manufacturer: ____ Model: ____ S/N: ____ ID: ____

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

Date / Time

Standard: ____ Model: ____ S/N: ____

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

Pressure/Temp/Flow Standard

Standard: ____ Model: ____ S/N: ____

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

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

T_A: 0.0 ^oC + 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	Due Date
Semi-annual Smart Heater, RH, and Filter Temperature Test				Jun-00
Annual Span Membrane Foil Check and Beta Detector/Dark Count				Dec-00
Annual Vertical Inlet Tube, Internal Debris Filter Cleaning and Lithium Battery Replacement				Dec-00
Annual Background Zero Test				Dec-00
Pump Deployment				Dec-01

	Yes	No
Self Test Passed?		

Comments: ______________________________

File Name: BAM Worksheet_Alicat_2024.xlsx
Last Revision: 11/01/2024

QC Check/PDF:__________

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 Audit Assigned Alicat FP-25BT
- 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 21 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 fall outside acceptable limits, fill out a Corrective Action Request (see Figure 5) 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. Log “Start Time” on the BAM Worksheet.
4. Insert the probe of the “Audit” Alicat temperature standard into the gill shield.
5. Wait approximately 2 minutes for stabilization.
6. Record the temperature readings from the BAM display and the audit standard in the Ambient Temperature section of the BAM Worksheet.
7. 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.
8. Turn sensor dish upside down and place sensor into cold Thermos, while also placing Alicat temp probe into at the same time. Ensure the BAM sensor only is submerged no more than 1.5” past the thermistor sensor tip. Slight stirring of the water/ice will help eliminate cold/hot spots in the Thermos.
9. Record the temperature readings from the BAM display and the audit standard in the Low Temperature section of the BAM Worksheet.

10. Insert the sensor dish as prior into the hot water along with the audit standard. Ensure the BAM sensor only is submerged no more than 1.5” past the thermistor sensor tip. Slight stirring of the water/ice will help eliminate cold/hot spots in the Thermos.
11. Record the temperature readings from the BAM display and the audit standard in the High Temperature section of the BAM Worksheet.
12. All three points (ambient, low, and high) must be +/-2ºC to pass.
13. Remove the sensor dish from Thermos and reassemble the sensor to the downtube.
14. Log “End Time” on the BAM Worksheet.
15. Record the Date, Start Time, End Time, and Parameter on the respective digital Data Exception Log (Figure 4). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
16. The worksheet will be checked by the QA Manager, finalized, and saved with a PDF copy.

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.

D.4.3 QA/QC Worksheet Review and PDF Finalization

After completing the QA/QC worksheet, it needs to be reviewed by an Air Quality Specialist and then saved as a read only PDF to lock the worksheet from editing, creating the official record.

1. Once a QA/QC worksheet is completed, the assigned QC person for that site will review and PDF the worksheet. QA Manager will be responsible for reviewing and creating a PDF for all audit QA/QC worksheets.
2. It is the responsibility of the assigned QC person to monitor the QA/QC folder on the AQMonitoring drive for new QA/QC worksheets to review and PDF. When a new worksheet is completed, the QC person will review the worksheet for errors, including content and calculations.
    a. If an error is found, contact should be made to the operator to get the issue fixed.
3. After completing the review, click the Acrobat tab on the top ribbon. Click Create PDF. Click Convert to PDF, Yes, and Save. Save the PDF with the same naming convention, and notating “_RECORD” at the end of the file name.
4. The PDF will now be opened in Adobe. On the toolbar on the right, click the Fill & Sign option. On the top of the page, click Sign yourself.
5. If initials have not already been created, click Add Initials, and save your initials. If your initials have been saved, click on them in the dropdown menu and place them on the QC Check/PDF line at the bottom of the worksheet.
6. To create a read only copy, the QC person needs open Adobe Acrobat Pro DC with the Adobe Sign Add-In. After placing the initials, the QC person will click Next on the right

of the Fill and Sign ribbon. Click Save as a Read Only. Save the record with the same naming convention and click yes to replace existing file with the Read Only version.

7. Each folder will contain a RECORD and ARCHIVE folders, drag and place the original Excel file into the ARCHIVE folder and the _RECORD PDF file into the RECORD folder.

Figure 5 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 07/19/2024

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.

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 with the probe inserted into the gill shield.
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 5-9) 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 BAM's 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 5-9) 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 PM_{10} head from the inlet tube and install the Alicat FP-25BT flow standard onto the inlet in its place. If the BAM is a $PM_{2.5}$ 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 6). Enter flow value from the worksheet into the STD field using the arrow keys, and then press the CAL soft key.
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 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 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 6 BAM Flow Calibration Worksheet

Air Quality Management Division
PM Calibration Worksheet-BAM 1020

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	

Flow 1 (15.0 LPM)

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

Flow 2 (18.4 LPM)

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

Flow 3 (16.7 LPM)

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

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_BAM1020
Reviewed: 11/14/24

QC Check/PDF:__________

D.6 Routine Maintenance

Table 1 Maintenance Items and Frequency

Maintenance Item	Frequency
Clean PM_{10} inlet collection assembly	Monthly
Clean $PM_{2.5}$ 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 PM_{10} 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
Replace internal battery and debris filter assembly	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 (Figure 7).
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 (Figure 8).
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.

Figure 7 PM_{10} Inlet Head Exploded View

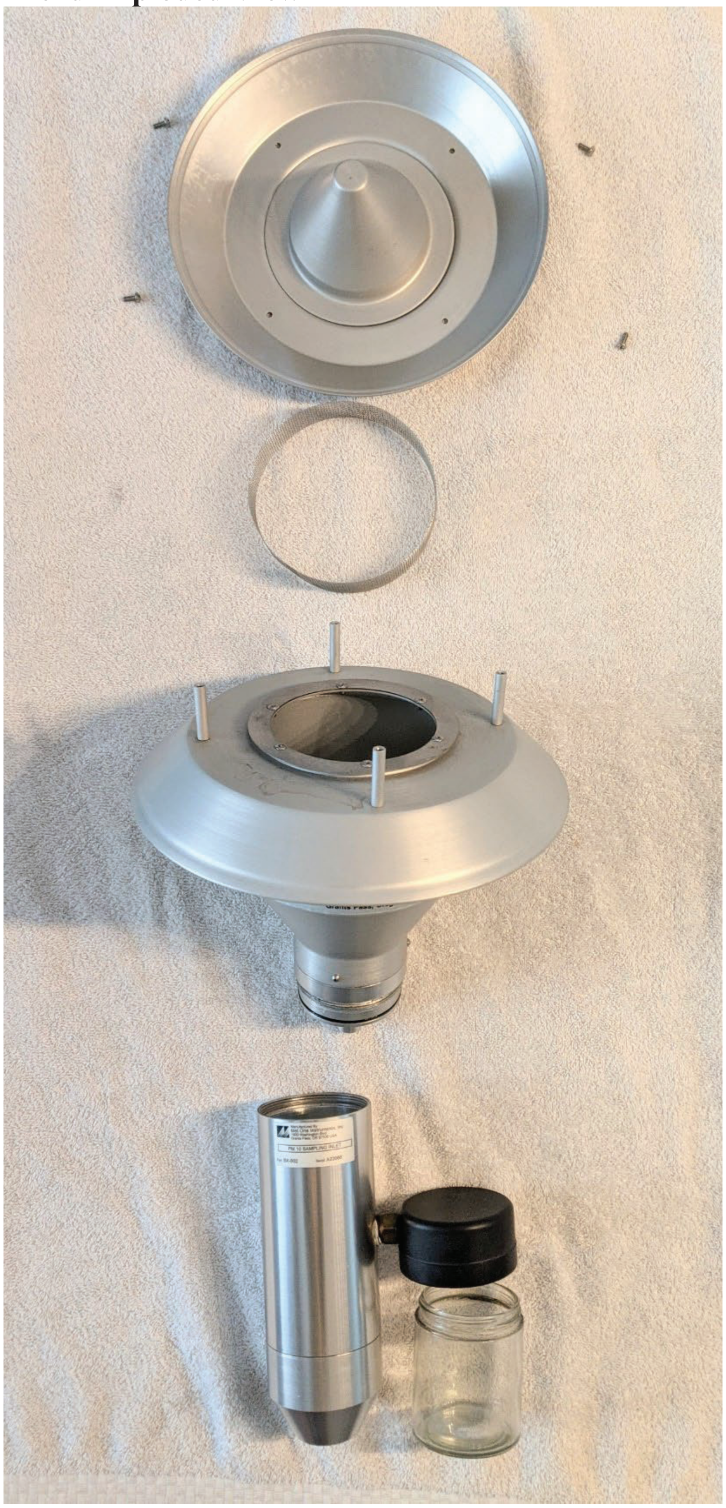
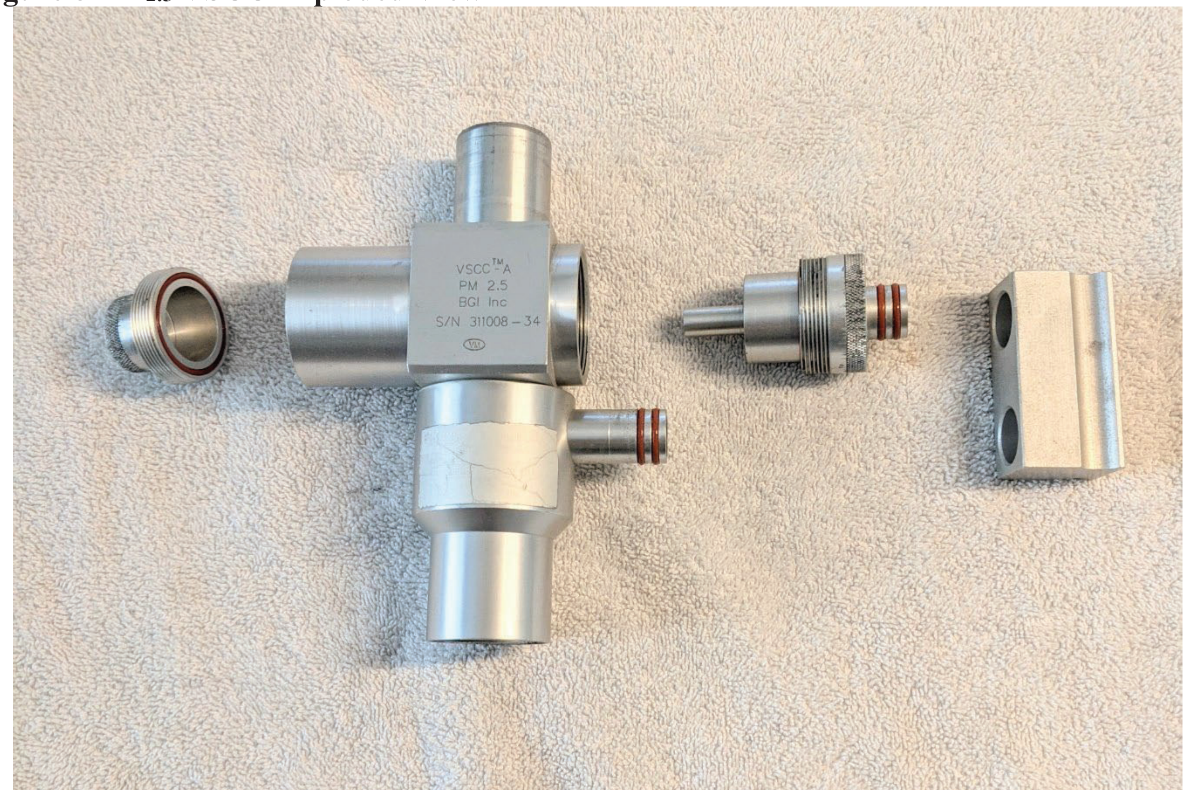


Figure 8 $PM_{2.5}$ VSCC Exploded View



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 9) 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

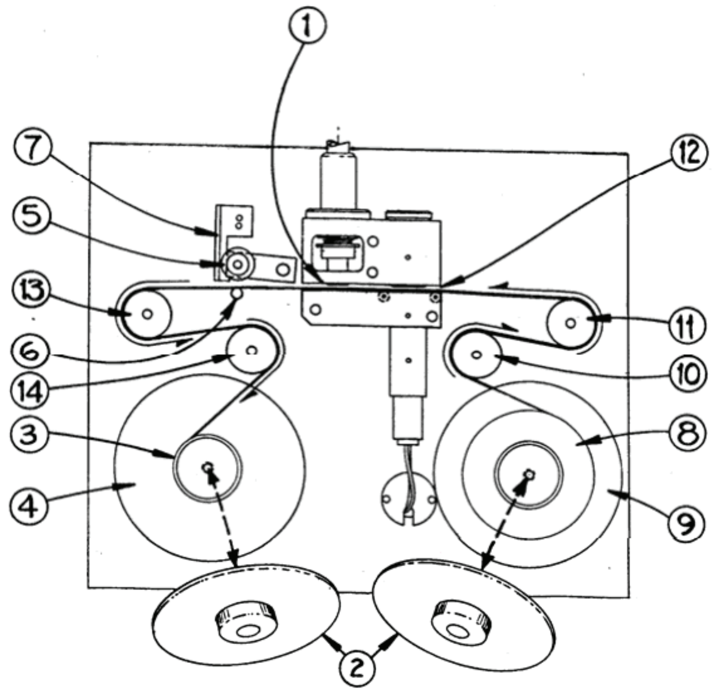
Figure 9 shows the location of the pinch rollers. The capstan shaft is the stainless steel shaft that the rubber pinch roller rests on. Use a cotton tipped swab moistened with distilled water to wipe down the capstan shaft. This action is easiest to do when the pinch roller is latched in the UP position. Use a dry Kimwipe to clean the pinch roller wheels of any tape debris. Do not use any liquid or solvents on the wheels as it will start to break down the rubber wheel and make them tacky thus sticking to the tape.

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 TEST menu from the main screen.
2. Press the PUMP key, then press MOVE NOZZLE 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 9 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, align the filter tape so that it is centered on all the rollers by using the score marks, then install the clear plastic spool covers and tighten down spool.
9. Unlatch and lower the pinch roller assembly onto the tape.
10. Press the TEST key then press TAPE key. Advance the tape forward several times till the left take up roll has at least 1-2 full revolutions of tape around it to help ensure it does not unroll.
11. Press EXIT to exit this menu.
12. Then run a SELF TEST to clear any errors and put BAM back into OPERATE status.

Figure 9 Filter Tape Loading Diagram



1----NOZZLE IN "UP" POSITION
2----CLEAR SPOOL COVER WITH KNOB
3----EMPTY CORE TUBE
4----TAKE-UP SPOOL
5----PINCH ROLLERS
6----CAPSTAN SHAFT
7----LATCH
8----FILTER TAPE
9----SUPPLY SPOOL
10--SUPPLY TENSION ROLLER
11--RIGHT END ROLLER
12--SAMPLING/MEASURING AREA
13--LEFT END ROLLER
14--TAKE-UP TENSION ROLLER

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 (Figure 7).
2. Lift the top plate off 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 blow 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 and 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 PM_{10} 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. Disconnect Heater plug from BAM and allow to fully cool down prior to this test. 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 +/- 1ºC.
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. Disconnect Heater plug from BAM and allow to fully cool down prior to this test. 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 several 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. compare this value with the ABS value in the SETUP >>CALIBRATE screen.

If the 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.

The Dark Count test is to be performed after the first Count test. A steel shim large enough to block the source and detector will be placed on top of the tape. The test is then started for 4 minutes. After 4 minutes, there will be a reading displayed that should be less than 10 counts. If the total is more than 50 counts, contact Met One Technical service.

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 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%.

Install the zero filters 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. Remove the site BX-596 electronics module from the gill shield and install into the spare gill shield dedicated for Zero Test inside the shelter. Disconnect the temperature cable on the back of the BAM on Channel 6. Install the Zero Test dedicated temperature/pressure cables to the electronics module and the other end connected to Channel 6 on the back of the BAM. 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. Start the BAM sampling for about 72 hours. The unit should be operating just like it would for regular sampling, only with the zero filter installed instead of the PM_{10} inlet and cyclone.
2. After at least 72 hours of sampling, download the hourly concentration data from AirVision and import it into Excel for analysis. An Excel template to expedite the zero test data evaluation (shown below Figure 10) 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 will be discarded and the remaining hours used for analysis. This improves the data set because of the tape tracking for the first few hours, if not perfectly centered when installed.

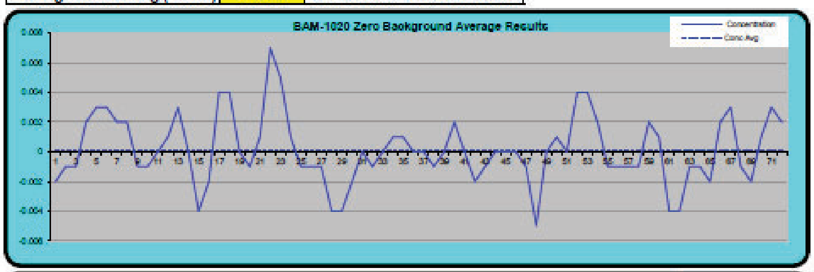
5. Graph the concentration data. The zero noise levels of the BAM-1020 from the test will be visible. The example below shows a typical zero data set from a BAM-1020 (Figure 10).
6. Calculate the average of the zero data to four decimal places. Calculate a new **BKGD** value for the unit by taking the 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 and negative values, 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 PM_{10} and $PM_{2.5}$ inlets/downtube, and reassemble the BX-596 temp/pressure sensor. Resume normal operation.

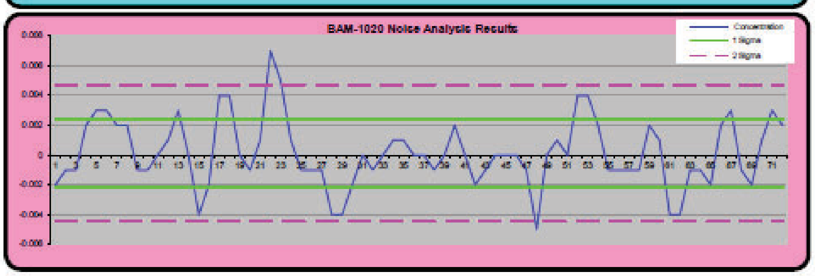
Figure 10 Met One Zero Data Analysis Excel Template Sample

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 and 12V Backup Battery

An internal debris filter is 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 assembly can only be replaced (Met One PN 580291).

An internal 3V Lithium Coin battery is located on the back of the BAM behind a rectangle shaped cover held on by 4 Phillips head screws. Power off unit, remove the cover and carefully replace the battery. After battery replacement, verify that the settings were saved (BACKGROUND VALUE). Often, the time and date will need to be adjusted to the correct time. The battery can be either sourced locally from a battery supplier or ordered from Met One (Met One PN 390044).

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 EE: Met One E-SEQ-FRM Sequential Reference Method Particulate Sampler - $PM_{2.5}$ and PM_{10}

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

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

Approved:

Name: Michael Crawford

Title of Author: Air Quality Specialist

Signature: MICHAEL CRAWFORD Digitally signed by MICHAEL CRAWFORD Date: 2024.11.27 08:20:31 -08'00' Date: 11/27/24

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.27 08:15:29 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.27 08:16:38 -08'00' 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
AQMD	Northern Nevada Public Health Air Quality Management Division
AT	Ambient Temperature
BoxP	Box Pressure
BP	Ambient or Barometric Pressure
BT	Box or Current Temperature
ºC	Degrees Celsius
CFR	Code of Federal Regulations
CV	Coefficient of Variation
DVM	Digital Volt Meter
EPA	U.S. Environmental Protection Agency
FRM	Federal Reference Method
FP	Filter Pressure
FT	Filter Temperature
ID	Identification
K	Kelvin
L/min	Liters Per Minute
LPM	Liters Per Minute
mm	Millimeters
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 $PM_{2.5}$
PTFE	Polytetrafluoroethylene
QA	Quality Assurance
QC	Quality Control
SOP	Standard Operating Procedures
USB	Universal Serial Bus
VAC	Volts of Alternating Current
VDC	Volts of Direct Current
VSCC	Very Sharp Cut Cyclone

List of Figures

EE.1 Introduction

The Met One Instruments, Inc. Model E-SEQ-FRM (Figure 1) is a programmable multi-event filter sampler designed to meet EPA specifications as a reference method for the determination of daily $PM_{2.5}$ or PM_{10} particulate concentrations in ambient air. The E-SEQ-FRM employs a supply magazine containing up to 16 pre-weighed 47 mm sample filter discs in individual EPA-standardized cassettes which will be automatically exchanged by the sampler prior to each sample period. The instrument runs a series of samples based on an operator programmed schedule with defined start times and sampling durations. A vacuum pump, controlled to 16.67 liters per minute (L/min), draws ambient air through a series of standardized inlets that provide the PM_{10} and, if applicable, $PM_{2.5}$ cut points. The sample then passes through the filter, where the airborne particulate matter is deposited.

Figure 1 Image of Assembled E-SEQ-FRM

After the sample period is complete, the PM-laden filter is automatically moved to the storage magazine which is later emptied. The filters are then transported to a lab to be equilibrated and reweighed. The resulting clean and dirty mass values for the filter are then combined with the volume of air sampled to determine the concentration of particulate matter in micrograms per cubic meter ($\mu g/m^3$). The E-SEQ-FRM can easily be configured for EPA $PM_{2.5}$ FRM operation using the Met One Instruments BX-808 Very Sharp Cut Cyclone (VSCC), or the BX-804 WINS Impactor. Alternatively, other cyclonic separators may be used with the E-SEQ-FRM if operation as an EPA designated reference method is not required. If PM_{10} sampling is desired, the $PM_{2.5}$ VSCCs can be omitted entirely, and a pass-through adapter can be installed in its place.

E-SEQ-FRM EPA Configurations

The E-SEQ-FRM is EPA designated under the following designation numbers:

- RFPS-0717-245: $PM_{2.5}$ designation
- RFPS-0717-246: PM_{10} designation
- RFPS-0717-247: $PM_{10-2.5}$ designation

EPA designated methods using the E-SEQ-FRM are modified from time to time in order to reflect hardware or software improvements. These modifications do not impact previously designated configurations of the E-SEQ-FRM but may provide the end user with a product upgrade path that will allow the monitor to continue to be operated as a EPA designated method. For further details, please contact the Met One service department. Details concerning EPA designated configurations of the E-SEQ-FRM may be found on the EPA website: https://www.epa.gov/system/files/documents/2024-06/amtic-list-june-2024-update.pdf

EE.2 Theory of Operation

Met One has developed the 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 polytetrafluoroethylene (PTFE) 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 USB thumb drive.

EE.3 Precautions

The E-SEQ-FRM sampler uses 12 VDC power supply which can be used 115-230 VAC input power. The sampler is rated at 40 Watt (W) max continuous with the pump running. Be cautious of moving and rotating components while working on sampler. The sample site needs to be equipped with Alternating Current (AC) power and a standard weatherproof outdoor electrical outlet. An earth-ground point near the unit is recommended.

- Caution should always be given when attaching the 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.
- Do not allow the fan opening to become clogged or blocked.

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

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

EE.4 Instrument Operation

EE.4.1 Sampling Procedure

The E-SEQ-FRM $PM_{2.5}$ and PM_{10} samplers are run every third day as specified by the EPA Sampling Schedule (Figure 2). The sampling duration is 24 hours, running from midnight-to-midnight PST.

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)
- Chain of Custody/Field Sample Report
- USB thumb drive (Data downloads)

EE.4.2. Preparing Filters

1. Follow lab weigh procedure to weigh pre-run filters.

2. Clean the prep surface, filter cassettes and filter cassette caps with anti-static Staticide cleaner.
3. Utilize the flat tipped, uncoated tweezers to remove filter from petri container and insert into white sampler cassette, press together firmly, and cover with thin metal covers on both sides of the cassette.
4. Insert filter cassette into metal transport can and load first date run lower in can and next date run in upper location in the can.
5. Lightly screw canister cover onto the lower can housing.
6. Fill out Chain of Custody/Field Sample Report (Figure 3) with pre-run information. Circle 2.5/10 selection, fill out lab blank number, run filter number, run date and day, and weigh by date (filters should be weighed in 30 days after the filter run date).
7. Insert filter Chain of Custody/Field Sample Report that matches the filter ID number on the petri dish into a folder. Folders are marked with "2.5" and "10" numbers on them. Insert paperwork for 2.5 filters into 2.5 folder and 10 filters into 10 folder.
8. Gather folders with field chain of custody forms and filter canisters and transport to site.

Figure 2 EPA Sampling Schedule

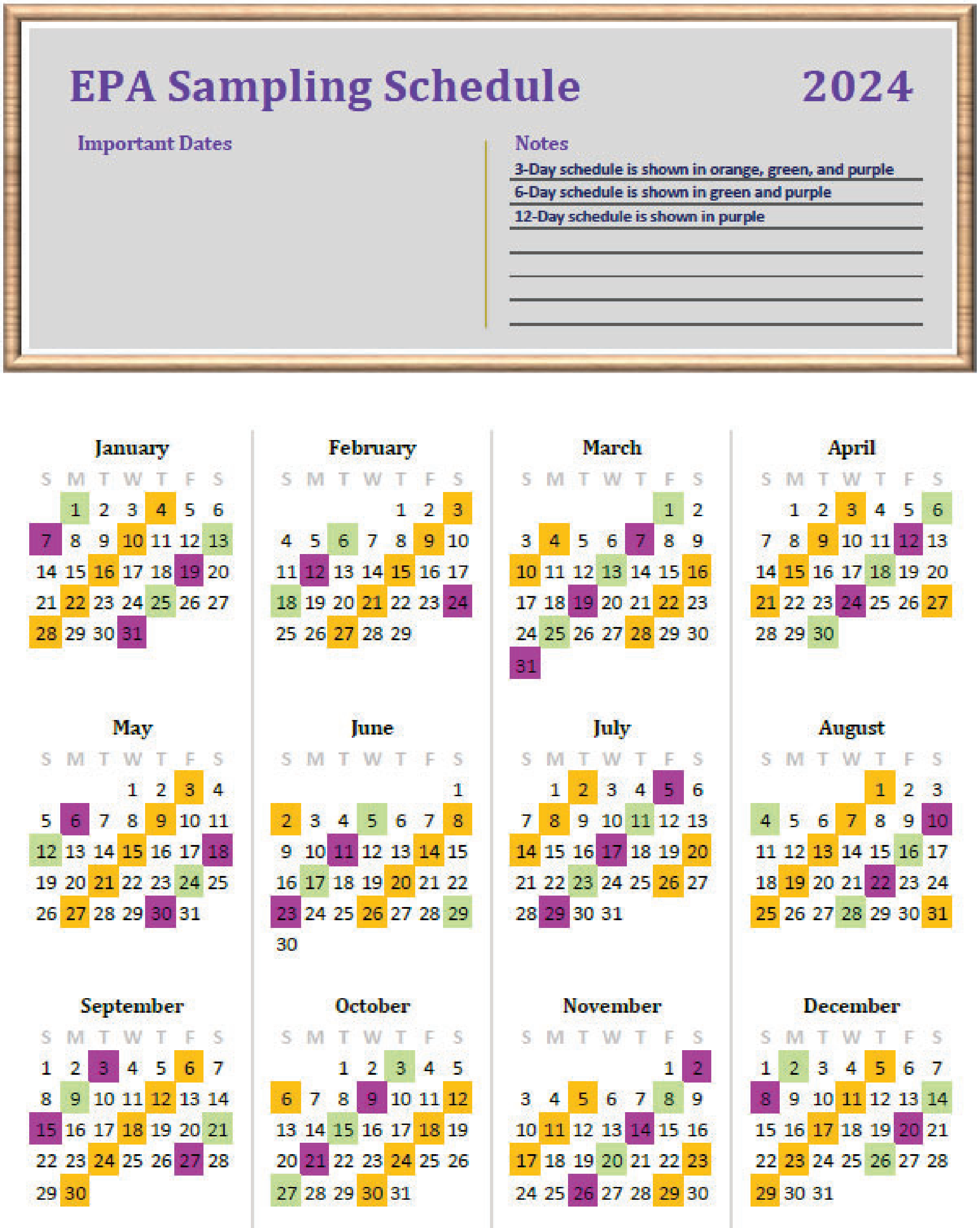


Figure 3 Field Sample Report

Air Quality Management Division
Chain of Custody / Field Sample Report

Site: *Reno 4*
Sampler: *MET ONE SEQUENTIAL*
Model: *E-SEQ-FRM*

Filter Number:

S/N:	*B13407*	*B13408*	*FB*
ID:	*$PM_{2.5}$*	*PM_{10}*	

Sample Date: Su M T W Th F Sa

Lab Blank:

Weigh by:

Transport:

STAFF	DATE	TIME

Field Fridge Temp: °C
Max Transport Temp: °C

Pre Weighed on:

Post Weighed on:

Chain of Custody

Action	Date	Time (PST)	SEQ RUN	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:

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 5
Reviewed: 11/07/2024

EE.5 Installing Filters

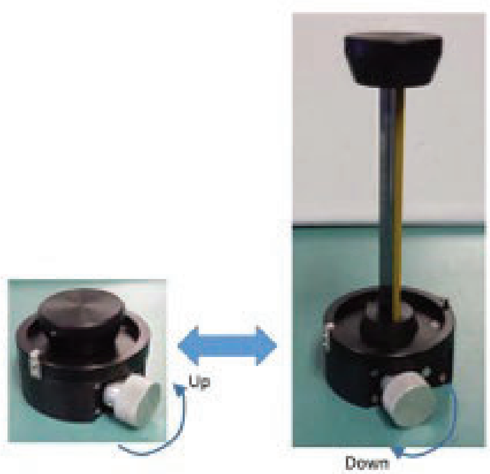
EE.5.1 Loading and Unloading the Filter Cassette Magazines

The E-SEQ-FRM Sampler comes with three filter cassette magazines and one adjustable bottom lid. Filter cassettes (Figure 4) may be purchased separately. The sampler uses an industry standard filter size of 47 mm for collecting particulate.

Figure 4 Filter Cassettes, Magazine and Adjustable Bottom Lid

The filter cassette magazines hold a maximum of 16 filter cassettes. An adjustable bottom lid is used whenever loading or unloading the filter cassette magazines. It also secures the internal stack of filter cassettes and prevents them shaking whenever the filter cassette magazine is transferred from one place to another. A plunger is mounted on a steel ribbon which allows it to be moved up and down by rotating a knob in the base. Rotating the knob in the clockwise direction lowers the plunger while rotating the knob counterclockwise raises it (Figure 5).

Figure 5 Adjustable Bottom Lid Operation



EE.5.2 Loading New Filter Cassettes into the Filter Cassette Magazine

The adjustable bottom lid is used whenever loading (or unloading) filter cassette holders into the filter cassette magazine (Figure 6). It seals the bottom of the magazine so the holders cannot fall out of the bottom while also providing a controlled means of lowering them into place to ensure proper positioning. The following procedure assumes pre-weighed filters are already loaded into properly identified filter cassette holders.

Figure 6 Loading New Filter Cassettes into the Magazine

1. Remove top magazine lid and install the adjustable bottom lid into the base of the filter cassette magazine.
2. Rotate the adjustable bottom lid to secure it in place.
3. Turn the knob of the bottom lid counterclockwise until the plunger is positioned near the top of the magazine.
4. Note the ID of the first filter cassette (first filter inserted is first filter scheduled to run) and then set it on top of the plunger. It should be resting nearly level with the top of the magazine.
5. Note the ID of the next filter cassette (next filter will be next scheduled filter to be run). Be certain to indicate this cassette's position in the magazine stack. It will be necessary to know the exact order of the filters later when programming the sequential sampling events.
6. Rotate the knob in the bottom lid clockwise to lower the plunger just far enough to set the next filter cassette holder in place so that it is level with the top of the magazine.
7. Repeat steps five and six as needed until all the desired filter cassette holders are loaded and then install the top lid.
8. The adjustable bottom lid should remain in place. Raise the plunger just enough to secure the filter stack in place so that it does not wobble, shake, or turn the filter over during transit.
9. Keep the folder with the chain of custody forms with this magazine. It will be needed when the magazine is installed in the sampler.

EE.5.3 Installing and Removing Supply Filter Cassette Magazine into E-SEQ-FRM

Installing the supply magazine loaded with new filters is a simple process. Verify that no filters remaining in the supply magazine in the sampler (if one is installed) and that any previously loaded filters have already been moved to the storage magazine.

1. Remove the current storage magazine and set it aside.
2. Remove the empty supply magazine and install it in the storage position.
3. On the new supply magazine, slowly lower the plunger until the filter stack is supported on the stops (Figure 7).
4. Gently rotate and remove the bottom lid from the magazine.
5. Carefully align the magazine's mount slot with the supply mounting index inside the sampler (Figure 8).
6. Insert supply magazine into mounting index and rotate it as shown by the arrows in (Figure 8). The magazine can be rotated in either direction. Rotate it until the magnets catch the magazine stops and retract them. When the stops retract, an audible clicking sound should be heard and the filters should drop down in to place.

Figure 7 Preparing Magazine for Installation

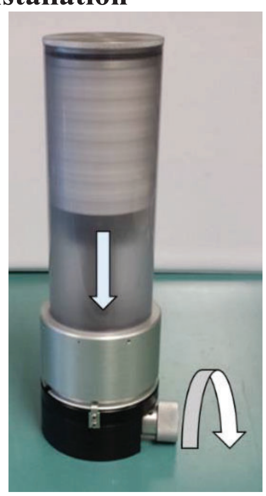
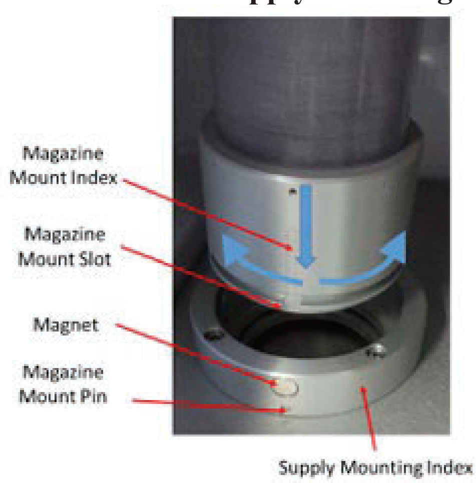


Figure 8 Supply Magazine Installation into Supply Mounting Index



EE.6 Pulling Filters

EE.6.1 Removing a Filter Cassette Magazine

1. Rotate Post run filter cassette (right side) until the magazine mounting index aligns with the magazine mounting pin (Figure 8).
2. Gently lift up on the magazine to remove it from the mounting index.

EE.6.2 Removing Filter Cassettes from a Magazine

Removing used filter cassettes from the storage magazine is essentially reversing the sequence for installation of filter cassettes.

1. If it is not already installed, install the adjustable bottom lid into the base of the filter cassette magazine.
2. Rotate the adjustable bottom lid to secure it in place.
3. Remove top magazine lid.
4. Turn the knob of the bottom lid counterclockwise until the plunger raises the top of the used filters just above the top of the magazine. This will make it easy to lift off the stack.
5. Remove the top filter, put metal lids onto the filter, and insert into slots of metal storage canister.
6. Repeat steps four and five as needed until all the used filter cassette holders have been removed and then install the top lid. This will keep the lid on the magazine and prevent it from becoming lost. After all filters are placed into metal canister store in refrigerator at the site until time for transport.
7. The adjustable bottom lid may now be lowered and placed in storage or used elsewhere.

EE.7 Programming Sample Runs

1. From the Home menu, press the triple line icon in the top left corner, select (Operate), select (Event Manager), then press (Add).
2. Input filter ID as shown on Chain of Custody form which matches filter to be scheduled to run and press (OK).
3. If run filter is a Field Blank, select (Blank) button and press (Yes).
4. Verify filter ID, then press start time display. Enter the start date and duration for the filter. Duration for normal sampling should be set to 1 Day, 0 Hour, and 0 Min.
5. Select the correct Inlet type (PM_{10} for PM_{10} sampling and $PM_{2.5}$ VSCC for $PM_{2.5}$ sampling), then press (Save). For additional filter scheduling, repeat steps (2-5).
6. Press (X) icon in top right corner, then press (Home) icon to go back to the home screen. Home screen should show (Waiting) status and be the next filter scheduled to run.

EE.8 Post Run Filter Data Retrieval

1. Select Event Manager screen, press left or right arrow keys to select filter run to record. Use the Up/Down arrows to view different run data information and record on the Chain of Custody form.
2. Press top left button to return to the main menu. Insert the USB thumb drive marked (SEQ) into the front panel of the E-SEQ-FRM sampler. Select the (Operate) menu, select (7) Days for transfer dates and Files to (User), then press (Copy).
3. Sampler will display 100% upon completion of downloaded data, remove the thumb drive, and press (X) in the top right corner to go back to Operate menu, then press Home icon in top right corner to return to the home screen.
4. Insert thumb drive into AQ Laptop and open thumb drive location for B13407 ($PM_{2.5}$ Sampler) run data. Open a second drive location and open this location: (AQMonitoring\Field Mgmt Functions\QA-QC\MET ONE SEQUENTIAL SAMPLERS\PM2.5 SAMPLER\SAMPLER DOWNLOAD DATA\B13407). Copy thumb drive file of the recently downloaded file to the location on the AQ monitoring drive. Repeat for the B13408 (PM_{10} Sampler) and select location on the AQ monitoring drive for the B13408 folder.
5. After file transfers, remove USB thumb drive and store at field shelter.

EE.8.1 Filter Data Backup

1. Open FS Comm Software.
2. Click icon on top (Import Files)
3. Select this location on AQMonitoring Drive: Field Mgmt Functions\QA-QC\MET ONE SEQUENTIAL SAMPLERS\PM2.5 SAMPLER\SAMPLER DOWNLOAD DATA\B13407, select current year.
4. Open the date for each file and open the (.BIN) file.
5. FS Comm will automatically generate a folder for the month and place the (.BIN) file into it. Repeat steps 2-5 for all the dates in the (B13407) folder.
6. After all the (B13407) files are imported. Select on the left side of the screen folder (B13408) and select current year.
7. Repeat steps 2-5 for all (B13408) files.
8. After all files have been imported, on the left side of the screen, select the month in the current year.
9. Click on the upper right side of the screen (XLS CSV EXPORT).
10. Verify all the dates in the month have a check mark next to them.
11. The box will also prompt for (Output Folder) select either $PM_{2.5}$ or PM_{10} sampler, current year, and the correct month for the files.
12. Open "Second Address Location" and verify files were copied to the correct location.

EE.9 Transporting Filters

1. Open cooler and place blue freeze packs from site freezer (pack number will vary depending on number of canisters being transported).
2. Place filter canisters into cooler (Figure 9), limit canisters to maximum of 3. If there are more canisters, just combine the filters from extra canisters to others with open slots for filters.
3. Check the Fridge/Freezer Thermometer that is kept inside the refrigerator and record on the Chain of Custody forms for each filter the current temperature, date, time, and site operator performing the transportation.
4. The Fridge/Freezer Thermometer that is labeled (Transport), press the CLR (Clear) button then place inside the transport cooler and close the cooler lid.
5. Transport the cooler back to the office with minimal stops to prevent the filters from going out of temperature spec.
6. Upon return to the office, inspect the Transport Thermometer and record on the Chain of Custody form the Max temperature reading which must not exceed 4 degrees C.
7. Either then store the filters in the metal canisters in the fridge located in the AQMD repair room or refer to Lab procedures to dismantle filter cassettes and condition Post Run filters.

Figure 9 Filter Transport Case Cooler

EE.10 Quality Control

EE.10.1 Monthly Verifications

Monthly verifications of the E-SEQ-FRM's are completed once a month.

Equipment Needed

- Alicat FP-25BT Traceable Flow/Temp/BP Standard
- External and Internal Leak Test Filters
- Stopcock
- QC Filter Cassette
- E-SEQ-FRM Monthly Worksheet Form

Verification Procedure

1. Fill out the instrument identification information, select Verification box, date, time, and operator on the E-SEQ-FRM Monthly Verification Form (Figure 10). Fill out the verification standard information on the field form. Remove both clear filter canister tubes prior to performing verifications.
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 11 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 11 for Calibration Procedures.
4. Place the temperature standard probe in the ambient temperature radiation shield (Figure 11) 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 5 for Calibration Procedures.
5. To perform the leak check, remove the inlet head from the downtube and place the stopcock on the top of the downtube and verify stopcock is in the closed position
6. From the Test Menu, select either external or internal and insert the matching and labeled QC external or internal leak check filter. External is the normal Leak Check method which tests the entire sample flow path. Internal Test is to check the sample path before the filter holder and inside the pneumatic flow path inside the unit. Select Load filter, sampler will load filter and then press Start on screen.
7. E-SEQ-FRM will pressurize and will start the Leak Check, after about 3-4 minutes, the unit will show if it Passed or Failed the Leak Check.
8. Unit will then prompt to remove Leak check filter cassette and slowly open stopcock and remove from downtube. In the event the unit fails External Leak Check, insert Internal QC Leak Check Filter and start an internal leak test. If this passes, it'll let you know if the leak is from the pre-filter holder or post filter holder to assist with troubleshooting.

9. To verify the flow rate, attach the flow standard to the top of the downtube and place the standard temperature probe in the E-SEQ-FRM radiation shield, then go to the Test > Flow calibrate, the Insert Cassette screen will appear, insert a clean QC filter on the load (left side) and press “Verify Flow Calibration.”
10. The sampler will begin to pump air at the current selected flow rate. After the flow is stable, record the value of the E-SEQ-FRM flow rate and the flow rate off the flow standard. 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 11 for Calibration Procedures.
11. Press the X screen button to exit the test. Press the REMOVE button to advance the cassette to the storage magazine position and remove the cassette from the right storage magazine side. Press the EXIT button to exit the test and return to the Test Menu.
12. Remove the flow standard from the inlet tube.
13. Remove VSCC ($PM_{2.5}$ sampler) or internal pass-through adapter (PM_{10} sampler) (Figure 12) and place temperature standard probe down the lower sampler intake hole. (Figure 13) Change temperature display from AT (ambient temperature) to FT (filter temperature). Allow temperature to stabilize on the temperature standard. Record the sampler’s filter temperature from the main screen and the actual temperature from the temperature standard on the field form. The sampler’s filter 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 11 for Calibration Procedures. This step is best performed last since it requires dismantlement to the sample flow path and could affect Leak Check and Flow verification.
14. Select AT, then press the menu button to return to the Main Menu.
15. Detach the flow equipment, replace the inlet to the top of the downtube, reassemble VSCC or internal pass-through adapter assemblies, and reinstall clear filter load cassettes.
16. Close the front of the instrument and reconnect the latch.

Figure 10 Monthly Verification Form

Air Quality Management Division
E-SEQ-FRM Worksheet

Verification:		Calibration:		Audit:	
Manufacturer:		Model:		S/N:	
ID:					
Start Time (PST):		Date:		Operator:	
Site:					

Date / Time

Standard: ______ Model: ______ S/N: ______

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

Verification Standard

Standard: ______ Model: ______ S/N: ______

Pressure

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

Temperature

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

Flow

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):					
	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		Yes	No
	I_S vs. M_S	#DIV/0!	+/- 4%	#DIV/0!	#DIV/0!

Leak Check

As Found: ______ After Maint.: ______

Maintenance

	Yes	No	N/A
Monthly PM_{10} Inlet Maintenance Completed?			
Monthly $PM_{2.5}$ VSCC Maintenance Completed?			
Quarterly PM_{10} Inlet Maintenance Completed?			

Comments: ____________________

File Name: BLANK_FORM_E-SEQ-FRM
Reviewed: 08/06/2024

QC Check/PDF:________

Figure 11 Ambient Temp Sensor

Figure 12 $PM_{2.5}$ VSCC and PM_{10} Pass-through Adapter

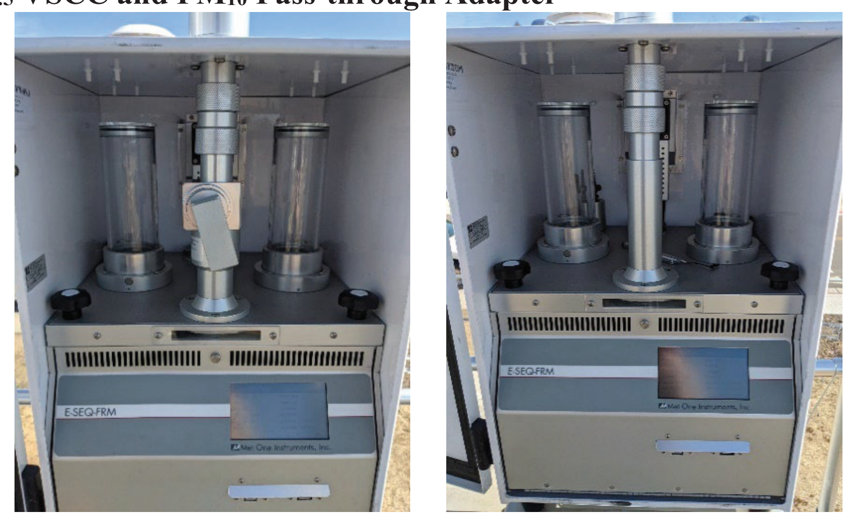
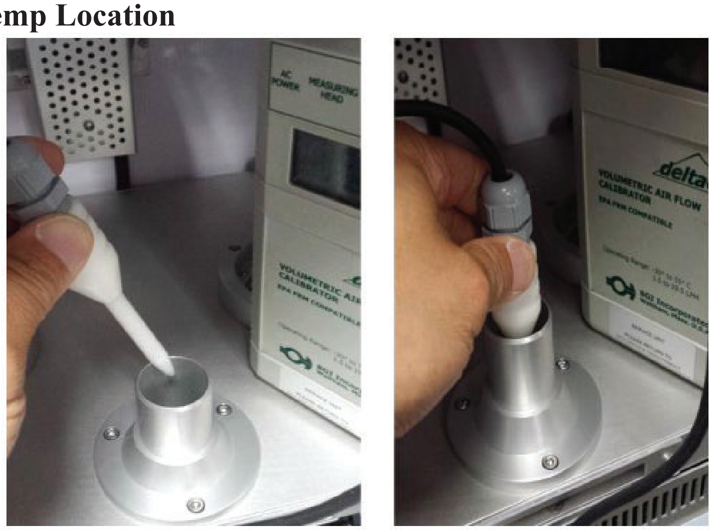


Figure 13 Filter Temp Location



EE.10.2 Quarterly Audit Checks

Equipment Needed

- Alicat FP-25BT Traceable Flow/Temp/BP Standard
- External Leak Test Filter
- Stopcock
- QC Filter Cassette
- Thermos Containers with Hot and Cold Ice Water
- E-SEQ-FRM Monthly Worksheet Form

EE.10.2.1 Audit Procedures

1. Fill out the instrument identification information, select Audit box, date, time, and operator on the E-SEQ-FRM Monthly Worksheet Form (Figure 10). Fill out the verification standard information on the field form. Remove both clear filter canister tubes prior to performing verifications.
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.
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, a corrective action form (Figure 15) needs to be filled out and acknowledged by instrument operator.
4. Place the temperature standard probe in the ambient temperature radiation shield (Figure 11) 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, a corrective action form needs to be filled out and acknowledged by instrument operator.
5. Loosen screws that hold the Ambient Temp sensor so the sensor can be removed from radiation shield (Figure 14). Submerge the AT sensor and Alicat Temp Probe into the cold ice water thermos and stir up to eliminate any stagnant temps in the thermos and let stabilize. Once stable, record the temp values from the Alicat and the E-SEQ-FRM sampler on the Worksheet form. Remove both sensors from cold thermos. Insert Alicat sensor into the hot water thermos, ensure water temp is under 50 Degrees C, use ambient temp water or some cold water and frequently stir until water is under the 50 Degree range. Insert the AT sensor into the hot water and stir up to eliminate any stagnant temps in the thermos and let stabilize. Once stable, record the temp values from the Alicat and the E-SEQ-FRM sampler on the Worksheet form. The sampler's temperature must be within +/- 2°C of the verification temperature. If it is outside +/- 2°C, a corrective action form needs to be filled out and acknowledged by instrument operator. Reassemble the sampler AT sensor back into the radiation shield.
6. To perform the leak check, remove the inlet head from the downtube and place the stopcock on the top of the downtube and verify stopcock is in the closed position.

7. From the Test Menu, select either external or internal and insert the matching and labeled QC external or internal leak check filter. Each External is the normal Leak Check method which tests the entire sample flow path. Internal Test is to check the sample path before the filter holder and inside the pneumatic flow path inside the unit. Select Load filter, sampler will load filter and then press Start on screen.
8. E-SEQ-FRM will pressurize and will start the Leak Check, after about 3.4 minutes, the unit will show if it Passed or Failed the Leak Check.
9. Unit will then prompt to remove Leak check filter cassette and slowly open stopcock and remove from downtube.
10. To verify the flow rate, attach the flow standard to the top of the downtube and place the standard temperature probe in the E-SEQ-FRM radiation shield, then go to the Test > Flow Calibrate, the Insert Cassette screen will appear, insert a clean QC filter on the load (left side) and press "Verify Flow Calibration."
11. The sampler will begin to pump air at the current selected flow rate. After the flow is stable, record the value of the E-SEQ-FRM flow rate and the flow rate off the flow standard. 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, a corrective action form needs to be filled out and acknowledged by instrument operator.
12. Press the X screen button to exit the test. Press the REMOVE button to advance the cassette to the storage magazine position and remove the cassette from the right storage magazine side. Press the EXIT button to exit the test and return to the Test Menu.
13. Remove the flow standard from the inlet tube.
14. Remove VSCC ($PM_{2.5}$ sampler) or internal pass-through adapter (PM_{10} sampler) (Figure 12) and place temperature standard probe down the lower sampler intake hole (Figure 13). Change temperature display from AT (ambient temperature) to FT (filter temperature). Allow temperature to stabilize on the temperature standard. Record the sampler's filter temperature from the main screen and the actual temperature from the temperature standard on the field form. The sampler's filter temperature must be within +/- 2°C of the verification temperature. If it is outside +/- 2°C, the sampler's filter temperature must be recalibrated, a corrective action form needs to be filled out and acknowledged by instrument operator. This step is best performed last since it requires dismantlement to the sample flow path and could affect Leak Check and Flow verification.
15. Reinstall VSCC ($PM_{2.5}$ sampler) or internal downtube assembly (PM_{10} sampler) and inlet head on downtube.
16. Close the front of the instrument and reconnect the latch.

Figure 14 Ambient Temp Sensor Removal

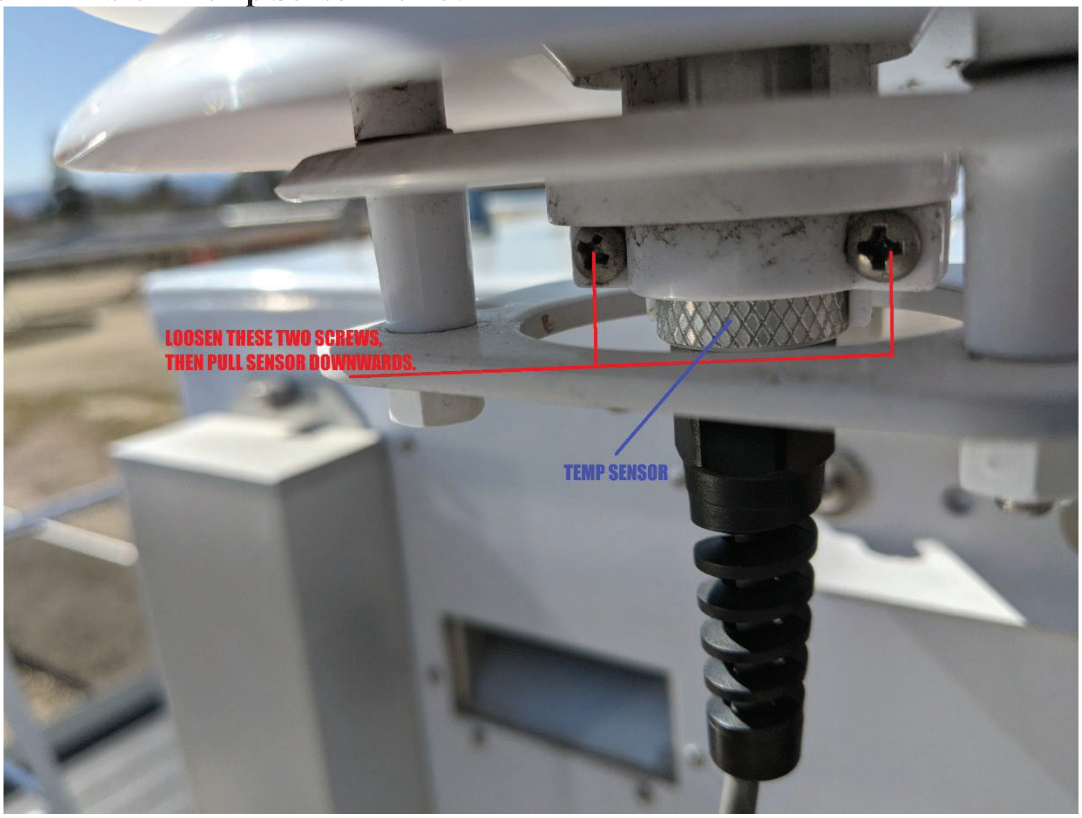


Figure 15 Corrective Action Form

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 08/23/24

EE.11 Calibration Procedures

EE.11.1 Flow Calibration

Equipment Needed
- Alicat FP-25BT Traceable Flow/Temp/BP Standard
- QC Filter Cassette
- PM Calibration Worksheet-SEQ-FRM

1. Complete all information on the PM Calibration Worksheet-SEQ-FRM (Figure 16).
2. Remove the PM_{10} inlet head but leave the inlet tube installed and install the Alicat flow standard on the downtube.
3. Inside the sampler, remove both the supply and storage magazines along with all filters, if installed.
4. Go to the Test > Flow Calibrate screen. The Insert Cassette screen should appear.
5. Place the QC flow test cassette in the supply side magazine receiver (left side). Once the test cassette is in position, press the INSERT button on the Insert Cassette screen. The sampler should advance the test cassette to the sample position and display the Flow Calibrate screen. The pump will start automatically and adjust flow to the 16.7 LPM test point.
6. Press the green bordered Set Point field and the Set Point flow rate selection screen appears (Figure 17).
7. Select 15.00 LPM from the list of flow rate set points and then press the OK button. The display will return to the Flow Calibrate screen and adjust the flow to the new test point.
8. Allow the E-SEQ-FRM and the standard readings to stabilize (at least one minute) and then record the sampler flow value and standard's flow reading on the PM Calibration Worksheet-SEQ-FRM. If the flow rate is within ± 4% of the transfer standard, record the results and select from the screen 18.34 and 16.7 LPM flow rates and compare to standard. If within ± 4%, record values.
9. If the difference of any of the values exceeds ±4% of the transfer standard, press the DEFAULT button to remove any previous offsets for each 15.00, 18.34, and 16.7 LPM rates.
10. Recheck all three flow points to verify it is now in the ± 4% of the transfer standard. If the flow rate still does not pass it needs to be adjusted.
11. Select the 15.00 LPM flow rate, allow time for stabilization, then view the standard's flow rate. Press the green bordered Reference field and the numerical entry keypad will be displayed. Enter the flow standard's value and press OK to return to the Flow Calibrate screen. Press SET to apply the change.
12. Select the 18.34 LPM flow rate, allow time for stabilization, then view the standard's flow rate. Press the green bordered Reference field and the numerical entry keypad will be displayed. Enter the flow standard's value and press OK to return to the Flow Calibrate screen. Press SET to apply the change.
13. When setting the 16.7 LPM flow rate, the SET option will change to read CALIBRATE (as shown in Figure 17). Allow time for stabilization, then view the standard's flow rate. Press the green bordered Reference field and the numerical entry keypad will be

displayed. Enter the flow standard's value and press OK to return to the Flow Calibrate screen. Press CALIBRATE to apply the change.

14. Press the X icon in the top right corner to exit out of the calibration screen, reenter calibration screen and select the 16.7 flow rate. Verify that the E-SEQ-FRM and the flow standard are both now within the ± 4% and record on the PM Calibration Worksheet under the Post Flow Cal Verification section.
15. Press the X icon in the top right corner to exit out of the calibration screen.

Figure 16 PM Calibration Worksheet-SEQ-FRM

Air Quality Management Division
PM Calibration Worksheet-SEQ-FRM

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	

Filter Temperature Cal

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

Flow 1 (15.0 LPM)

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

Flow 2 (18.4 LPM)

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

Flow 3 (16.7 LPM)

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

Post Flow Cal Verification (16.7 LPM)

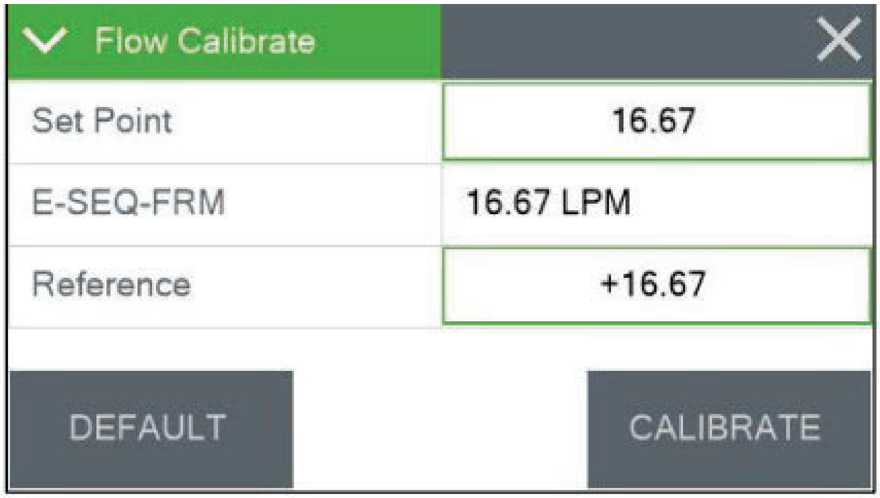
	Display (LPM)	Standard (LPM)	% Dev.		Yes	No
Act. Flow:			#DIV/0!	+/- 4%	#DIV/0!	#DIV/0!

Comments: ______________________________

File Name: PM Calibration Worksheet_SEQFRM
Reviewed: 09/25/2024

QC Check/PDF:________

Figure 17 Flow Calibrate Screen



EE.11.2 Temperature Calibration

Equipment Needed

- Alicat FP-25BT Traceable Flow/Temp/BP Standard
- PM Calibration Worksheet

The filter temperature sensor is located inside the radiation shield mounted to the back of the E-SEQ-FRM sampler.

1. Place the reference temperature sensor probe inside the radiation shield (Figure 11) and allow to equilibrate.
2. Navigate to the Test> Temp Calibrate menu.
3. The display will show the ambient temperature sensor test interface first. Read the current temperature (AT) on the Parameters screen and compare it to the reference temperature. The reference and AT readings should be within ± 2 °C of each other. If the sensors do not match within specification, press the green bordered Standard value field. The numeric entry keypad (Figure 18) will be displayed. Enter the value reported by the standard and press the OK button to return to the Temp Calibrate screen. Press the CALIBRATE button to set the new calibration.
4. Tap the green bordered Temp Sensor field and select FT for the filter temperature sensor. Remove VSCC or PM_{10} pass through tube adapter, if installed. Ensure there is no filter or QC filter inserted in the unit at this time. Insert the reference temperature sensor near filter temperature sensor as shown in Figure 13. Do not let the reference temperature sensor touch any of the components within the sampling chamber. Allow the sensors enough time to fully equilibrate.
5. Read the current temperature (FT) on the Parameters screen and compare it to the reference temperature. The reference and FT readings should be within ± 2 °C of each other. If the sensors do not match within specification, press the green bordered Standard value field. The numeric entry keypad will be displayed. Enter the value reported by the standard and press the OK button to return to the Temp Calibrate screen. Press the CALIBRATE button to set the new calibration.
6. Tap the green bordered Temp Sensor field and select BT for the filter temperature sensor. Remove the ventilated cover protecting the box monitoring sensors (Figure 19). Place the reference temperature sensor near the box temperature sensor. Do not let the reference sensor touch any of the nearby components. Allow the sensors enough time to fully equilibrate. Read the current temperature (BT) on the Parameters screen and compare it to the reference temperature. The reference and BT readings should be within ± 2 °C of each other. If the sensors do not match within specification, press the green bordered Standard value field. The numeric entry keypad will be displayed. Enter the value reported by the standard and press the OK button to return to the Temp Calibrate screen. Press the CALIBRATE button to set the new calibration. Remove the reference sensor and replace the ventilation cover and internal accessories and then resume normal sampling operations.

Figure 18 Temp Calibrate Screen

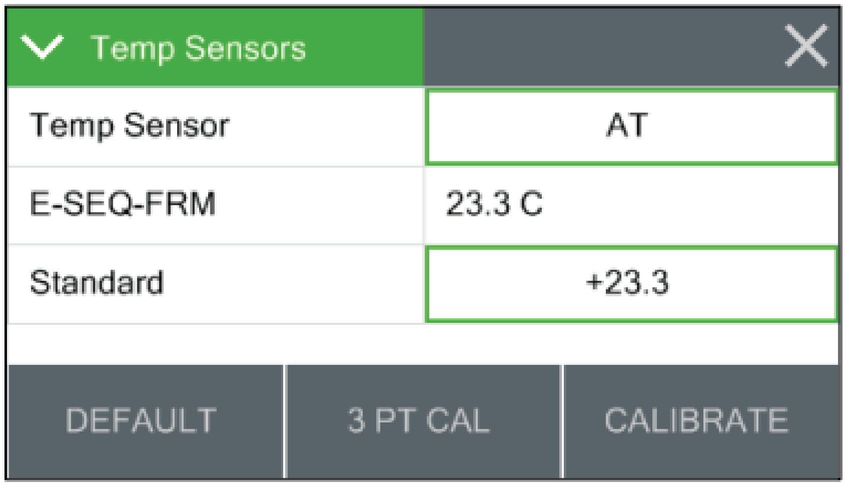
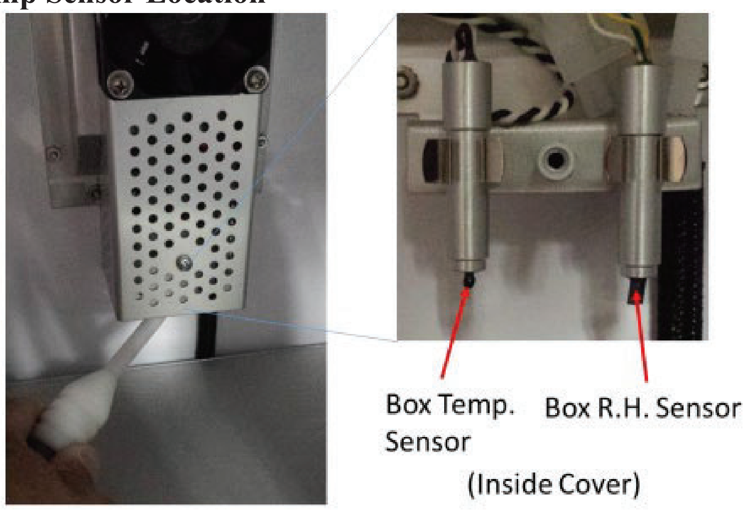


Figure 19 Box Temp Sensor Location



EE.11.3 Barometric (Box) and Filter Pressure Calibration

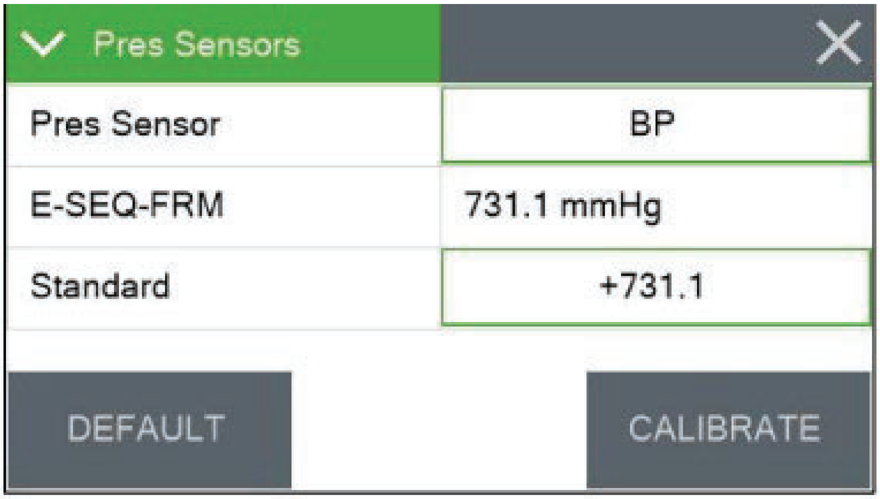
Equipment Needed

- Alicat FP-25BT Traceable Flow/Temp/BP Standard
- PM Calibration Worksheet

The filter pressure sensor is located downstream of the sample filter location and the box pressure sensor is located completely outside of the flow path. This allows the filter pressure to measure the lower pressure inside the flow path while the box pressure indicates actual ambient conditions. This means the filter and box pressure values should both indicate actual ambient pressure when the pump is not running, and the sample flow path is vented. Because of this, these two sensors may be audited simultaneously using the following procedure.
Verify the pump is off and there is no sample filter cassette holder installed in the sample position. Read the current filter pressure (FP) and box pressure (BoxP) on the Parameters screen and compare them to the reference pressure. The reference value should be within ±10 mm Hg of each sampler pressure sensor. If it is not, perform the calibration procedure for whichever pressure sensor does not meet the specification. Verify that the Ambient Pressure (BP) and Filter Pressure (FP) on Parameter screen is within ±10 mm Hg of the measured ambient pressure. If the difference is not within the limits, perform a pressure calibration when the Sampler is not in Sample mode.

1. Verify the pump is off and there is no sample filter cassette holder installed in the sample position.
2. Read the barometric pressure (BP) on the Parameters screen and compare them to the reference pressure. The reference value should be within ±10 mm Hg of each sampler pressure sensor. If it is not, perform the calibration procedure for whichever pressure sensor does not meet the specification. Verify that the Ambient Pressure (BP) on Parameter screen is within ±10 mm Hg of the measured ambient pressure. If the differences are not within the limits, perform a pressure calibration when the Sampler is not in Sample mode.
3. Navigate to the Test> Pres Calibrate menu (Figure 20) Barometric Pressure Calibration Screen.
4. The display will show the barometric pressure (BP) sensor test interface first. Read the current pressure (BP) on the Parameters screen and compare it to the reference temperature. The reference and AT readings should be within ±10 mm Hg of each other. If the sensors do not match within specification, press the green bordered Standard value field. The numeric entry keypad (Figure 20) will be displayed. Enter the value reported by the standard and press the OK button to return to the Temp Calibrate screen. Press the CALIBRATE button to set the new calibration.
5. Repeat steps 2-4 for filter pressure (FP).

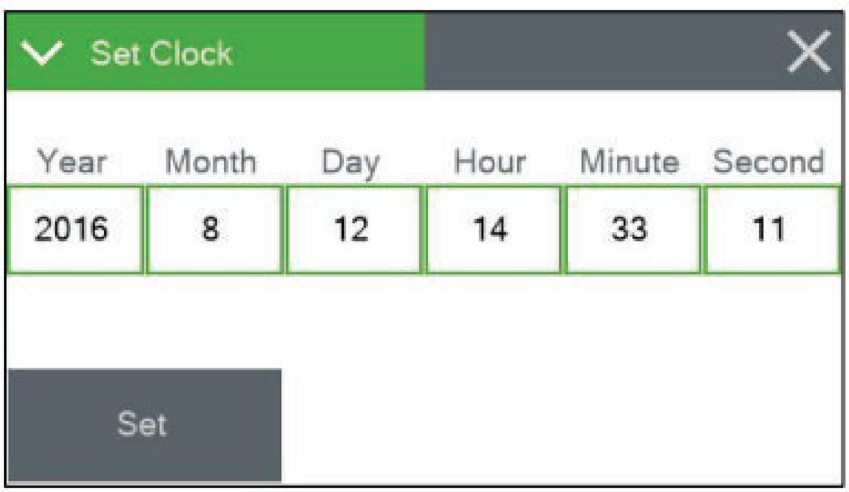
Figure 20 Barometric Pressure Calibration Screen



EE.11.4 Time and Date Calibration

This is where the date and time are set. Time is a 24-hour clock only. Press the green box of the field that needs to be modified. The numerical entry keypad (Figure 21) will be displayed allowing users to enter the value for that parameter. Once all fields have been entered, press the Set button to set the clock. The lithium battery backup keeps the clock running during power-down. Met One Instruments recommends a monthly check of the clock.

Figure 21 Clock Calibration Screen



EE.12 Routine Maintenance

EE.12.1 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 dry cloth.

EE.12.2 Monthly Maintenance

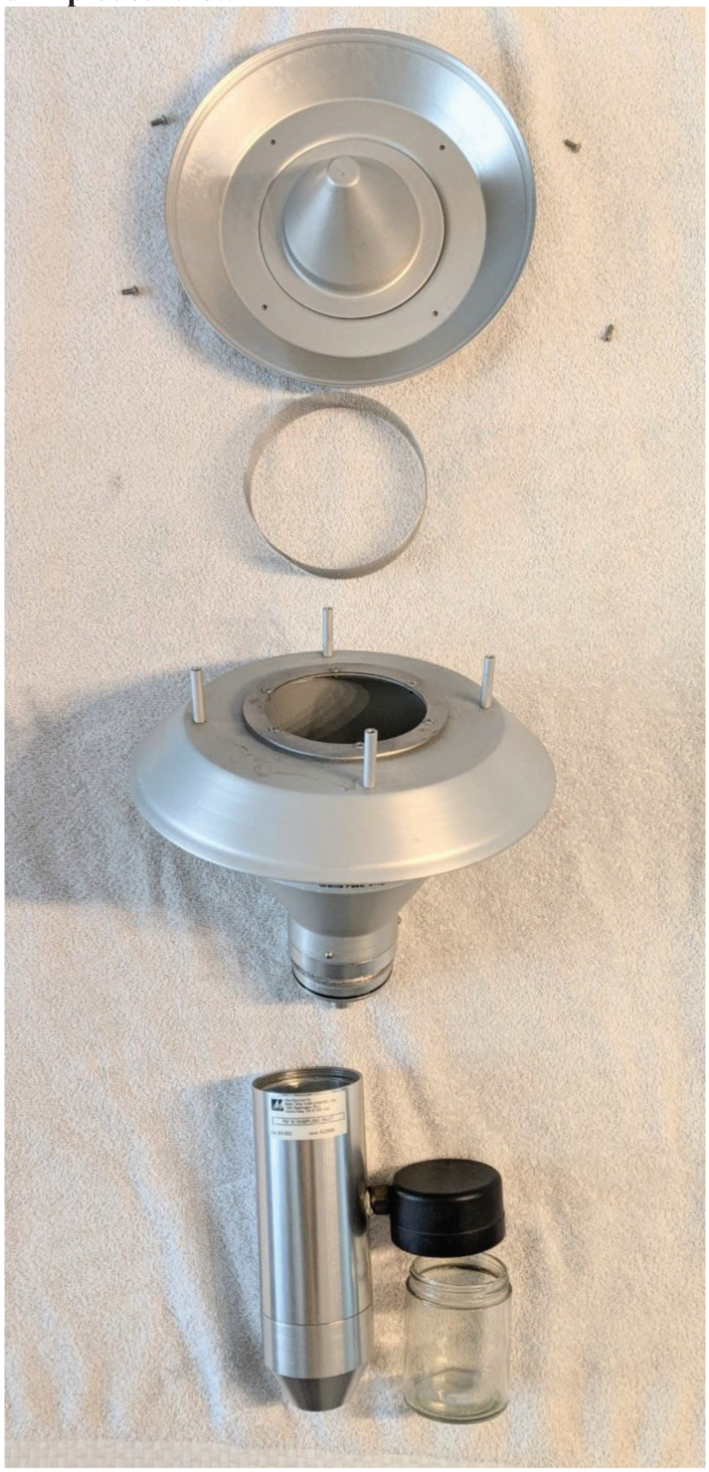
Monthly PM_{10} inlet, downtube and $PM_{2.5}$ VSCC maintenance is usually completed at the same time as monthly verifications.

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

EE.12.2.1 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 assembly from the lower assembly. See PM_{10} Head Exploded View (Figure 22). 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. Do not overtighten due to may cause glass breakage or cracking.

Figure 22 PM_{10} Head Exploded View

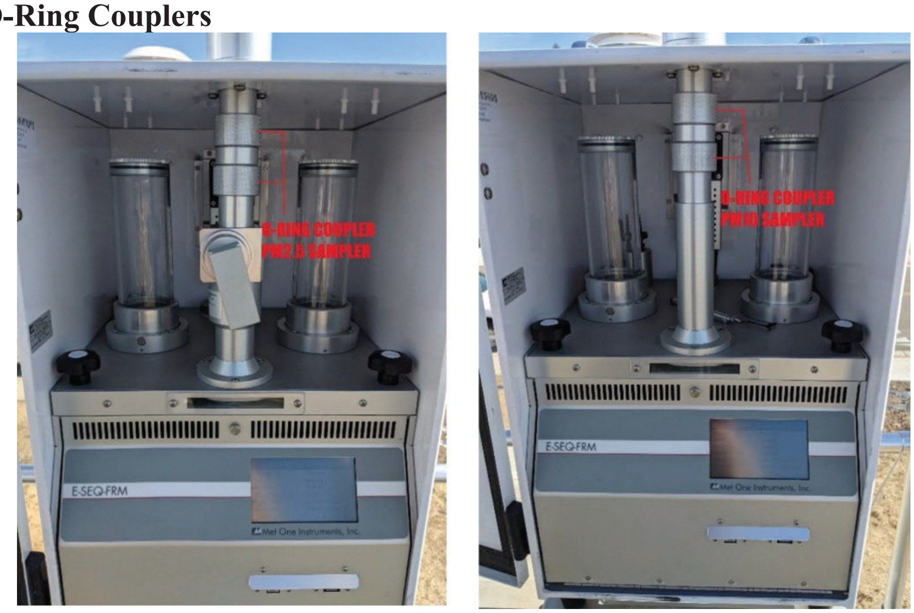


EE.12.2.2 Downtube Maintenance

1. Loosen large Downtube retaining nut located on top of the E-SEQ-FRM (Figure 23). Inside the sampler, slide O-ring couplers (Figure 24) to release downtube or VSCC in $PM_{2.5}$ unit. Once released, pull the downtube up and out of the sampler.
2. Utilize a rag and compressed air to clean inside of downtube.
3. Clean couplers and reapply a small amount of vacuum grease on the O-rings to help with seal.
4. Reassemble PM_{10} unit if $PM_{2.5}$ sampler VSCC will need to be cleaned before reassembly.

Figure 23 Downtube Retaining Nut

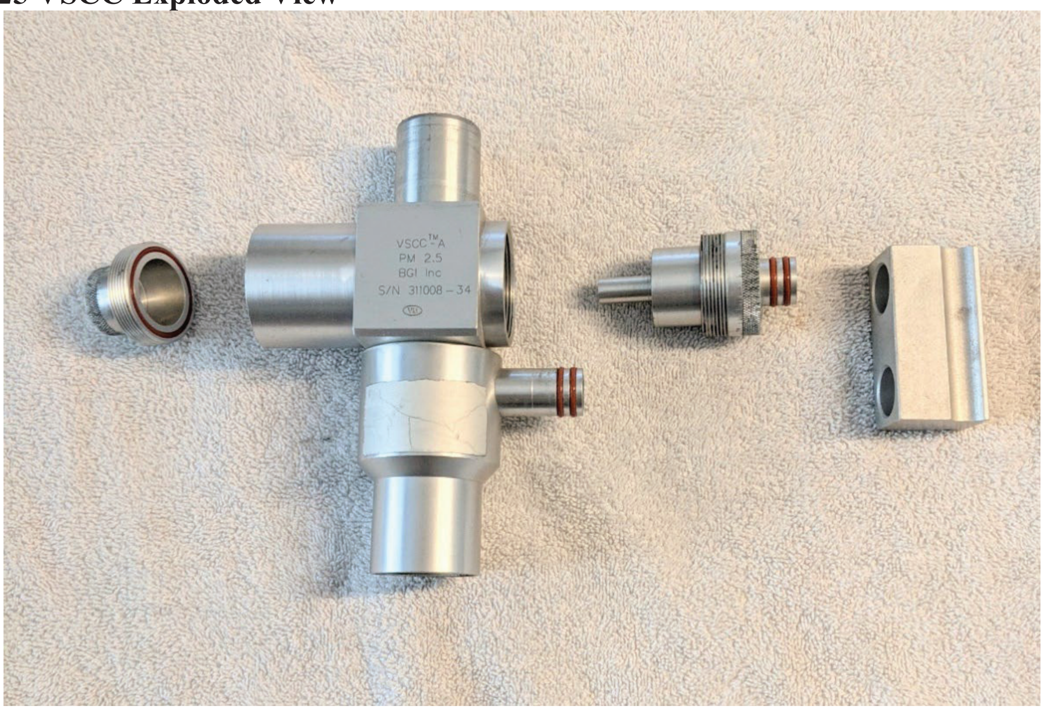
Figure 24 O-Ring Couplers



EE.12.2.3 $PM_{2.5}$ VSCC Maintenance

1. Remove VSCC from sampler by pulling up on the VSCC and lifting out the sampler.
2. Disassemble the VSCC (Figure 25) exploded view.
3. Utilizing rags, brushes, cotton swabs, and compressed air, clean the internal and external areas of the VSCC.
4. Apply a very small amount of vacuum grease to the O-rings to help with sealing and lubrication to prevent tears or rips when reassembling. Inspect O-rings for any tears or defects that could cause a leak. If O-ring is suspect, replace O-ring.
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. Reassemble VSCC.

Figure 25 VSCC Exploded View



EE.12 Troubleshooting

Refer to E-SEQ-FRM-9800 REV G Manual section 8 for troubleshooting.

Appendix G: Ozone Analyzers

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Jordan Volk

Title of Author: Air Quality Specialist

Signature: Jordan Volk Digitally signed by Jordan Volk Date: 2024.11.27 07:32:54 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.25 14:58:41 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.26 10:33:19 -08'00' 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	Air Quality Management Division
CPU	Central Processing Unit
cc/min	cubic centimeters per minute
DAS	Data Acquisition System
FEP	Fluorinated ethylene propylene
LPM	Liters per Minute
inHg	inches of mercury
NCore	National Core multipollutant monitoring station
nm	Nanometers
NNPH	Northern Nevada Public Health
NV	NumaView
O_3	Ozone
PCB	Printed Circuit Board
PDF	Portable Document Format
ppb	Parts per Billion
PSI	Pounds per Square Inch
PST	Pacific Standard Time
QC	Quality Control
QA	Quality Assurance
SLAMS	State and Local Air Monitoring Stations
SOP	Standard Operating Procedures
SS	Stainless steel
TAPI	Teledyne Advanced Pollution Instrumentation
UV	Ultraviolet
V/F	Voltage-to-Frequency
Z/P/S	Zero, precision, span

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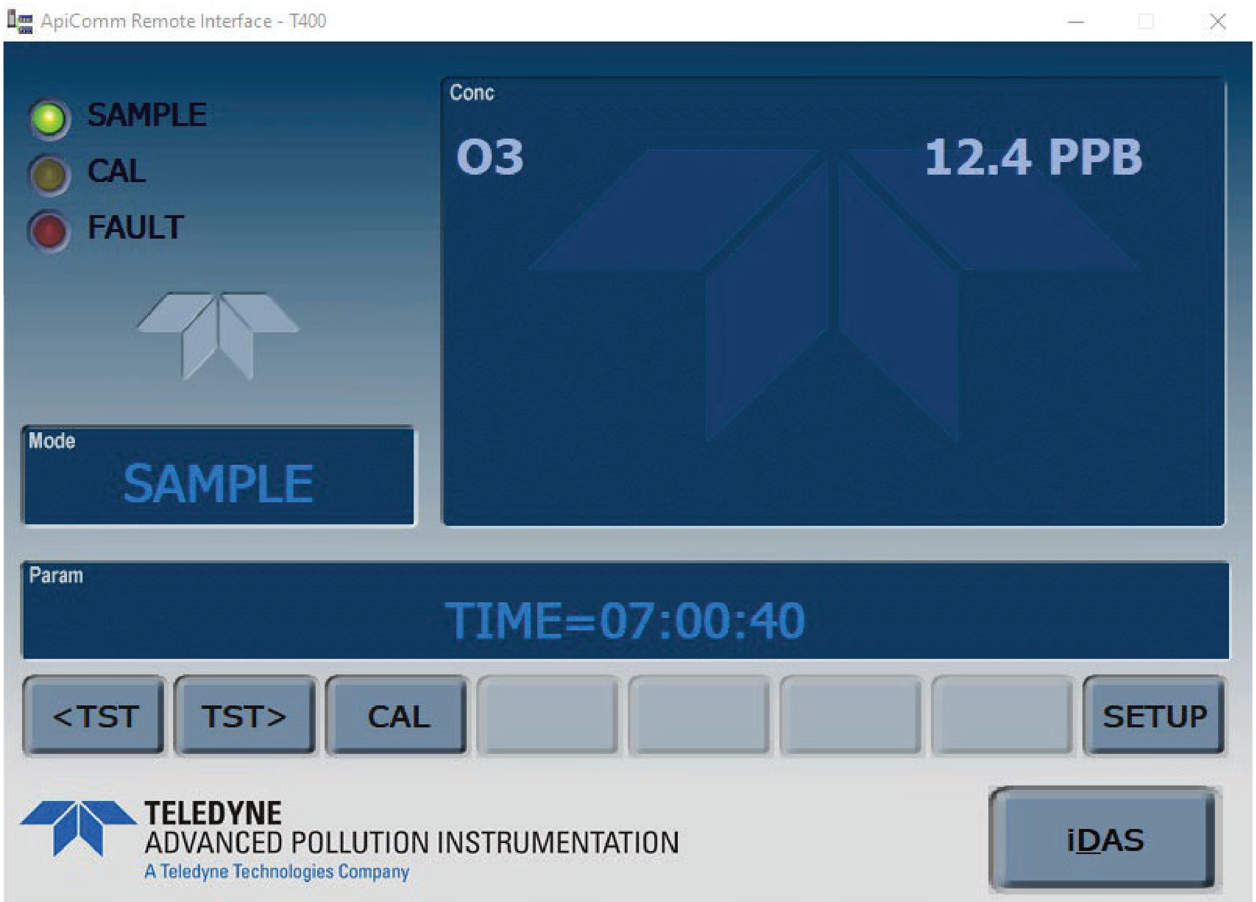
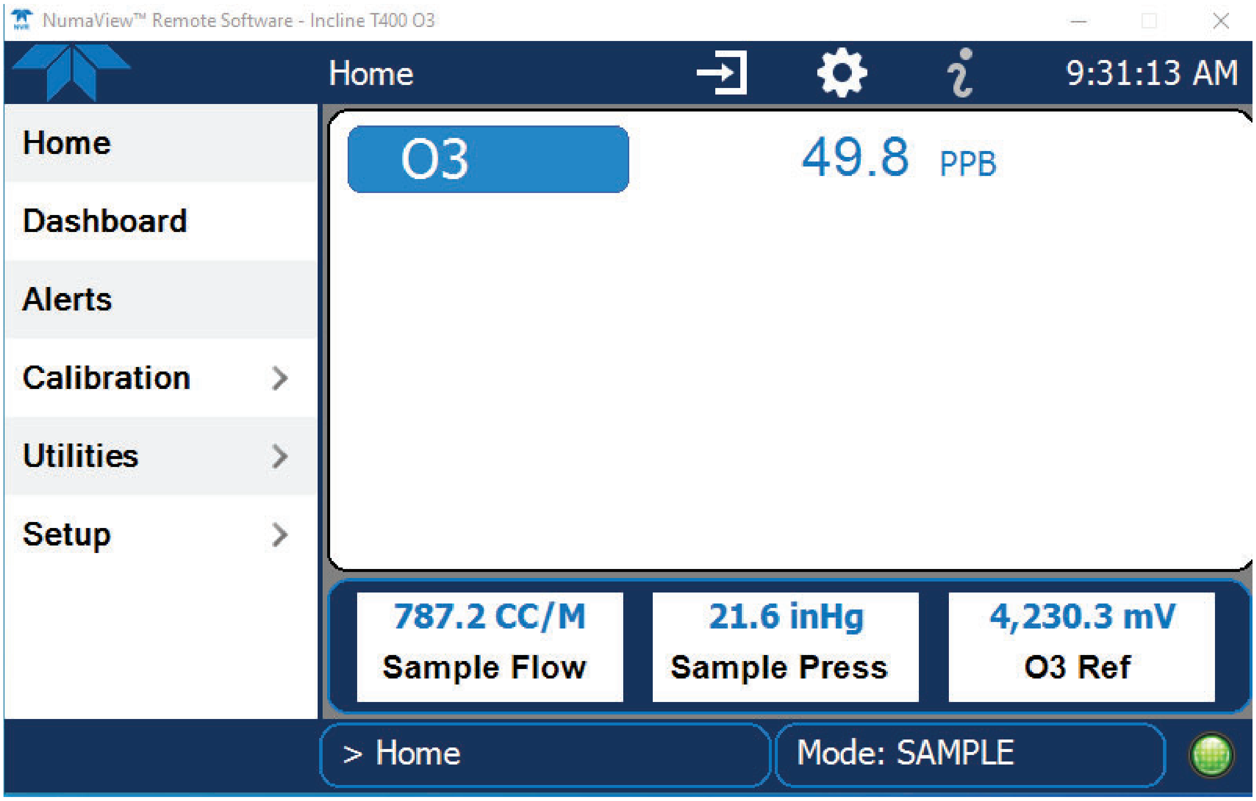
G.1 Introduction

The Teledyne Advance Pollution Instrumentation (TAPI) Model 400 series analyzers measure ozone (O_3) 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.

Currently, AQMD employs Model 400 series analyzers with two different operating systems, the older operating system named Legacy (Picture 1), and the new system named NumaView or NV (Picture 2). This document will act as the Standard Operating Procedures (SOP) for both operating systems. The differences in processes between the two will be explained in the corresponding sections within this document.



Picture 1. Legacy Front Panel



Picture 2. NumaView Front Panel

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. Log into AV Trend on the 8872 datalogger and compare the instrument front panel concentration to the Data Acquisition System (DAS) concentrations to check for deviations. Check all analyzer diagnostics are within range. For Legacy use the <TST> button on the front of the analyzer and scroll through each diagnostic. For NV instruments, press the Dashboard button on the display screen to bring up all diagnostics. **Note**: On NV instruments there is more than one screen for diagnostics. Use the arrow buttons at the bottom of the screen to display the other diagnostics. 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 Logbook.

Figure 2 Station Log Report

Washoe County Health District - Air Quality Management Division
Station Log Report

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^0 Sentry Status Light Green:												
12	Station Inside Temperature (^0C):												
13	Instruments Adjusted:												

Additional Comments:

Station_Log_Report_Master_Template
Last Revision: 09/16/2024

G.4.1.2 Daily Checks – NCore Site

Daily span/zero checks are performed at 0045 Pacific Standard Time (PST) using automatic calibrations programmed into the Agilaire 8872 data logger (see Appendix VV). 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 logbook.
2. Record the Sample Flow and Reference Voltage from the analyzer display by scrolling through the <TST> functions in Legacy or by bringing up the Home screen in NV. The sample flow must be 800 cc/min +/- 20%. The O_3 reference voltage must be within 3000-4800 mv.
3. Record the concentration in parts per billion (ppb) of O_3 off 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.

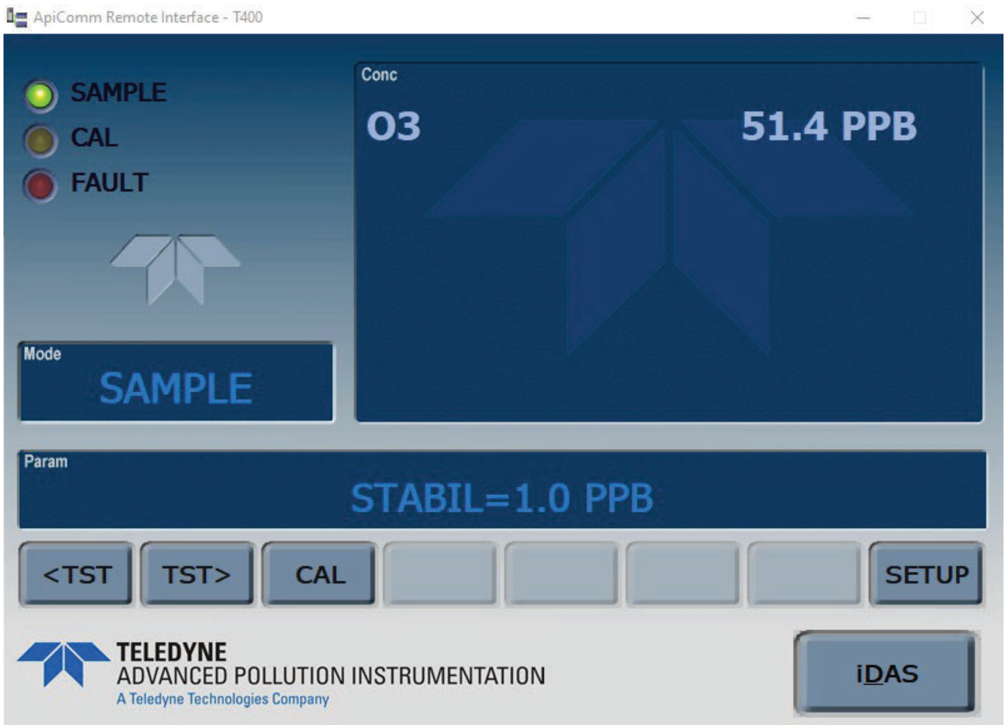
G.4.1.3.2 Calibration Checks – NCore Site

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. Log into the 8872 data logger using your Northern Nevada Public Health username and password. Once logged in, log into AV Trend on the data logger.
2. Once logged into AV Trend, click on Utilities on the left side of the screen. Then choose Site Node Logger Toolbox option.
3. When you are ready to begin the Z/P/S, put the site instrument in maintenance mode by clicking on the maintenance flag button on the right side of the Site Node Logger Toolbox screen for the O3PPM parameter. This will change the maintenance flag from saying, "False" to "True" and will also darken out the maintenance flag button that was clicked. Note the time that you put the site instrument in maintenance mode.
4. Using your field laptop, locate the AQMonitoring drive. 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 20240916 _Reno 4_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 AV Trend.
5. Ensure the pressure on the zero air generator is at 30 PSI.

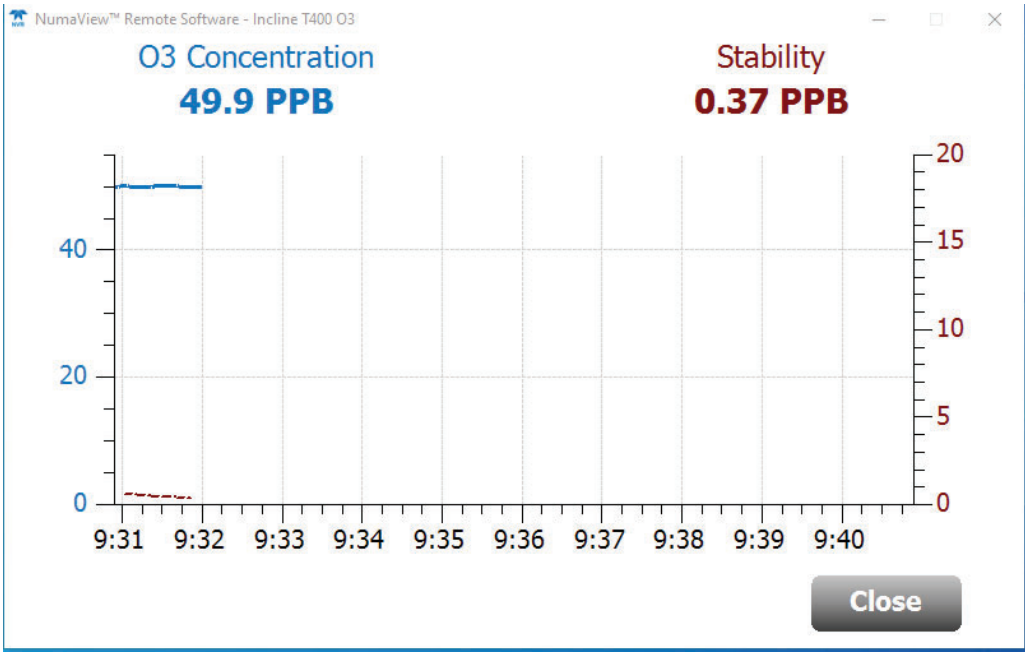
6. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press GEN, and then press AUTO. Update the touchscreen buttons to read 180 ppb O_3, then press ENTER. Ensure the flow delivered to the instrument from the calibrator is 6 liters per minute (LPM), and then press ENTER. The instrument will begin to sample 180 ppb O_3. Allow the instrument to stabilize to below 1.0 ppb. To view stability on the T400:

    a. **Legacy Instruments:** Press the <TST> button on the O_3 analyzer until STABIL is displayed.



Picture 3. Legacy Stability Screen

b. **NV Instruments:** Click on the Home Screen then click the blue "O3" button to the left of the concentration reading. This will bring up the concentration reading as well as the stability with a time graph of both parameters. This allows for easy viewing of concentration and stability over a period of time.



Picture 4. NumaView Stability Screen

7. Once STABIL is reading 1.0 ppb or less record the O_3 reading from the DAS and record the ACTUAL reading from the calibrator. View the percent deviation calculation on the Ozone Worksheet to verify that it is +/- 5%. Adjust the span if the percent deviation is +/- 3.5% (see section G.4.2 for Calibration Procedures).
8. Precision Check: Repeat Steps 5-6 above using 55 ppb O_3 for the concentration.
9. Zero Check: For a Zero check set the concentration to 0.0 ppb. The instrument will begin to sample zero air. Wait until Stability is reading 1.0 ppb or less and record the O_3 reading from the DAS and record the ACTUAL reading from the calibrator. Adjust the zero if the O_3 concentration is outside +/- 1.0 ppb[1] (see section G.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 AV Trend. Click on the maintenance flag button on the right-hand side of the Site Node Logger Toolbox Screen for the O3PPM parameter. The button will go from saying "True" to "False" and will no longer be darkly shaded.
12. Record "End Time" on the Ozone Worksheet and make sure to save the document.
13. Enter the results from the field form onto the respective control chart (Figure 4). Control charts are maintained on the AQMonitoring data management drives.
14. Record the Date, Start Time, End Time, and Parameter on the site's digital Data Exception Log (Figure 4) and into the composite Instrument Notebook left at the station.

[1] EPA zero drift criteria is 3 ppb for 24 hours and 5 ppb for 14 days, 1.0 ppb reflects our in-house action level.

Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.

15. Make sure that all documentation has been saved and exit out of each as well as exit out of AV Trend on the 8872 datalogger. Sign out of the datalogger.

G.4.1.4 Bi-weekly Checks – SLAMS Sites

At all SLAMS sites, perform a Z/P/S check of the analyzer every other week. Record all readings on the Ozone Worksheet (Figure 3).

1. Follow steps 1 – 14 in section G.4.1.3.2, using 5 LPM for calibrator flow rate.

Figure 3 Ozone Worksheet

Air Quality Management Division

Ozone Worksheet

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!
Corrected		#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!		
Percent Dev	#DIV/0!		#DIV/0!		#DIV/0!		#DIV/0!			
Difference							#DIV/0!			
*EPA Accp. Criteria	+/- 7% dev.		+/- 7% dev.		+/- 7% dev.		+/- 7% dev or +/-1.5 ppb, whichever is greater		+/- 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 +/- 1.0 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_2024
Last Revision: 7/19/2024

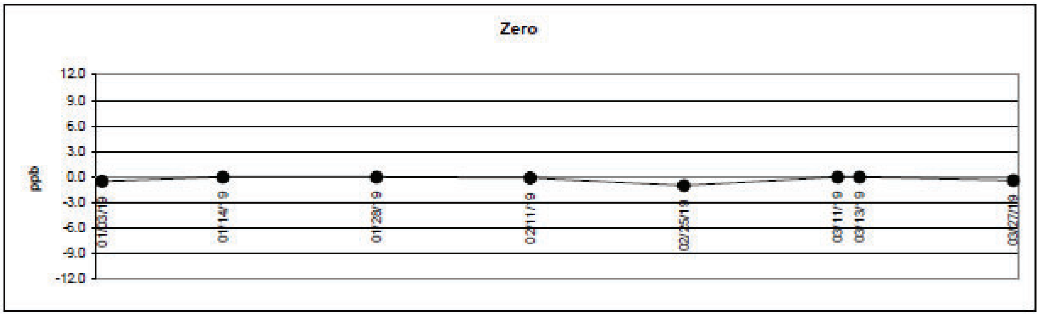
QC Check/PDF:__________

Figure 4 Ozone Control Chart

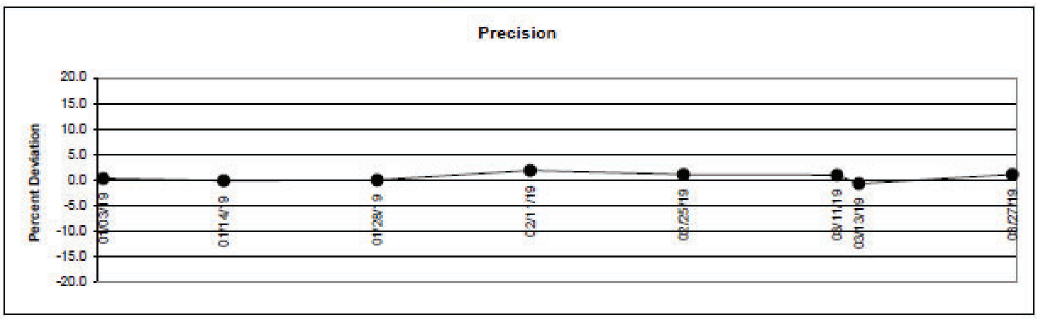
Ozone Control Chart

Site: Spanish Springs
Year: 2019
Quarter: 1st

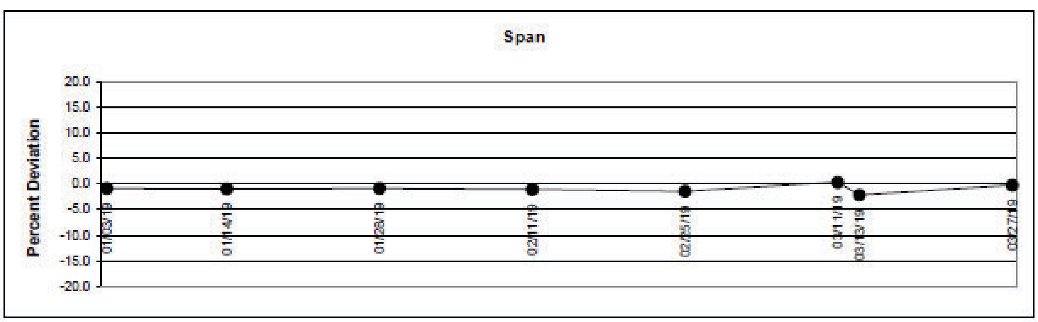
Instrument: TAPI
Model: T400
Serial #: 2789



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 the 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" fluorinated ethylene propylene (FEP) Teflon 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 – 12 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. Record the audit results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
3. Record the Date, Start Time, End Time, and Parameter on the respective digital Data Exception Log (Figure 4). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
4. After the worksheet has been checked by the QA Manager and finalized, file a copy in the Quarterly Audit folder made by the monitoring Senior Air Quality Specialist.

Figure 6 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 07/19/2024

G.4.2 Calibration Procedures – SLAMS and NCore Sites

G.4.2.1 Zero Adjustment

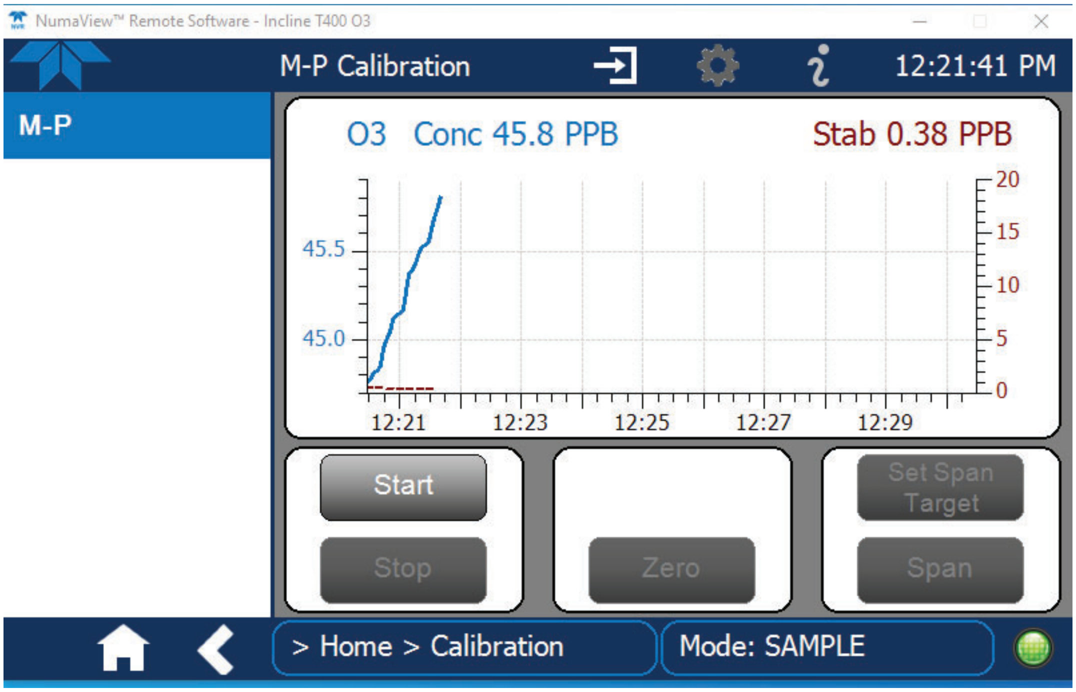
Perform a zero adjustment when the zero point is outside +/- 1.0 ppb during the weekly checks for NCore and bi-weekly checks for SLAMS. The zero adjustment must be done after the completion of the weekly/bi-weekly Z/P/S checks.

G.4.2.1.1 Legacy Instrument Zero Adjustment

1. Upon completion of the weekly/bi-weekly Z/P/S, press GEN, and then press AUTO. Press the O_3 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 O_3 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 O_3 concentration. Log "zero adjustment" in the comments section of the original Z/P/S worksheet.
4. Allow the instrument to stabilize and record the reading from AV Trend and record the ACTUAL reading from the calibrator 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 & Actual ppb values of O_3 during the re-check. If the span or precision points are outside the required acceptance criteria, continue with section G.4.2.2.1 for span adjustment and G.4.2.3.1 for multipoint calibration.
6. If span and precision points are within acceptance criteria take instrument out of maintenance mode on AV Trend and fill out the data exception log with the correct flag.

G.4.2.1.2 NumaView Instrument Zero Adjustment.

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.
2. While the instrument is stabilizing, click on the calibration button of the left side of the instrument's touch screen display. Then click on M-P. This will bring up a display of concentration and stability similar to the home screen display.



Picture 5. NumaView Calibration Screen

3. Wait for Stability to be under 1.0 ppb. Once stabilized click Start.
4. If Stability remains steady and below 1.0 ppb, press Zero. The instrument will adjust automatically to 0.0 ppb O_3 concentration. Log "zero adjustment" in the comments section of the original Z/P/S worksheet. **Note: The Zero button will only become available if the analyzer is reading a concentration close 0.0 ppb, if the instrument is reading a concentration that is too far from 0.0 ppb that you cannot get the zero button to be available, contact Teledyne Technical Support for guidance.**
5. Allow the instrument to stabilize and record the reading from AV Trend and the ACTUAL reading from the calibrator on a new Z/P/S worksheet.
6. Click the stop button to turn off the calibration sequence.
7. After a ZERO adjustment, a re-check of the span and precision points is recommended. Label in the comments section the Indicated & Actual ppb values of O_3 during the re-check. If the span or precision points are outside the required acceptance criteria, continue with section G.4.2.2.2 for span adjustment and G.4.2.3.2 for multipoint calibration.
8. If span and precision points are within acceptance criteria take instrument out of maintenance mode on AV Trend and fill out data exception log with the correct flag.

G.4.2.2. Span Adjustment

Perform a span adjustment when the percent deviation of the span point is outside +/- 3.5% during the weekly/bi-weekly checks. The span adjustment must be done after the completion of the weekly/bi-weekly check.

G.4.2.2.1 Legacy Instrument Span Adjustment

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 O_3, 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 180 ppb O_3. Allow the instrument to stabilize. Press the TEST button on the O_3 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 O_3 concentration. Log "span adjustment" in the comments section of the original Z/P/S worksheet.
4. Allow the instrument to stabilize and record the reading from AV Trend and record the ACTUAL reading from the calibrator on a new ozone worksheet.
5. Fill out the data exception log with the start/end time and use the calibration flag.
6. Complete a multipoint calibration as described in sections G.4.2.3.

G.4.2.2.2 NumaView Instrument Span Adjustment

1. Upon completion of the weekly/bi-weekly Z/P/S, press GEN, and then press AUTO. Press the O_3 touchscreen buttons to read 180 ppb O_3, 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 180 ppb O_3.
2. While the instrument is stabilizing, click on the calibration button of the left side of the instrument's touch screen display. Then click on M-P. This will bring up a display of concentration and stability similar to the home screen display (see Picture 5 in Section G.4.2.1.2).
3. Wait for Stability to be below 1.0 ppb. Once stabilized click start.
4. Click on Set Span Target and verify that your span is set to 180 ppb.
5. If Stability remains steady and below 1.0 ppb, click Span. The instrument will adjust automatically to 180 ppb O_3 concentration. Log "span adjustment" in the comments section of the original Z/P/S worksheet. **Note: The Span button will only become available if the analyzer is reading a concentration close to the span concentration that is programed in, if the instrument is reading a concentration that is too far from programmed span concentration that you cannot get the Span button to be available, verify that 180 ppb is programed in. If so, and the span button is still unavailable, contact Teledyne Technical Support for guidance.**
6. Allow the instrument to stabilize and record the reading from AV Trend and record the ACTUAL reading from the calibrator on a new ozone worksheet.
7. Click the stop button to turn off the calibration sequence.
8. Fill out the data exception log with the start/end time and use the calibration flag.
9. 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 is made to the instrument. A multipoint calibration must be performed before any other adjustments are made to the instrument.

1. Log into the 8872 data logger using your Northern Nevada Public Health username and password. Once logged in, log into AV Trend on the data logger.
2. Once logged into AV Trend, click on Utilities on the left side of the screen. Then choose Site Node Logger Toolbox option.
3. When you are ready to begin the multipoint, put the site instrument in maintenance mode by clicking on the maintenance flag button on the right side of the Site Node Logger Toolbox screen for the O3PPM parameter. This will change the maintenance flag from saying, “False” to “True” and will also darken out the maintenance flag button that was clicked. Note the time that you put the site instrument in maintenance mode.
4. Ensure the pressure on the zero air generator is at 30 PSI.
5. Using your field laptop, locate the AQMonitoring drive. 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 **NOTE: add MP to the end of the file name to denote this is a multi-point check and separate from the earlier QC check** (ex 20230916_Reno 4_O3_MP). 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 AV Trend.
6. Span Check: Preform Steps 6-7 from section G.4.1.3.2 Calibration Checks making sure to set 6 LPM if you are at the NCORE site and 5 LPM for SLAMS sites on the calibrator. Once you have recorded your results repeat these steps for the following O_3 gas concentrations:
   - 130 ppb O_3
   - 80 ppb O_3
   - 55 ppb O_3
7. Zero Check: Preform Step 9 from Section G.4.1.3.2 and record your results.
8. Take the instrument out of maintenance mode on AV Trend. Click on the maintenance flag button on the right-hand side of the Site Node Logger Toolbox Screen for the O3PPM parameter. The button will go from saying “True” to “False” and will no longer be darkly shaded
9. Record “End Time” on the Ozone Worksheet and make sure to save the document.
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 sites digital Data Exception Log (Figure 4). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
12. Ensure that all documentation has been saved on your field laptop. Once complete shut down the laptop.
13. Close out of AV Trend on the 8872 datalogger and sign out.
14. Remove the old multipoint sticker from the front of the analyzer and fill out a new one with the date of the multipoint, your initials and the next multipoint due date. Place it in front of the analyzer.

G.4.3 QA/QC Worksheet Review and Portable Document Format (PDF) Finalization

After completing the QA/QC worksheet, it needs to be reviewed by an Air Quality Specialist and then saved as a read only PDF to lock the worksheet from editing, creating the official record.

1. Once a QA/QC worksheet is completed, the dedicated QC person will review and PDF the worksheet. For verifications, the Senior Air Quality Specialist and the Air Quality Specialists have each been assigned sites that they are not the normal site operator of to review and PDF. The QA Manager will be responsible for reviewing and creating a PDF for all audit QA/QC worksheets.
2. It is the responsibility of the dedicated QC person to monitor the QA/QC folder on the AQMonitoring drive for new QA/QC worksheets to review and PDF. When a new worksheet is completed, the QC person will review the worksheet for errors, including content and calculations.
    a. If an error is found, contact should be made to the operator to get the issue fixed.
3. After completing the review, click the Acrobat tab on the top ribbon. Click Create PDF. Click Convert to PDF, Yes, and Save. Save the PDF with the same naming convention, and notating "_RECORD" at the end of the file name.
4. The PDF will now be opened in Adobe. On the toolbar on the right, click the Fill & Sign option. On the top of the page, click Sign yourself.
5. If initials have not already been created, click Add Initials, and save your initials. If your initials have been saved, click on them in the dropdown menu and place them on the QC Check/PDF line at the bottom of the worksheet.
6. To create a read only copy, the QC person needs to open Adobe Acrobat Pro DC with the Adobe Sign Add-In. After placing the initials, the QC person will click Next on the right of the Fill and Sign ribbon. Click Save as a Read Only. Save the record with the same naming convention and click yes to replace existing file with the Read Only version.

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. **Note: If particulate filter is being replaced when no other work is being performed on the instrument, the instrument needs to be placed in maintenance mode on the datalogger, a Misc. form needs to be filled out and the Data Exception Log needs to be logged.**

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, Kimwipes, 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 logbook. 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 AV Trend.
2. Log Start Date and Time on a Misc. Instrument Maintenance Form (Figure 8) and Data Exception Log (Figure 5).
3. Check Z/P/S points to verify instrument functionality. If Z/P/S performs poorly or fails, diagnose issue with instrument before proceeding with manifold replacement. Once the functionality of instrument is verified proceed with next steps.
4. Using your field laptop, navigate to the Residence Time folder under the QA-QC folder on the AQmonitoring drive. Open the current years excel file (Figure 7).
5. The amount of ¼” FEP Teflon tubing needed for each site is shown on the Residence Time excel file. Measure and cut the length of line needed for the site you are located at.
6. Completely remove all ¼” FEP Teflon lines from the sample manifold.
7. Measure the removed line to the fresh line and verify they are the same length. If they are not, verify the fresh line was measured correctly. If it was, then measure the removed line. If the removed line length is incorrect on the Residence Time file, create a copy of the previous year’s file and update the copy. Make a note of the error and inform the Senior Air Quality Specialist and the QA Manager once you are back in the office.
8. Clean the bug screen at the top of the sample inlet and all Teflon tees in the sample manifold with alcohol and cotton swabs.
9. After cleaning, install the new ¼” FEP Teflon tubing. Write down the length on the Residence Time sheet, the Misc. Form, and the Instrument Logbook.
10. Prior to leaving the site, leak check the instrument. 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.
11. Record the Sample Flow and the Pressure on Misc. Form and instrument logbook. 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.
12. Condition new sample manifold lines with 500 ppb O_3 for at least one hour. This can be done remotely.

13. After the line has conditioned, recheck Z/P/S points to verify instrument functionality. If this post manifold replacement performs poorly, condition the line an additional hour and recheck. If the Z/P/S points perform poorly again further diagnostics is needed.
14. Once proper instrument functionality is confirmed, take the instrument out of maintenance mode on AV Trend.
15. Log End Date and Time on Misc. Form and Data Exception Log and save all forms.
16. Residence time equation for the sites has been built into the Residence Time excel spreadsheet and are updated annually when each line is replaced. Refer to the excel spreadsheet for the equations.

Figure 7 Residence Time Excel Sheet

Sample Manifold Residence Time Calculations 2024

	Incline	Lem Val	Reno NOy	Reno NOx	So Reno	Spanish Springs	Sparks	Toll	Average All Stations	Total All Stations (1/4" OD)
Line length (inches)	296	218	600	171	133	126	181.75	150	**234.5**	1914
Line length (feet)	24.67	18.17	50.00	14.25	11.08	10.50	15.15	12.50	**19.54**	159.48
Line length (cm)	752	554	1524	434	338	320	462	381	**595.6**	
Inside diameter (cm)	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	**0.3**	
No. of filter holders	1	1	0	1	1	1	1	1	**0.9**	
Total flow (cc/min)	797	759	966	950	783	818	736	741	**818.8**	
Volume line (cm3)	60.47	44.53	122.57	34.93	27.17	25.74	37.13	30.64	**47.9**	
Volume filter holder (cm3)	50	50	0	50	50	50	50	50	**43.8**	
Residence time (sec)	**8**	**7**	**8**	**5**	**6**	**6**	**7**	**7**	**6.7**	
DATE COMPLETED	4/16/2024	4/5/2024			5/23/2024	4/8/2024	4/9/2024	5/23/2024		

	Reno4 (3/8" OD)	Reno4 (1/4" OD)	Reno4 Total
Line length (inches)	207	38	
Line length (feet)	17.25	3.17	
Line length (cm)	526	97	
Inside diameter (cm)	0.64	0.32	
No. of filter holders	3	3	3
Total flow (cc/min)	3209	3209	3209
Volume line (cm3)	169.14	7.76	176.91
Volume filter holder (cm3)	150	150	150.00
Residence time (sec)			**6**

G.6 Troubleshooting

Refer to the instruments operation's manual for a troubleshooting guide specific to the instrument.

Figure 8 Misc. Instrument Maintenance/Data Exception Worksheet

Air Quality Management Division
Misc. Instrument Maintenance / Data Exception Worksheet

Site ________________ Operator ________________ Parameter(s) ________________

Start Date ________________ **End Date** ________________

Start Time ________________ **End Time** ________________

Comments ____

File Name: Misc Data Exception Worksheet
Last Revision: 07/19/2024

QC Check/PDF:__________

Appendix H: Trace Carbon Monoxide Analyzers

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Matthew McCarthy

Title of Author: Senior Air Quality Specialist

Signature: Matthew McCarthy Digitally signed by Matthew McCarthy Date: 2024.11.26 15:26:40 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.25 14:59:07 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.27 08:17:47 -08'00' 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	Northern Nevada Public Health Air Quality Management Division
cc/min	Cubic Centimeters per Minute
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
FEP	Fluorinated Ethylene Propylene
GFC	Gas Filter Correlation
H_2O	Water
iDAS	Internal Data Acquisition System
inHg	Inches of Mercury
IR	Infrared
LPM	Liters per Minute
µm	Micrometers
mv	Milivolts
NV	NumaView
N_2	Nitrogen
PDF	Portable Document Format
PSI	Pounds per Square Inch
PST	Pacific Standard Time
ppb	Part per Billion
ppm	Parts per Million
QA	Quality Assurance
QC	Quality Control
SLPM	Standard Liters Per Minute
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedures
SS	Stainless Steel
TAPI	Teledyne Advanced Pollution Instrumentation
Z/P/S	Zero, Precision, Span

List of Figures

H.1 Introduction

The Teledyne Advanced Pollution Instrumentation (TAPI) T300U 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-αLc

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 T300U 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 T300U 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 4.7 µm. 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 T300U 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 4.7 µm, 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 T300U 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 H_2O 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 T300U rejects most of this interference at a 300:1 ratio. The two primary methods used to accomplish this are:

1. The 4.7 µm 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 T300U makes it more susceptible than the T300 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 T300U accounts for these issues by adding an additional component to the CO concentration calculation called 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. Log into AV Trend on the 8872 datalogger and compare the instrument front panel concentration to the Data Acquisition System (DAS) concentrations to check for deviations. Check all analyzer diagnostics by pressing the Dashboard button on the display screen and ensure all diagnostics are within range. **Note**: There is more than one screen for diagnostics. Use the arrow buttons at the bottom of the screen to display the other diagnostics. 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 Logbook.

Figure 1 Station Log Report

Air Quality Management Division
Station Log Report

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_Master_Template.xlsx
Last Revision: 11/07/2024

H.4.1.2 Daily Checks

Daily span/zero checks are performed at 0046 PST using automatic calibrations programmed into the Agilaire 8872 data logger (see appendix VV for the Agilaire 8872 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 logbook.
2. Record the Sample Flow and Reference Voltage from the Home screen on the analyzer display. 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 from 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. Log into the 8872 data logger using your Northern Nevada Public Health username and password. Once logged in, log into AV Trend on the data logger.
2. Once logged into AV Trend, click on Utilities on the left side of the screen. Then choose Site Node Logger Toolbox option.
3. When you are ready to begin the Z/P/S, put the site instrument in maintenance mode by clicking on the maintenance flag button on the right side of the Site Node Logger Toolbox screen for the COT parameter. This will change the maintenance flag from saying, "False" to "True" and will also darken out the maintenance flag button that was clicked. Note the time that you put the site instrument in maintenance mode.
4. Ensure the valve to the CO cylinder is open and the regulator pressure is at 30 PSI.
5. Ensure the pressure on the zero air generator is at 30 PSI.
6. Using your field laptop locate the AQMonitoring drive. 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 20240916 _Reno 4_CO). Clear the contents from the old data sheet and input all the new information on the Trace Level Carbon Monoxide Worksheet. Ensure the instrument's reference voltage and sample flow is within the instrument's diagnostic range. Record "Start Time" on the Trace Level Carbon Monoxide Worksheet from when you put the channel in maintenance on AV Trend.

7. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press Generate, ensure “Output” is toggled to “A”, press AUTO. Update the Gas to read 9.0 ppm CO and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample 9.0 ppm of CO. Allow the instrument to stabilize. The CO Stability is displayed on the Home screen of the analyzer.
8. Wait until the CO Stability is reading 0.10 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).
9. Precision Check: Repeat step 7 above using 0.6 ppm CO for the concentration.
10. Zero Check: Press Generate, and then press AUTO. Update the Gas to read ZERO and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample zero air. Allow the instrument to stabilize. The CO Stability is displayed on the Home screen of the analyzer. Wait until CO Stability is reading 0.10 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).
11. Press Generate, Standby on the dilution calibrator, this will stop all calibration procedures.
12. Take the instrument out of maintenance mode on AV Trend. Click on the maintenance flag button on the right-hand side of the Site Node Logger Toolbox Screen for the COT parameter. The button will go from saying “True” to “False” and will no longer be darkly shaded.
13. Record “End Time” on the Trace Level CO Worksheet and make sure to save the document.
14. Enter the results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring data management drives.
15. Record the Date, Start Time, End Time, and Parameter on the site’s digital Data Exception Log (Figure 4) and into the composite Instrument Notebook left at the station. Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
16. Make sure that all documentation has been saved and exit out of each as well as exit out of AV Trend on the 8872 datalogger. Sign out of the datalogger.

[1] EPA zero drift criteria is 0.4 ppm for 24 hours and 0.6 ppm for 14 days, 0.03 ppm reflects our in-house action level.

Figure 2 Trace Level Carbon Monoxide Worksheet

Air Quality Management Division
Trace Level Carbon Monoxide Worksheet

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.
0.6 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 ______________________________

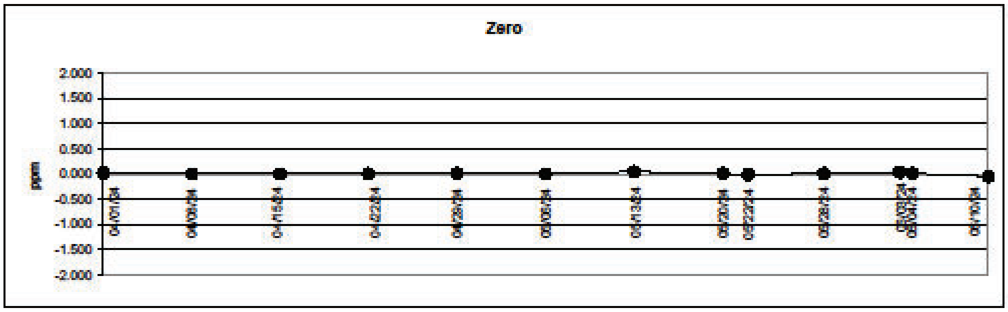
File Name: Master_Template_CO_Trace_NCore
Last Revision: 07/19/2024

QC Check/PDF:__________

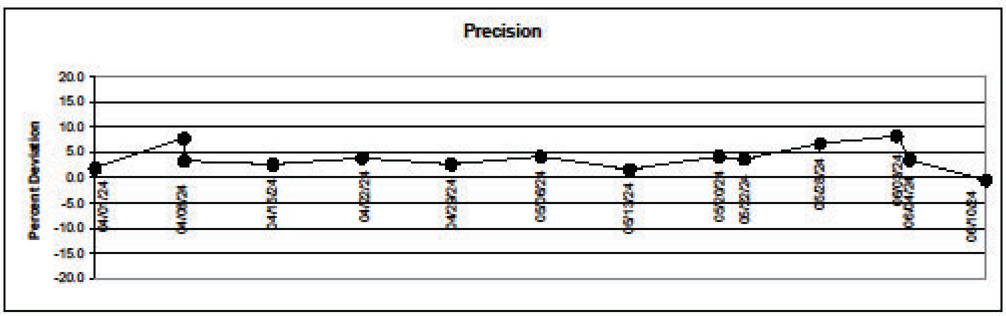
Figure 3 CO Control Chart

Carbon Monoxide Control Chart

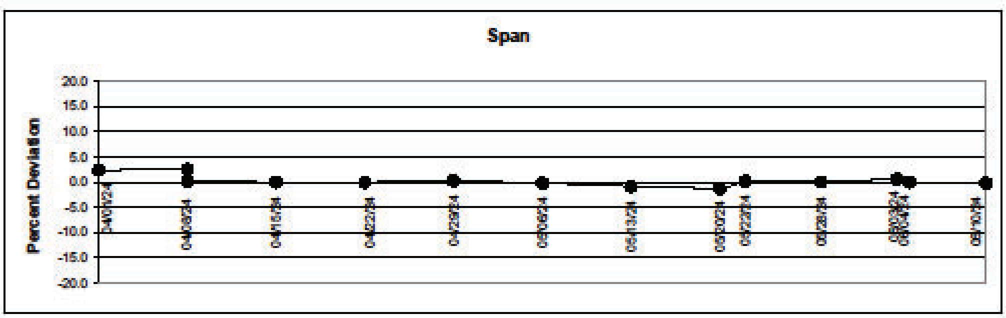
Site:	Reno 4	Instrument:	TAPI
Year:	2024	Model:	T300U
Quarter:	2nd	Serial #:	704



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: 04/08/24 Span/Zero Adj. Multipoint
05/13/24 Zero Adj.
05/22/24 Span Zero Adj with Multipoint
05/28/24 Zero Adj.
06/04/24 New T300U MP calibration

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

Year(s): ________/________
Site: ________________

Date	Cylinder ID #	Concentration (ppm)			Expiration Date	Pressure (PSI)	Initials
		CO	NO	SO_2			

Comments: ____

File Name: Monthly Cylinder Pressure Log_2024
Last Revision: 10/29/24

QC Check/PDF_____

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/SO_2 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/SO_2 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/SO_2 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. Record the audit results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
3. Record the Date, Start Time, End Time, and Parameter on the respective digital Data Exception Log (Figure 4). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
4. After the worksheet has been checked by the QA Manager and finalized, file a copy in the Quarterly Audit folder made by the monitoring Senior Air Quality Specialist.

Figure 6 Calibration Cylinder/Regulator Diagram

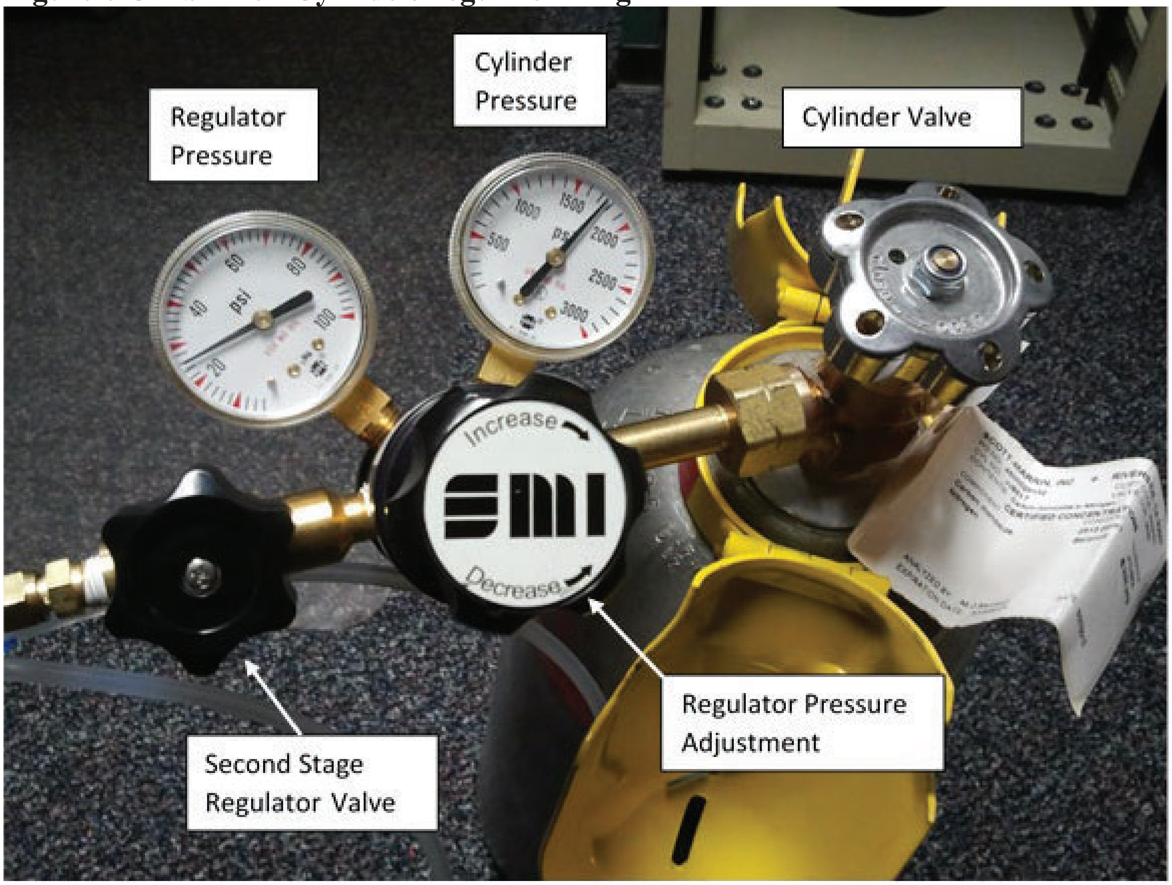


Figure 7 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 07/19/2024

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, on the dilution calibrator, press Generate, and then press AUTO. Update the Gas to read ZERO and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample zero air. Allow the instrument to stabilize The CO Stability is displayed on the Home screen of the analyzer.
2. While the instrument is stabilizing, click on the calibration button of the left side of the instrument's touch screen display. Then click on M-P. This will bring up a display of concentration and stability similar to the home screen display.
3. Wait for Stability to be under 0.10 ppm. Once stabilized, press Start.
4. If Stability remains steady and below 0.10 ppm, press Zero. The instrument will adjust automatically to 0.000 ppm CO concentration. Log "zero adjustment" in the comments section of the original Z/P/S worksheet. **Note: The Zero button will only become available if the analyzer is reading a concentration close to 0.000 ppm, if the instrument is reading a concentration that is too far from 0.000 ppm that you cannot get the zero button to be available, contact Teledyne Technical Support for guidance.**
5. Allow the instrument to stabilize to 0.10 ppm and record the reading from the DAS on a new Z/P/S worksheet.
6. Click the stop button to turn off the calibration sequence.
7. 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: on the dilution calibrator, press Generate, press AUTO. Update the Gas to read 9.0 ppm CO and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample 9.0 ppm of CO. Allow the instrument to stabilize. The CO Stability is displayed on the Home screen of the analyzer.
2. While the instrument is stabilizing, click on the calibration button of the left side of the instrument's touch screen display. Then click on M-P. This will bring up a display of concentration and stability similar to the home screen display.
3. Wait for Stability to be under 0.10 ppm. Once stabilized, press Start.
4. Click on Set Span Target and verify that your span is set to 9.0 ppm.

5. If Stability remains steady and below 0.10 ppm, click Span. The instrument will adjust automatically to 9.0 ppm CO concentration. Log “span adjustment” in the comments section of the original Z/P/S worksheet. **Note: The Span button will only become available if the analyzer is reading a concentration close to the span concentration that is programed in, if the instrument is reading a concentration that is too far from programmed span concentration that you cannot get the Span button to be available, verify that 9.0 ppm is programed in. If so, and the span button is still unavailable, contact Teledyne Technical Support for guidance.**
6. Allow the instrument to stabilize and record the reading from AV Trend and record the ACTUAL reading from the calibrator on a new Trace Level Carbon Monoxide worksheet.
7. Click the stop button to turn off the calibration sequence.
8. Fill out the data exception log with the start/end time and use the calibration flag.
9. 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. Additionally, a multipoint calibration is required to be completed annually. A multipoint calibration must be performed before any other adjustments are made to the instrument.

1. Log into the 8872 data logger using your Northern Nevada Public Health username and password. Once logged in, log into AV Trend on the data logger.
2. Once logged into AV Trend, click on Utilities on the left side of the screen. Then choose Site Node Logger Toolbox option.
3. When you are ready to begin the multipoint, put the site instrument in maintenance mode by clicking on the maintenance flag button on the right side of the Site Node Logger Toolbox screen for the COT parameter. This will change the maintenance flag from saying, “False” to “True” and will also darken out the maintenance flag button that was clicked. Note the time that you put the site instrument in maintenance mode.
4. Ensure the valve to the CO cylinder is open and the regulator pressure is at 30 PSI.
5. Ensure the pressure on the zero air generator is at 30 PSI.
6. Using your field laptop locate the AQMonitoring drive. 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 **NOTE: add MP to the end of the file name to denote this is a multi-point check and separate from the earlier QC check** (ex 20230916_Reno 4_CO_MP). Clear the contents from the old data sheet and input all the new information on the Trace Level CO worksheet. Ensure the instrument’s reference voltage and sample flow is within the instrument’s diagnostic range. Record “Start Time” on the Trace Level CO worksheet from when you put the channel in maintenance on the AV Trend.
7. Span Check: Preform Steps 7-8 from Section H.4.1.3.2 Calibration Checks. Once you have recorded your results repeat these steps for the following CO gas concentrations:
    - 5.0 ppm CO

- 3.5 ppm CO
- 0.6 ppm CO

8. Zero Check: Preform Step 10 from Section H.4.1.3.2 and record your results.
9. Press Generate, Standby on the dilution calibrator, this will stop all calibration procedures.
10. Take the instrument out of maintenance mode on AV Trend. Click on the maintenance flag button on the right-hand side of the Site Node Logger Toolbox Screen for the COT parameter. The button will go from saying “True” to “False” and will no longer be darkly shaded.
11. Record “End Time” on the Trace CO Worksheet and make sure to save the document.
12. Record the multipoint results from the field form onto the respective control chart (Figure 4). Control charts are maintained on the AQMonitoring drive.
13. Record the Date, Start Time, End Time, and Parameter on the sites digital Data Exception Log (Figure 3). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
14. Ensure that all documentation has been saved on your field laptop. Once complete shut down the laptop.
15. Closeout of AV Trend on the 8872 datalogger and sign out.
16. Remove the old multipoint sticker from the front of the analyzer and fill out a new one with the date of the multipoint, your initials and the next multipoint due date. Place on front of the analyzer.

H.4.3 QA/QC Worksheet Review and PDF Finalization

After completing the QA/QC worksheet, it needs to be reviewed by an Air Quality Specialist and then saved as a read only PDF to lock the worksheet from editing, creating the official record.

1. Once a QA/QC worksheet is completed, the dedicated QC person will review and PDF the worksheet. For verifications, the Senior Air Quality Specialist and the Air Quality Specialists have each been assigned sites that they are not the normal site operator of to review and PDF. The QA Manager will be responsible for reviewing and creating a PDF for all audit QA/QC worksheets.
2. It is the responsibility of the dedicated QC person to monitor the QA/QC folder on the AQMonitoring drive for new QA/QC worksheets to review and PDF. When a new worksheet is completed, the QC person will review the worksheet for errors, including content and calculations.
    a. If an error is found, contact should be made to the operator to get the issue fixed.
3. After completing the review, click the Acrobat tab on the top ribbon. Click Create PDF. Click Convert to PDF, Yes, and Save. Save the PDF with the same naming convention, and notating “_RECORD” at the end of the file name.
4. The PDF will now be opened in Adobe. On the toolbar on the right, click the Fill & Sign option. On the top of the page, click Sign yourself.
5. If initials have not already been created, click Add Initials, and save your initials. If your initials have been saved, click on them in the dropdown menu and place them on the QC Check/PDF line at the bottom of the worksheet.

6. To create a read only copy, the QC person needs open Adobe Acrobat Pro DC with the Adobe Sign Add-In. After placing the initials, the QC person will click Next on the right of the Fill and Sign ribbon. Click Save as a Read Only. Save the record with the same naming convention and click yes to replace existing file with the Read Only version.

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. **Note: If particulate filter is being replaced when no other work is being performed on the instrument, the instrument needs to be placed in maintenance mode on the datalogger, a Misc. form needs to be filled out and the Data Exception Log needs to be logged.**

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, Kimwipes, 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 logbook. 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 AV Trend.
2. Log Start Date and Time on a Misc. Instrument Maintenance Form and Data Exception Log (Figure 9).
3. Check Z/P/S points to verify instrument functionality. If Z/P/S performs poorly or fails, diagnose issue with instrument before proceeding with manifold replacement. Once functionality of instrument is verified proceed with next steps.
4. Using your field laptop, navigate to the Residence Time folder under the QA-QC folder on the AQmonitoring drive. Open the current year’s excel file (Figure 8).

5. The amount of ¼” FEP Teflon tubing needed for each site is shown on the Residence Time excel file. Measure and cut the length of line needed for the site you are located at.
6. Completely remove all ¼” FEP Teflon lines from the sample manifold.
7. Measure the removed line to the fresh line and verify they are the same length. If they are not, verify the fresh line was measured correctly. If it was, then measure the removed line. If the removed line length is incorrect on the Residence Time file, create a copy of the previous year’s file and update the copy. Make a note of the error and inform the Senior Air Quality Specialist and the QA Manager once you are back in the office.
8. Clean the bug screen at the top of the sample inlet and all Teflon tees in the sample manifold with alcohol and cotton swabs.
9. After cleaning, install the new ¼” FEP Teflon tubing. Write down the length on the Residence Time sheet, the Misc. Form, and the Instrument Logbook.
10. Prior to leaving the site, leak check the instrument. 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.
11. Record the Sample Flow and the Pressure on Misc. Form and instrument logbook. 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.
12. Condition new sample manifold lines with 500 ppb O_3 for at least one hour. This can be done remotely.
13. After the line has conditioned, recheck Z/P/S points to verify instrument functionality. If this post manifold replacement performs poorly, condition the line an additional hour and recheck. If the Z/P/S points perform poorly again further diagnostics is needed.
14. Once proper instrument functionality is confirmed, take the instrument out of maintenance mode on AV Trend.
15. Log End Date and Time on Misc. Form and Data Exception Log and save all forms.
16. Residence time equation for the sites has been built into the Residence Time excel spreadsheet and are updated annually when each line is replaced. Refer to the excel spreadsheet for the equations.

Figure 8 Residence Time Excel Sheet

Sample Manifold Residence Time Calculations 2024

	Incline	Lem Val	Reno NOy	Reno NOx	So Reno	Spanish Springs	Sparks	Toll	Average All Stations	Total All Stations (1/4" OD)
Line length (inches)	296	218	600	171	133	126	181.75	150	**234.5**	1914
Line length (feet)	24.67	18.17	50.00	14.25	11.08	10.50	15.15	12.50	**19.54**	159.48
Line length (cm)	752	554	1524	434	338	320	462	381	**595.6**	
Inside diameter (cm)	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	**0.3**	
No. of filter holders	1	1	0	1	1	1	1	1	**0.9**	
Total flow (cc/min)	797	759	966	950	783	818	736	741	**818.8**	
Volume line (cm3)	60.47	44.53	122.57	34.93	27.17	25.74	37.13	30.64	**47.9**	
Volume filter holder (cm3)	50	50	0	50	50	50	50	50	**43.8**	
Residence time (sec)	**8**	**7**	**8**	**5**	**6**	**6**	**7**	**7**	**6.7**	
DATE COMPLETED	4/16/2024	4/5/2024			5/23/2024	4/8/2024	4/9/2024	5/23/2024		

	Reno4 (3/8" OD)	Reno4 (1/4" OD)	Reno4 Total
Line length (inches)	207	38	
Line length (feet)	17.25	3.17	
Line length (cm)	526	97	
Inside diameter (cm)	0.64	0.32	
No. of filter holders	3	3	3
Total flow (cc/min)	3209	3209	3209
Volume line (cm3)	169.14	7.76	176.91
Volume filter holder (cm3)	150	150	150.00
Residence time (sec)			**6**

H.6 Troubleshooting

Refer to the Troubleshooting section in the operator's manual for troubleshooting options specific to each instrument.

Figure 9 Misc. Instrument Maintenance/Data Exception Worksheet

Air Quality Management Division

Misc. Instrument Maintenance / Data Exception Worksheet

Site ____________________ Operator ____________________ Parameter(s) ____________________

Start Date ____________________ **End Date** ____________________

Start Time ____________________ **End Time** ____________________

Comments ____

File Name: Misc Data Exception Worksheet
Last Revision: 07/19/2024

QC Check/PDF:__________

Appendix I: Trace NOx/NOy Analyzers

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

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

Approved:

Name: Matthew McCarthy

Title of Author: Senior Air Quality Specialist

Signature: Matthew McCarthy Digitally signed by Matthew McCarthy Date: 2024.11.27 07:14:12 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.25 15:00:06 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.27 08:18:45 -08'00' 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
cc/min	Cubic Centimeters per Minute
DAS	Data Acquisition System
ESC	Environmental Systems Corporation
DFU	Disposable Filter Unit
FEP	Fluorinated Ethylene Propylene
GDS	Gas Dilution System
GPT	Gas-Phase Titration
hv	Light
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
PFA	Perfluoroalkoxy
PMT	Photo-Multiplier Tube
ppb	Parts per Billion
ppm	Parts per Million
QA	Quality Assurance
QC	Quality Control
RCel	Reaction Cell
PDF	Portable Document Format
PSI	Pounds per Square Inch
SOP	Standard Operating Procedures
TAPI	Teledyne-Advanced Pollution Instrumentation
Z/P/S	Zero, Precision, Span

List of Figures

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 NOx 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 T200U 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 T200U, 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 T200U 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

T200U 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 T200U 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 T200U 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 usable 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 T200U's 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 T200U will respond. The narrowness of this band of sensitivity allows the T200U to ignore extraneous light and radiation that might interfere with the T200U's 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 T200U 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 T200U 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 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 T200U 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 instrument's front panel display for indication of analyzer malfunction or warning messages. Log into AV Trend on the 8872 datalogger and compare the instrument front panel concentration to the Data Acquisition System (DAS) concentrations to check for deviations. Check all analyzer diagnostics by pressing the Dashboard button on the display screen and ensure all diagnostics are within range. **Note**: There is more than one screen for diagnostics. Use the arrow buttons at the bottom of the screen to display the other diagnostics. 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 Logbook.

Figure 1 Station Log Report

Air Quality Management Division
Station Log Report

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_Master_Template.xlsx
Last Revision: 11/07/2024

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 Agilaire 8872 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 logbook.
2. Record the Sample Flow, O_3 Flow, and Reaction Cell (RCel) Pressure from the "Dashboard" on the analyzer display. The sample flow must be 1000 cc/min +/- 20%. The O_3 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 NO_2 from 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. Log into the 8872 data logger using your Northern Nevada Public Health username and password. Once logged in, log into AV Trend on the data logger.
2. Once logged into AV Trend, click on Utilities on the left side of the screen. Then choose Site Node Logger Toolbox option.
3. When you are ready to begin the Z/P/S, put the site instrument in maintenance mode by clicking on the maintenance flag buttons on the right side of the Site Node Logger Toolbox screen for the parameters associated with the instrument. If completing NOx, click on NO, NO2, and NOx. If completing NOy, click on NOT, NO2Y, and NOY. This will change the maintenance flag from saying, "False" to "True" and will also darken out the maintenance flag button that was clicked. Note the time that you put the site instrument in maintenance mode.
4. Ensure the valve to the NO cylinder is open and the regulator pressure is at 30 PSI.
5. Ensure the pressure on the zero air generator is at 30 PSI.
6. Using your field laptop, locate the AQMonitoring drive. Open the Field Management Functions folder, QA-QC folder, then NOx QA-QC folder or NOy 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 20240916 _Reno 4_NOx). Clear the contents from the old data sheet and input all the new information on the Trace Level Carbon NOx/NOy Worksheet. Ensure the instrument's

sample flow, O_3 flow, high voltage power supply (HVPS) voltage, and RCel pressure are within the instrument's diagnostic range. Record "Start Time" on the Trace Level NOx/NOy Worksheet from when you put the channel in maintenance on AV Trend.

7. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press Generate, ensure "Output" is toggled to "B", press AUTO. Update the Gas to read 450 ppb NO and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample 450 ppb of NO. Allow the instrument to stabilize. The NOx/NOy Stability is displayed on the Home screen of the analyzer.
8. Wait until the NOx/NOy Stability is reading 0.1 ppb or less and record 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).
9. Repeat step 8 above for the following points:
    - 250 ppb NO
    - 100 ppb NO
    - 25 ppb NO
10. GPT Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press Generate, ensure "Output" is toggled to "B", press GPT. Update the Gas to read 450 ppb NO and 400 ppb O_3 and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample a mixture of 450 ppb of NO and 400 ppb O_3. Allow the instrument to stabilize. The NOx/NOy Stability is displayed on the Home screen of the analyzer.
11. Wait until the NOx/NOy Stability is reading 0.1 ppb or less and record 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).
12. Repeat step 7 above for the following points:
    - 450 ppb NO, 180 ppb O_3
    - 450 ppb NO, 55 ppb O_3
13. Zero Check: Press Generate, and then press AUTO. Update the Gas to read ZERO and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample zero air. Allow the instrument to stabilize. The NOx/NOy Stability is displayed on the Home screen of the analyzer. Wait until NOx/NOy Stability 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).
14. Press Generate, Standby on the dilution calibrator, this will stop all calibration procedures.
15. Take the instrument out of maintenance mode on AV Trend. Click on the maintenance flag button on the right-hand side of the Site Node Logger Toolbox Screen for the NO,

[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.

NO2 and NOx (or NOT, NO2y, NOy) parameter. The button will go from saying "True" to "False" and will no longer be darkly shaded.

16. Record "End Time" on the Trace Level NOx/NOy Worksheet and make sure to save the document before shutting down the computer.
17. Enter the results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring data management drives.
18. Record the Date, Start Time, End Time, and Parameter on the site's digital Data Exception Log (Figure 4) and into the composite Instrument Notebook left at the station. Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
19. Make sure that all documentation has been saved and exit out of each as well as exit out of AV Trend on the 8872 datalogger. Sign out of the datalogger.

Figure 2 Trace Level NOx/NOy Worksheet

Air Quality Management Division
Trace Level NO_Y Worksheet

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_Y Slope		Cyl. Pressure (PSI)			
NO_Y Offset					
NO Slope					
NO Offset					

Date of Last Particulate Filter Change ____

Start Time (PST) ____ End Time (PST) ____

Multipoint

NO Set Point	NOT (ppb)		Percent Deviation	NO_{YY} (ppb)		Percent Deviation	NO_Y (ppb)		Percent Deviation	*EPA NO/NO_Y Acceptance Criteria	Audit Acceptance Criteria
	Indicated	Actual		Indicated	Actual		Indicated	Actual			
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 NOT (ppb)		NO_{YY} (ppb)		Percent Deviation	Remaining NO_Y (ppb)		Percent Deviation	*EPA NO_2 Acceptance Criteria	Audit Acceptance Criteria
		Indicated		Indicated	Calculated		Indicated	Actual			
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_NOy
Last Revision: 07/19/2024

QC Check/PDF:__________

Figure 2a NO_2/Convertor Efficiency Calculation Worksheet

Air Quality Management Division
NO_2 / Convertor Efficiency Calculation Worksheet

Linear Regression

	NO		NO_y		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 = $\left(\frac{\left[NO_2\ Calculated-\left(\left[m\left(NO_x\ Original\right)+b\right]-\left[m\left(NO_x\ Remaining\right)+b\right]\right)\right]}{NO_2\ Calculated}\right)\times 100$

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! %

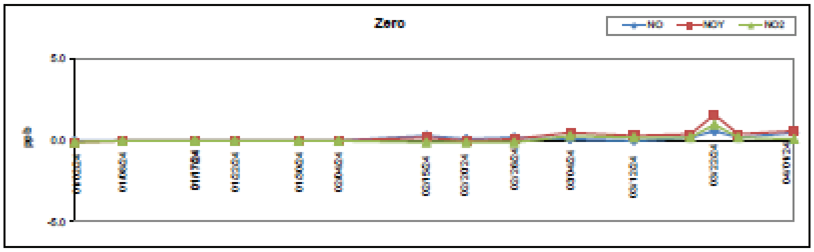
File Name: Master_Template_NOy
Last Revision: 03/10/14

Figure 3 Trace Level NOx/NOy Control Chart

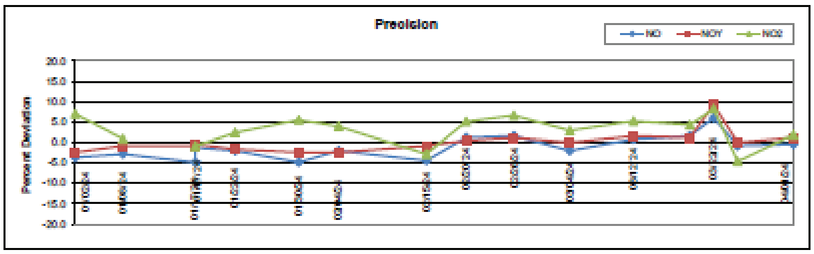
NOy Control Chart

Site: Reno 4
Year: 2024
Quarter: 1st

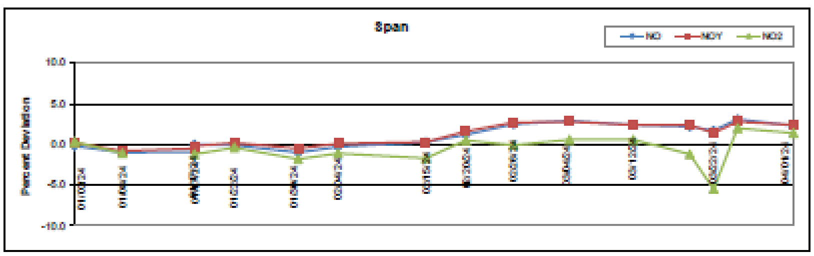
Instrument: TAPI
Model: T200U
Serial #: 404



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: 01/17/24 Span adj with Multipoint
02/15/24 Multipoint after Span
03/22/24 Qrtly Audit passed

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's 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

Year(s): ________/________
Site: ________________

Date	Cylinder ID #	Concentration (ppm)			Expiration Date	Pressure (PSI)	Initials
		CO	NO	SO_2			

Comments: ____
____
____

File Name: Monthly Cylinder Pressure Log_2024
Last Revision: 10/29/24

QC Check/PDF_____

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 the 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 near 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 counterclockwise. 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 counterclockwise. 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 the 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 – 15 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 the instrument operator.
2. Record the audit results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
3. Record the Date, Start Time, End Time, and Parameter on the respective digital Data Exception Log (Figure 4). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
4. After the worksheet has been checked by the QA Manager and finalized, file a copy in the Quarterly Audit folder made by the monitoring Senior Air Quality Specialist.

I.4.1.6 QA/QC Worksheet Review and PDF Finalization

After completing the QA/QC worksheet, it needs to be reviewed by an Air Quality Specialist and then saved as a read only PDF to lock the worksheet from editing, creating the official record.

1. Once a QA/QC worksheet is completed, the dedicated QC person will review and PDF the worksheet. For verifications, the Senior Air Quality Specialist and the Air Quality Specialists have each been assigned sites that they are not the normal site operator of to review and PDF. The QA Manager will be responsible for reviewing and creating a PDF for all audit QA/QC worksheets.
2. It is the responsibility of the dedicated QC person to monitor the QA/QC folder on the AQMonitoring drive for new QA/QC worksheets to review and PDF. When a new worksheet is completed, the QC person will review the worksheet for errors, including content and calculations.
    a. If an error is found, contact should be made to the operator to get the issue fixed.
3. After completing the review, click the Acrobat tab on the top ribbon. Click Create PDF. Click Convert to PDF, Yes, and Save. Save the PDF with the same naming convention, and notating "_RECORD" at the end of the file name.
    a. If the QA/QC worksheet is for NOx or NOy, add the Calculations sheet before clicking Convert to PDF.
4. The PDF will now be opened in Adobe. On the toolbar on the right, click the Fill & Sign option. On the top of the page, click Sign yourself.
5. If initials have not already been created, click Add Initials, and save your initials. If your initials have been saved, click on them in the dropdown menu and place them on the QC Check/PDF line at the bottom of the worksheet.
6. To create a read only copy, the QC person needs to open Adobe Acrobat Pro DC with the Adobe Sign Add-In. After placing the initials, the QC person will click Next on the right of the Fill and Sign ribbon. Click Save as a Read Only. Save the record with the same naming convention and click yes to replace existing file with the Read Only version.

Figure 6 Calibration Cylinder/Regulator Diagram

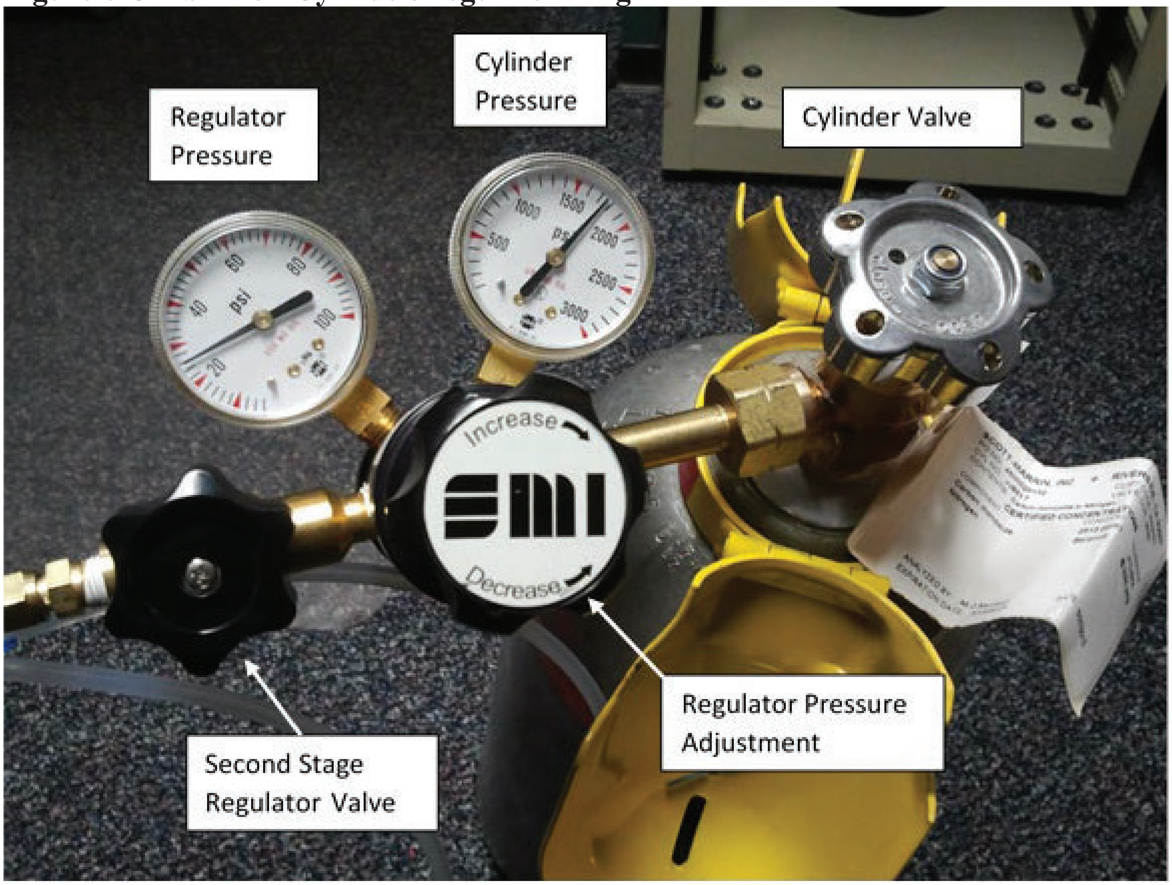


Figure 7 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 07/19/2024

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 Generate, and then press AUTO. Update the Gas to read ZERO and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample zero air. Allow the instrument to stabilize. The NOx/NOy Stability is displayed on the Home screen of the analyzer.
2. While the instrument is stabilizing, click on the calibration button of the left side of the instrument's touch screen display. Then click on M-P. This will bring up a display of concentration and stability similar to the home screen display.
3. Wait for Stability to be under 0.1 ppb. Once stabilized, press Start
4. If Stability remains steady and below 0.10 ppb, press Zero. 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. **Note: The Zero button will only become available if the analyzer is reading a concentration close to 0.000 ppm, if the instrument is reading a concentration that is too far from 0.000 ppm that you cannot get the zero button to be available, contact Teledyne Technical Support for guidance.**
5. Allow the instrument to stabilize to 0.1 ppb and record the reading from the DAS on a new NOx/NOy worksheet.
6. 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: on the dilution calibrator, press Generate, press AUTO. Update the Gas to read 450 ppb NO and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample 450 ppb of NO. Allow the instrument to stabilize. The NOx/NOy Stability is displayed on the Home screen of the analyzer.
2. While the instrument is stabilizing, click on the calibration button of the left side of the instrument's touch screen display. Then click on M-P. This will bring up a display of concentration and stability similar to the home screen display.
3. Wait for Stability to be under 0.1 ppb. Once stabilized, press Start.
4. Click on Set Span Target and verify that your span is set to 450 ppb of NO and NOx (or NOT and NOy).
5. If Stability remains steady and below 0.1 ppb, click Span. The instrument will adjust automatically to 450.0 ppb of NO and NOx (or NOT and NOy) concentration and will "zero out" NO2 (or NO2y). Log "span adjustment" in the comments section of the original multipoint with GPT worksheet. **Note: The Span button will only become available if the analyzer is reading a concentration close to the span concentration that is programed in, if the instrument is reading a concentration that is too far from programmed span concentration that you cannot get the Span button to be available, verify that 450 ppb is programed in. If so, and the span button is still unavailable, contact Teledyne Technical Support for guidance.**
6. Allow the instrument to stabilize and record the reading from AV Trend and record the ACTUAL reading from the calibrator on a new NOx/NOy worksheet.
7. Click the stop button to turn off the calibration sequence.
8. Fill out the data exception log with the start/end time and use the calibration flag.
9. 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 logbook. 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.

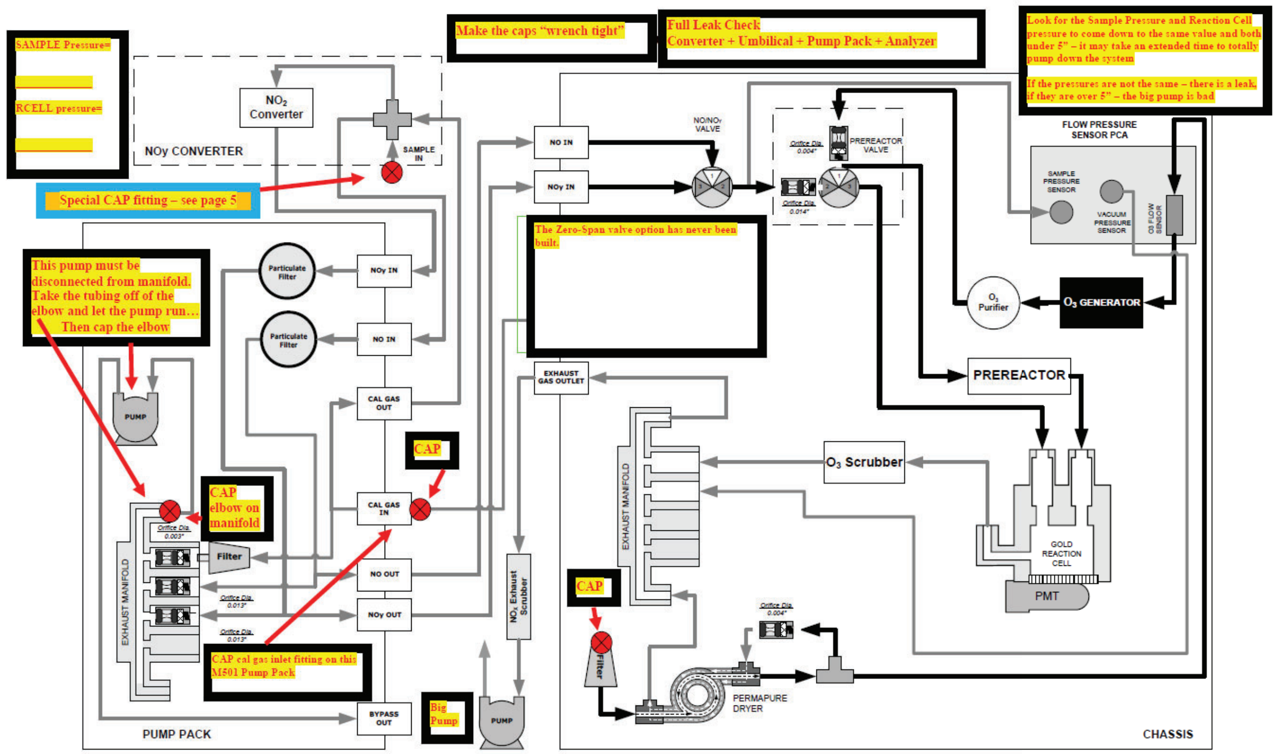
I.6.2 Replacing the Particulate Filter on NOy Analyzer/Leak Check

On 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. Lower the met tower outside the shelter to roof level. Refer to Figure 8 for pneumatic leak check description.
9. Remove the Teflon fitting on the sample in port on the converter box and install the ¼ inch Parker-Hannifin PFA Paragrip CAP leak check fitting (Figure 9) to the Teflon fitting on the sample in converter box outside the shelter.
10. Inside the shelter, remove the top panel of the 501-bypass pump box by removing the 4 screws on the sides.
11. On the back of the 501-bypass pump box, remove the Cal Gas "IN" Teflon tubing line and install ¼ inch cap over the bulkhead. The bulkhead may require an additional wrench to remove the Teflon line and install the cap.
12. On the inside of the 501-bypass pump box, locate the exhaust manifold, remove the tubing off the elbow, and let the pump run. Install a ¼ inch cap on the elbow coming off the manifold.
13. Remove the top panel on the analyzer by removing the 4 screws on the sides.
14. Inside the Model T200 analyzer, install a blue cap located inside the leak check bag over the Perma Pure dryer filter. It may take several minutes for the displayed sample flow and sample pressure to stabilize.
15. Record the Sample Flow and the Sample Pressure in the instrument logbook. The Sample Flow must be below 10 cc/min and the Sample Pressure and RCel Pressure on the front panel must be below 5 inHg to pass the leak test. These two pressure numbers should be the same value. If the leak test does not pass, refer to the instrument manual for instructions on diagnosing a leak.

Figure 8 Pneumatic Leak Check Diagram



T200U-NOy, M200EU-NOy Pneumatic Diagram with Zero/Span Valve Option

P/N 06115 Rev B: DIAGRAM, T200U/M200EU, NOY, PNEUMATIC Page 1 of 6 Printed documents are UNCONTROLLED TELEDYNE-API
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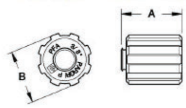
Figure 9 Parker-Hannifin Partek PFA Paragrip CAP

DCN #5822 Author: Patrick King

Parker- Hannifin Partek PFA Paragrip CAP fitting page 28 GCAP-4

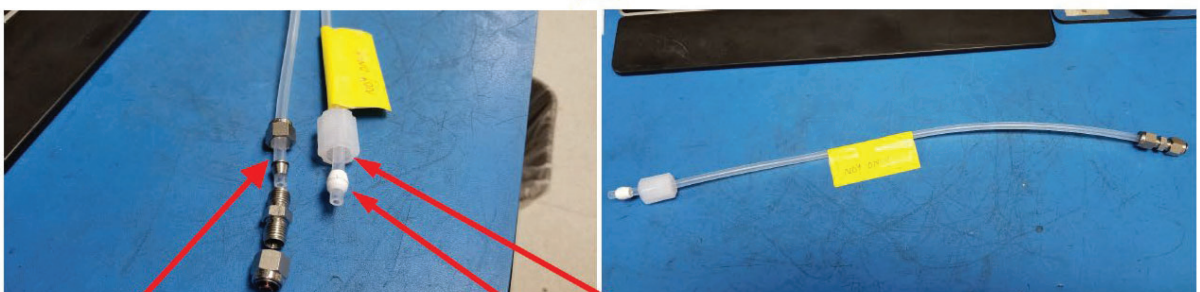
Fitting Cap



NOy CAP

Part Number	Tube Size	A		B	
		inch	mm	inch	mm
GCAP-4	1/4	1.13	28.70	0.84	21.34
GCAP-6	3/8	1.09	27.69	0.97	24.64

OR:



Regular ¼" fitting profile … Paragrip fitting, same ¼"tubing OD but Different Larger Diameter (OD) on ferrules and (ID) on the nut

P/N 06115 Rev B: DIAGRAM, T200U/M200EU, NOY, PNEUMATIC Page 5 of 6 Printed documents are UNCONTROLLED TELEDYNE-API

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I.6.3 Replacing the Sample Manifold

1. Flag all affected gas parameters on AV Trend.
2. Log Start Date and Time on a Misc. Instrument Maintenance Form and Data Exception Log (Figure 11).
3. Check multipoint and GPT points to verify instrument functionality. If it performs poorly or fails, diagnose issue with instrument before proceeding with manifold replacement. Once the functionality of instrument is verified proceed with next steps.
4. Using your field laptop, navigate to the Residence Time folder under the QA-QC folder on the AQmonitoring drive. Open the current year's excel file (Figure 10).
5. The amount of ¼" FEP Teflon tubing needed for each site is shown on the Residence Time excel file. Measure and cut the length of line needed for the site you are located at.
6. Completely remove all ¼" FEP Teflon lines from the sample manifold.
7. Measure the removed line to the fresh line and verify they are the same length. If they are not, verify the fresh line was measured correctly. If it was, then measure the removed line. If the removed line length is incorrect on the Residence Time file, create a copy of the previous year's file and update the copy. Make a note of the error and inform the Senior Air Quality Specialist and the QA Manager once you are back in the office.
8. Clean the bug screen at the top of the sample inlet and all Teflon tees in the sample manifold with alcohol and cotton swabs.
9. After cleaning, install the new ¼" FEP Teflon tubing. Write down the length on the Residence Time sheet, the Misc. Form, and the Instrument Logbook.
10. Prior to leaving the site, leak check the instrument. 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. If NOy, follow steps 8-15 in Section I.6.2.
11. Record the leak check parameters on Misc. Form and instrument logbook.
12. Condition new sample manifold lines with 500 ppb O_3 for at least one hour. This can be done remotely.
13. After the line has conditioned, recheck multipoint and GPT points to verify instrument functionality. If this post manifold replacement performs poorly, condition the line an additional hour and recheck. If the points perform poorly again further diagnostics is needed.
14. Once proper instrument functionality is confirmed, take the instrument out of maintenance mode on AV Trend.
15. Log End Date and Time on Misc. Form and Data Exception Log and save all forms.
16. Residence time equation for the sites has been built into the Residence Time excel spreadsheet and are updated annually when each line is replaced. Refer to the excel spreadsheet for the equations.

I.7 Troubleshooting

Refer to the Troubleshooting section in the operator's manual for troubleshooting options specific to each instrument.

Figure 10 Residence Time Excel Sheet

Sample Manifold Residence Time Calculations 2024

	Incline	Lem Val	Reno NOy	Reno NOx	So Reno	Spanish Springs	Sparks	Toll	Average All Stations	Total All Stations (1/4" OD)
Line length (inches)	296	218	600	171	133	126	181.75	150	**234.5**	1914
Line length (feet)	24.67	18.17	50.00	14.25	11.08	10.50	15.15	12.50	**19.54**	159.48
Line length (cm)	752	554	1524	434	338	320	462	381	**595.6**	
Inside diameter (cm)	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	**0.3**	
No. of filter holders	1	1	0	1	1	1	1	1	**0.9**	
Total flow (cc/min)	797	759	966	950	783	818	736	741	**818.8**	
Volume line (cm3)	60.47	44.53	122.57	34.93	27.17	25.74	37.13	30.64	**47.9**	
Volume filter holder (cm3)	50	50	0	50	50	50	50	50	**43.8**	
Residence time (sec)	**8**	**7**	**8**	**5**	**6**	**6**	**7**	**7**	**6.7**	
DATE COMPLETED	4/16/2024	4/5/2024			5/23/2024	4/8/2024	4/9/2024	5/23/2024		

	Reno4 (3/8" OD)	Reno4 (1/4" OD)	Reno4 Total
Line length (inches)	207	38	
Line length (feet)	17.25	3.17	
Line length (cm)	526	97	
Inside diameter (cm)	0.64	0.32	
No. of filter holders	3	3	3
Total flow (cc/min)	3209	3209	3209
Volume line (cm3)	169.14	7.76	176.91
Volume filter holder (cm3)	150	150	150.00
Residence time (sec)			**6**

Figure 11 Misc. Instrument Maintenance/Data Exception Worksheet

Air Quality Management Division
Misc. Instrument Maintenance / Data Exception Worksheet

Site ________________ Operator ________________ Parameter(s) ________________

Start Date ________________ **End Date** ________________

Start Time ________________ **End Time** ________________

Comments ____

File Name: Misc Data Exception Worksheet
Last Revision: 07/19/2024

QC Check/PDF:__________

Appendix J: Trace Sulfur Dioxide Analyzers

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Matthew McCarthy

Title of Author: Senior Air Quality Specialist

Signature: Matthew McCarthy Digitally signed by Matthew McCarthy Date: 2024.11.27 07:25:30 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.25 15:00:30 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.27 08:19:27 -08'00' 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
SO_2T	Sulfur Dioxide Trace
SOP	Standard Operating Procedures
TAPI	Teledyne Advanced Pollution Instrumentation
UV	Ultraviolet Radiation
Z/P/S	Zero, Precision, Span

Figures and Tables

J.1 Introduction

The T100U UV Fluorescence SO_2 Analyzer is a microprocessor-controlled analyzer that determines the concentration of sulfur dioxide (SO_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 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 T100U'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 (SO_2*). 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 instrument's front panel display for indication of analyzer malfunction or warning messages. Log into AV Trend on the 8872 datalogger and compare the instrument front panel concentration to the Data Acquisition System (DAS) concentrations to check for deviations. Check all analyzer diagnostics by pressing the Dashboard button on the display screen and ensure all diagnostics are within range. **Note**: There is more than one screen for diagnostics. Use the arrow buttons at the bottom of the screen to display the other diagnostics. 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 Logbook.

Figure 1 Station Log Report

Air Quality Management Division
Station Log Report

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_Master_Template.xlsx
Last Revision: 11/07/2024

J.4.1.2 Daily Checks

Daily span/zero checks are performed at 0046 PST using automatic calibrations programmed into the Agilaire 8872 data logger (see appendix VV for the Agilaire 8872 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 SO_2 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 from the Home screen on the analyzer display. 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 billion (ppb) of SO_2 from 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. Log into the 8872 data logger using your Northern Nevada Public Health username and password. Once logged in, log into AV Trend on the data logger.
2. Once logged into AV Trend, click on Utilities on the left side of the screen. Then choose Site Node Logger Toolbox option.
3. When you are ready to begin the Z/P/S, put the site instrument in maintenance mode by clicking on the maintenance flag button on the right side of the Site Node Logger Toolbox screen for the SO_2T parameter. This will change the maintenance flag from saying, "False" to "True" and will also darken out the maintenance flag button that was clicked. Note the time that you put the site instrument in maintenance mode.
4. Ensure the valve to the SO_2 cylinder is open and the regulator pressure is at 30 PSI.
5. Ensure the pressure on the zero air generator is at 30 PSI.
6. Using your field laptop locate the AQMonitoring drive. 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 20240916 _Reno 4_SO2). Clear the contents from the old data sheet and input all the new information on the Trace Level Sulfur Dioxide Worksheet. Ensure the instrument's reference voltage and sample flow is within the instrument's diagnostic range. Record "Start Time" on the Trace Level Sulfur Dioxide Worksheet from when you put the channel in maintenance on AV Trend

7. Span Check: From the standby screen on the Teledyne T700U Dilution Calibrator (see appendix LL for the SOP on this instrument), press Generate, ensure "Output" is toggled to "A", press AUTO. Update the Gas to read 90 ppb SO_2 and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample 90 ppb of SO_2. Allow the instrument to stabilize. The SO_2 Stability is displayed on the Home screen of the analyzer.
8. Wait until the SO_2 Stability is reading 0.1 ppb or less and record the SO_2 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).
9. Precision Check: Repeat step 7 above using 6 ppb SO_2 for the concentration.
10. Zero Check: Press Generate, and then press AUTO. Update the Gas to read ZERO and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample zero air. Allow the instrument to stabilize. The SO_2 Stability is displayed on the Home screen of the analyzer. Wait until SO_2 Stability is reading 0.1 ppb or less and record the SO_2 concentration from the DAS. Adjust the zero if the SO_2 concentration is outside +/- 0.2 parts per billion (ppb)[1] (see section J.4.2 for Calibration Procedures).
11. Press Generate, Standby on the dilution calibrator, this will stop all calibration procedures.
12. Take the instrument out of maintenance mode on AV Trend. Click on the maintenance flag button on the right-hand side of the Site Node Logger Toolbox Screen for the SO_2T parameter. The button will go from saying "True" to "False" and will no longer be darkly shaded.
13. Record "End Time" on the Trace Level SO_2 Worksheet and make sure to save the document.
14. Enter the results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
15. Record the Date, Start Time, End Time, and Parameter on the site's digital Data Exception Log (Figure 4) and into the composite Instrument Notebook left at the station. Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
16. Make sure that all documentation has been saved and exit out of each as well as exit out of AV Trend on the 8872 datalogger. Sign out of the datalogger.

[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

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	
Norm PMT Signal (mV)					
UV Lamp (mV)		Cal. Cylinder No.			
Str. Light (ppb)		Concentration (ppm)			
		Expiration Date			
Slope		Cyl. Pressure (PSI)			
Norm Offset (mV)					

Date of Last Particulate Filter Change ______

Start Time ______ PST **End Time** ______ PST

Set Point	Indicated	Actual	Percent Dev.	Difference (ppb)	*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.
6 ppb			#DIV/0!	0.00	+/- 10% dev or +/- 1.5 ppb, whichever is greater	+/- 15% dev.
0 ppb			#DIV/0!	0.00	+/- 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 ______________________________

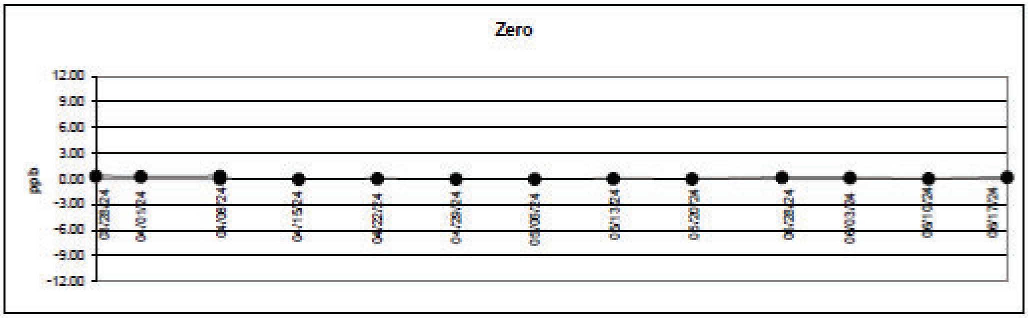
File Name: Master_Template_SO2_Trace_NCore
Last Revision: 07/19/2024

QC Check/PDF: ________

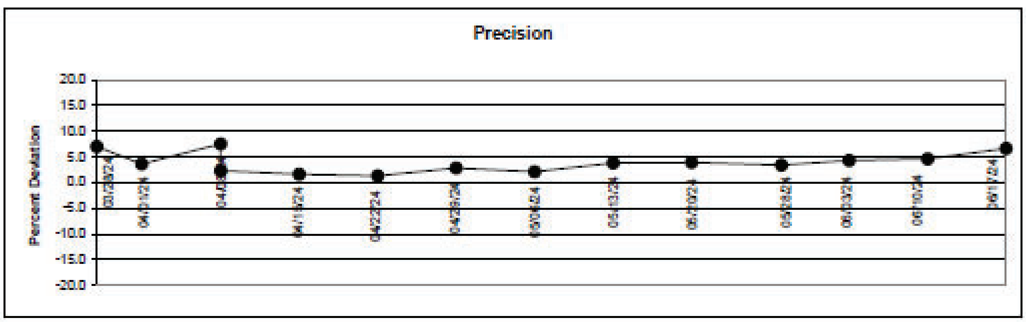
Figure 3 SO_2 Control Chart

SO2 Control Chart

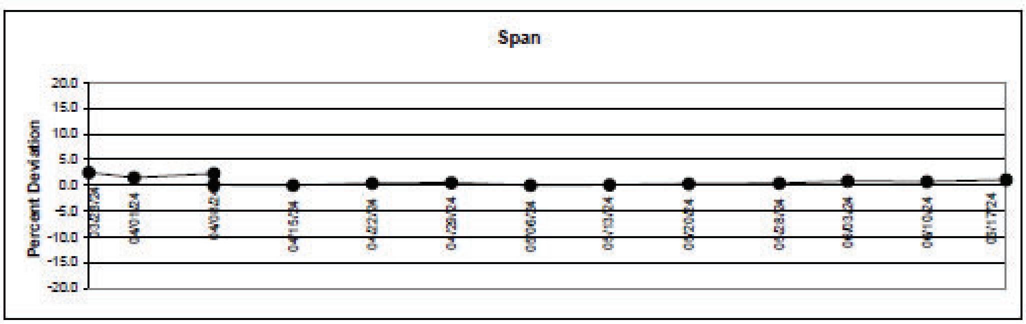
Site:	Reno 4	Instrument:	TAPI
Year:	2024	Model:	T100U
Quarter:	2nd	Serial #:	514



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: 04/08/24 Span/Zero Adj. Multipoint

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.4.1.4 Monthly Checks

Perform monthly checks at the beginning of each month.

1. Check pressure in the SO_2 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 SO_2.
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

Year(s): ____________/____________
Site: ________________________

Date	Cylinder ID #	Concentration (ppm)			Expiration Date	Pressure (PSI)	Initials
		CO	NO	SO_2			

Comments: ____
____
____

File Name: Monthly Cylinder Pressure Log_2024
Last Revision: 10/29/24

QC Check/PDF_____

J.4.1.5 Quarterly Audits

Equipment Needed:
- Certified audit ozone transfer standard/dilution calibrator (TAPI T750U)
- Audit zero air generator (TAPI 751H)
- Audit CO/SO_2 calibration cylinder

J.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/SO_2 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/SO_2 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.4.1.5.2 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. Record the audit results from the field form onto the respective control chart (Figure 3). Control charts are maintained on the AQMonitoring drive.
3. Record the Date, Start Time, End Time, and Parameter on the respective digital Data Exception Log (Figure 4). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
4. After the worksheet has been checked by the QA Manager and finalized, file a copy in the Quarterly Audit folder made by the monitoring Senior Air Quality Specialist.

Figure 6 Calibration Cylinder/Regulator Diagram

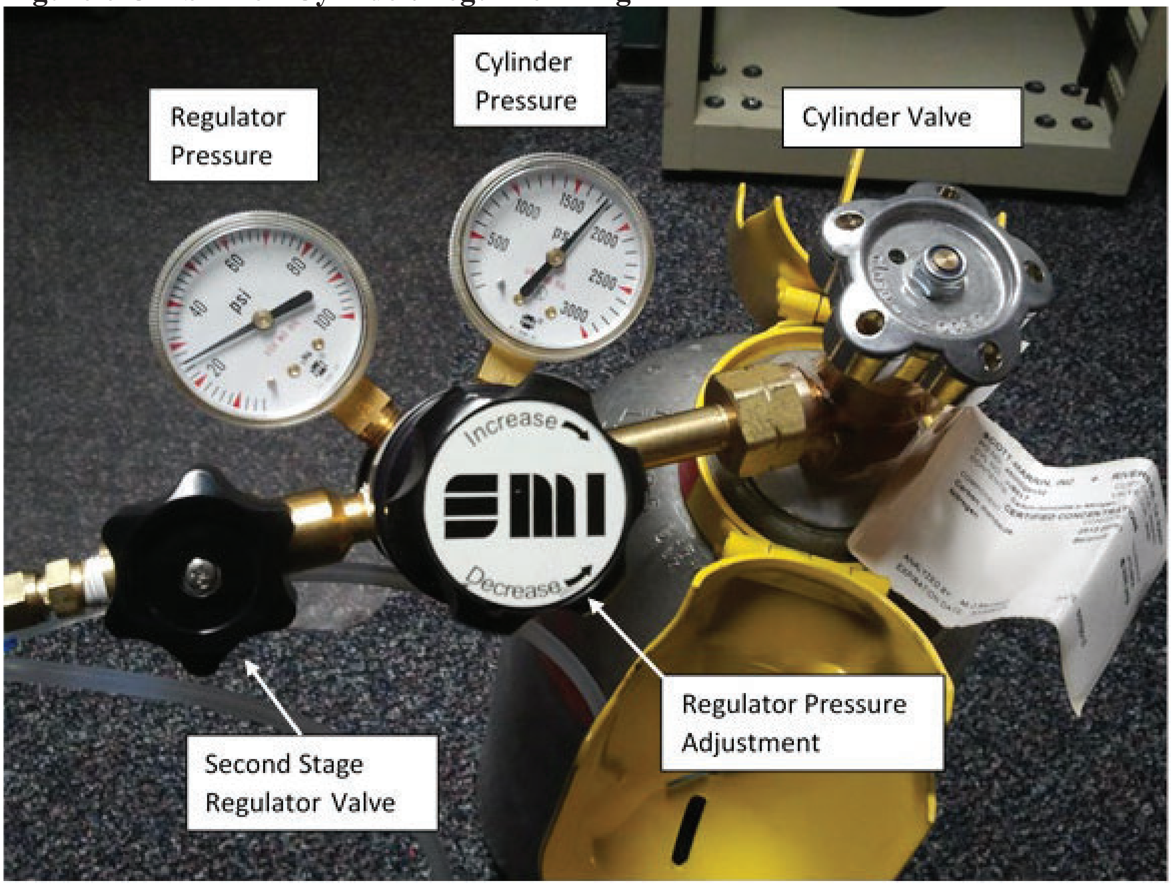


Figure 7 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 07/19/2024

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, on the dilution calibrator, press Generate, and then press AUTO. Update the Gas to read ZERO and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample zero air. Allow the instrument to stabilize The SO_2 Stability is displayed on the Home screen of the analyzer.
2. While the instrument is stabilizing, click on the calibration button of the left side of the instrument's touch screen display. Then click on M-P. This will bring up a display of concentration and stability similar to the home screen display.
3. Wait for Stability to be at or below 0.1 ppb. Once stabilized, press Start.
4. If Stability remains steady and below 0.1 ppb, press Zero. The instrument will adjust automatically to 0.0 ppb SO_2 concentration. Log "zero adjustment" in the comments section of the original Z/P/S worksheet. **Note: The Zero button will only become available if the analyzer is reading a concentration close to 0.0 ppb, if the instrument is reading a concentration that is too far from 0.0 ppb that you cannot get the zero button to be available, contact Teledyne Technical Support for guidance.**
5. Allow the instrument to stabilize to 0.1 ppb and record the reading from the DAS on a new Z/P/S worksheet.
6. Click the stop button to turn off the calibration sequence.
7. 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: on the dilution calibrator, press Generate, press AUTO. Update the Gas to read 90 ppb SO_2 and Total Flow to 6.000 SLPM. Press Generate. The instrument will begin to sample 90 ppb of SO_2. Allow the instrument to stabilize. The SO_2 Stability is displayed on the Home screen of the analyzer.
2. While the instrument is stabilizing, click on the calibration button of the left side of the instrument's touch screen display. Then click on M-P. This will bring up a display of concentration and stability similar to the home screen display.
3. Wait for Stability to be at or below 0.1 ppb. Once stabilized, press Start.
4. Click on Set Span Target and verify that your span is set to 90 ppb.
5. If Stability remains steady and below 0.1 ppb, click Span. The instrument will adjust automatically to 90 ppb SO_2 concentration. Log "span adjustment" in the comments

section of the original Z/P/S worksheet. **Note: The Span button will only become available if the analyzer is reading a concentration close to the span concentration that is programed in, if the instrument is reading a concentration that is too far from programmed span concentration that you cannot get the Span button to be available, verify that 90 ppb is programed in. If so, and the span button is still unavailable, contact Teledyne Technical Support for guidance.**

6. Allow the instrument to stabilize and record the reading from AV Trend and record the ACTUAL reading from the calibrator on a new Trace Level Sulfur Dioxide worksheet.
7. Click the stop button to turn off the calibration sequence.
8. Fill out the data exception log with the start/end time and use the calibration flag.
9. 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. Log into the 8872 data logger using your Northern Nevada Public Health username and password. Once logged in, log into AV Trend on the data logger.
2. Once logged into AV Trend, click on Utilities on the left side of the screen. Then choose Site Node Logger Toolbox option.
3. When you are ready to begin the multipoint, put the site instrument in maintenance mode by clicking on the maintenance flag button on the right side of the Site Node Logger Toolbox screen for the SO_2T parameter. This will change the maintenance flag from saying, “False” to “True” and will also darken out the maintenance flag button that was clicked. Note the time that you put the site instrument in maintenance mode.
4. Ensure the valve to the SO_2T cylinder is open and the regulator pressure is at 30 PSI.
5. Ensure the pressure on the zero air generator is at 30 PSI.
6. Using your field laptop, locate the AQMonitoring drive. 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 **NOTE: add MP to the end of the file name to denote this is a multi-point check and separate from the earlier QC check** (ex 20230916_Reno 4_SO2_MP). Clear the contents from the old data sheet and input all the new information on the Trace Level SO_2 worksheet. Ensure the instrument’s reference voltage and sample flow is within the instrument’s diagnostic range. Record “Start Time” on the Trace Level SO_2 worksheet from when you put the channel in maintenance on the AV Trend.
7. Span Check: Preform Steps 7-8 from Section J.4.1.3.2 Calibration Checks. Once you have recorded your results repeat these steps for the following SO_2 gas concentrations:
    - 50 ppb SO_2
    - 35 ppb SO_2
    - 6 ppb SO_2
8. Zero Check: Preform Step 10 from Section J.4.1.3.2 and record your results.

9. Press Generate, Standby on the dilution calibrator, this will stop all calibration procedures.
10. Take the instrument out of maintenance mode on AV Trend. Click on the maintenance flag button on the right-hand side of the Site Node Logger Toolbox Screen for the SO_2T parameter. The button will go from saying “True” to “False” and will no longer be darkly shaded.
11. Record “End Time” on the Trace SO_2 Worksheet and make sure to save the document.
12. Record the multipoint results from the field form onto the respective control chart (Figure 4). Control charts are maintained on the AQMonitoring drive.
13. Record the Date, Start Time, End Time, and Parameter on the sites digital Data Exception Log (Figure 3). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
14. Ensure that all documentation has been saved on your field laptop. Once complete shut down the laptop.
15. Close out of AV Trend on the 8872 datalogger and sign out.
16. Remove the old multipoint sticker from the front of the analyzer and fill out a new one with the date of the multipoint, your initials and the next multipoint due date. Place on front of the analyzer.

J.4.3 QA/QC Worksheet Review and PDF Finalization

After completing the QA/QC worksheet, it needs to be reviewed by an Air Quality Specialist and then saved as a read only PDF to lock the worksheet from editing, creating the official record.

1. Once a QA/QC worksheet is completed, the dedicated QC person will review and PDF the worksheet. For verifications, the Senior Air Quality Specialist and the Air Quality Specialists have each been assigned sites that they are not the normal site operator of to review and PDF. The QA Manager will be responsible for reviewing and creating a PDF for all audit QA/QC worksheets.
2. It is the responsibility of the dedicated QC person to monitor the QA/QC folder on the AQMonitoring drive for new QA/QC worksheets to review and PDF. When a new worksheet is completed, the QC person will review the worksheet for errors, including content and calculations.
    a. If an error is found, contact should be made to the operator to get the issue fixed.
3. After completing the review, click the Acrobat tab on the top ribbon. Click Create PDF. Click Convert to PDF, Yes, and Save. Save the PDF with the same naming convention, and notating “_RECORD” at the end of the file name.
4. The PDF will now be opened in Adobe. On the toolbar on the right, click the Fill & Sign option. On the top of the page, click Sign yourself.
5. If initials have not already been created, click Add Initials, and save your initials. If your initials have been saved, click on them in the dropdown menu and place them on the QC Check/PDF line at the bottom of the worksheet.
6. To create a read only copy, the QC person needs to open Adobe Acrobat Pro DC with the Adobe Sign Add-In. After placing the initials, the QC person will click Next on the right of the Fill and Sign ribbon. Click Save as a Read Only. Save the record with the same naming convention and click yes to replace existing file with the Read Only version.

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 logbook. 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 AV Trend.
2. Log Start Date and Time on a Misc. Instrument Maintenance Form and Data Exception Log (Figure 9).
3. Check Z/P/S points to verify instrument functionality. If Z/P/S performs poorly or fails, diagnose issue with instrument before proceeding with manifold replacement. Once the functionality of instrument is verified proceed with next steps.
4. Using your field laptop, navigate to the Residence Time folder under the QA-QC folder on the AQmonitoring drive. Open the current years excel file (Figure 8).
5. The amount of ¼” FEP Teflon tubing needed for each site is shown on the Residence Time excel file. Measure and cut the length of line needed for the site you are located at.
6. Completely remove all ¼” FEP Teflon lines from the sample manifold.
7. Measure the removed line to the fresh line and verify they are the same length. If they are not, verify the fresh line was measured correctly. If it was, then measure the removed line. If the removed line length is incorrect on the Residence Time file, create a copy of the previous year’s file and update the copy. Make a note of the error and inform the Senior Air Quality Specialist and the QA Manager once you are back in the office.

8. Clean the bug screen at the top of the sample inlet and all Teflon tees in the sample manifold with alcohol and cotton swabs.
9. After cleaning, install the new ¼" FEP Teflon tubing. Write down the length on the Residence Time sheet, the Misc. Form, and the Instrument Logbook.
10. Prior to leaving the site, leak check the instrument. 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.
11. Record the Sample Flow and the Pressure on Misc. Form and instrument logbook. 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.
12. Condition new sample manifold lines with 500 ppb O_3 for at least one hour. This can be done remotely.
13. After the line has conditioned, recheck Z/P/S points to verify instrument functionality. If this post manifold replacement performs poorly, condition the line an additional hour and recheck. If the Z/P/S points perform poorly again further diagnostics is needed.
14. Once proper instrument functionality is confirmed, take the instrument out of maintenance mode on AV Trend.
15. Log End Date and Time on Misc. Form and Data Exception Log and save all forms.
16. Residence time equation for the sites has been built into the Residence Time Excel spreadsheet and are updated annually when each line is replaced. Refer to the Excel spreadsheet for the equations.

Figure 8 Residence Time Excel Sheet

Sample Manifold Residence Time Calculations 2024

	Incline	**Lem Val**	**Reno NOy**	**Reno NOx**	**So Reno**	**Spanish Springs**	**Sparks**	**Toll**	**Average All Stations**	**Total All Stations (1/4" OD)**
Line length (inches)	296	218	600	171	133	126	181.75	150	**234.5**	1914
Line length (feet)	24.67	18.17	50.00	14.25	11.08	10.50	15.15	12.50	**19.54**	159.48
Line length (cm)	752	554	1524	434	338	320	462	381	**595.6**	
Inside diameter (cm)	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	**0.3**	
No. of filter holders	1	1	0	1	1	1	1	1	**0.9**	
Total flow (cc/min)	797	759	966	950	783	818	736	741	**818.8**	
Volume line (cm3)	60.47	44.53	122.57	34.93	27.17	25.74	37.13	30.64	**47.9**	
Volume filter holder (cm3)	50	50	0	50	50	50	50	50	**43.8**	
Residence time (sec)	**8**	**7**	**8**	**5**	**6**	**6**	**7**	**7**	**6.7**	
DATE COMPLETED	4/16/2024	4/5/2024			5/23/2024	4/8/2024	4/9/2024	5/23/2024		

	Reno4 (3/8" OD)	**Reno4 (1/4" OD)**	**Reno4 Total**
Line length (inches)	207	38	
Line length (feet)	17.25	3.17	
Line length (cm)	526	97	
Inside diameter (cm)	0.64	0.32	
No. of filter holders	3	3	3
Total flow (cc/min)	3209	3209	3209
Volume line (cm3)	169.14	7.76	176.91
Volume filter holder (cm3)	150	150	150.00
Residence time (sec)			**6**

J.6 Troubleshooting

Refer to the Troubleshooting section in the operator's manual for troubleshooting options specific to each instrument.

Figure 9 Misc. Instrument Maintenance/Data Exception Worksheet

Air Quality Management Division

Misc. Instrument Maintenance / Data Exception Worksheet

Site ________________ Operator ________________ Parameter(s) ________________

Start Date ________________ **End Date** ________________

Start Time ________________ **End Time** ________________

Comments ____

File Name: Misc Data Exception Worksheet
Last Revision: 07/19/2024

QC Check/PDF:__________

Appendix K: Zero Air Generator

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Michael Crawford

Title of Author: Air Quality Specialist

Signature: MICHAEL CRAWFORD Digitally signed by MICHAEL CRAWFORD Date: 2024.12.03 10:47:36 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.25 15:00:54 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.12.03 09:46:33 -08'00' 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

CO	Carbon Monoxide
°C	Degrees Celsius
DAS	Data Acquisition System
LPM	Liters per Minute
NCore	National Core Multi-Pollutant Monitoring Station
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
NOy	Reactive Oxides of Nitrogen
O_3	Ozone
PDF	Portable Document Format
PSI	Pounds per Square Inch
QA	Quality Assurance
QC	Quality Control
SLAMS	State or Local Air Monitoring Station
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedures
TAPI	Teledyne Advanced Pollution Instrumentation
TFE	Tetrafluoroethylene

List of Figures

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

The zero air generator should be turned on and running with a valve installed on the output of the zero air unit and set at 5 LPM verified with a flow standard. Ensure the display on the calibrator is reading a minimum of 30 PSI, but less than 55 PSI throughout zero/precision/span checks and calibrations. Verify the Dew Point light is displaying in green on newer zero air units with a Dew Point light.

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 701/701H zero air generator. Remove the station 701/701H 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 701/701H zero air line to the DILUENT IN port on the audit T750U.
4. Power on the station 701/701H 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).
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, O_3, and SO_2 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).
10. Log the “End Time” on the Zero Air Generator Audit Worksheet.
11. Record the Date, Start Time, End Time, and Parameter on the respective digital Data Exception Log (Figure 3). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
12. After the worksheet has been checked by the QA Manager and finalized, file a copy in the Quarterly Audit folder made by the monitoring Senior Air Quality Specialist.

K.4.1.1.3 QA/QC Worksheet Review and PDF Finalization

After completing the QA/QC worksheet, it needs to be reviewed by an Air Quality Specialist and then saved as a read only PDF to lock the worksheet from editing, creating the official record.

1. Once a QA/QC worksheet is completed, the dedicated QC person will review and PDF the worksheet. For verifications, the QC person will rotate monthly between the Senior Air Quality Specialist and the Air Quality Specialists in the Monitoring Program. The QA Manager will be responsible for reviewing and creating a PDF for all audit QA/QC worksheets.
2. It is the responsibility of the dedicated QC person to monitor the QA/QC folder on the AQMonitoring drive for new QA/QC worksheets to review and PDF. When a new worksheet is completed, the QC person will review the worksheet for errors, including content and calculations.
    a. If an error is found, contact should be made to the operator to get the issue fixed.
3. After completing the review, click the Acrobat tab on the top ribbon. Click Create PDF. Click Convert to PDF, Yes, and Save. Save the PDF with the same naming convention, and notating “_RECORD” at the end of the file name.
4. The PDF will now be opened in Adobe. On the toolbar on the right, click the Fill & Sign option. On the top of the page, click Sign yourself.
5. If initials have not already been created, click Add Initials, and save your initials. If your initials have been saved, click on them in the dropdown menu and place them on the QC Check/PDF line at the bottom of the worksheet.
6. To create a read only copy, the QC person needs open Adobe Acrobat Pro DC with the Adobe Sign Add-In. After placing the initials, the QC person will click Next on the right of the Fill and Sign ribbon. Click Save as a Read Only. Save the record with the same naming convention and click yes to replace existing file with the Read Only version.

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

Date ______ Operator ______ Site ______

Start Time (PST) ______ **End Time (PST)** ______

Site Zero Air Generator		**Audit Zero Air Generator**		**Ultra Pure Cylinder**	
Manufacturer		Manufacturer		Manufacturer	N/A
Model		Model		Cyl. No.	N/A
Serial No.		Serial No.		Cert. Date	N/A
PSI		PSI		Cyl. Press.	N/A

Instrument Response

CO

Site Zero Air Generator (ppm)	Audit Zero Air Generator (ppm)	Ultra Pure Cylinder (ppm)	Difference (ppm)			
			0.0	<0.1 ppm?	Yes ____	No ____

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	#DIV/0!	#DIV/0!		#DIV/0!	<10 ppb?	Yes ____	No ____

SO2

Site Zero Air Generator (ppb)	Audit Zero Air Generator (ppb)	Ultra Pure Cylinder (ppb)	Difference (ppb)			
			0.00	<1 ppb?	Yes ____	No ____

NO2

Site Zero Air Generator (ppb)	Audit Zero Air Generator (ppb)	Ultra Pure Cylinder (ppb)	Difference (ppb)			
			0.0	<10 ppb?	Yes ____	No ____

NOY-NO

Site Zero Air Generator (ppb)	Audit Zero Air Generator (ppb)	Ultra Pure Cylinder (ppb)	Difference (ppb)			
			0.0	<10 ppb?	Yes ____	No ____

Comments ______

File Name: Master_Template_Zero Air_SLAMS.xlsx
Last Revision: 11/05/2024

QC Check/PDF: ______

Figure 2 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 07/19/2024

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 701/701H 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. Install a valve to the output of the zero air unit. Turn on the zero air unit and connect a flow standard to the output of the valve. Set adjust valve so flow is at 5 LPM. Leave on for up to 48 hours to fully dry out and condition system.

NOTE: After replacing the material in these scrubbers, it can take up to 48 hours for the material to dry out before the 701/701H 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 701/701H 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 701/701H.
   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 701/701H 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

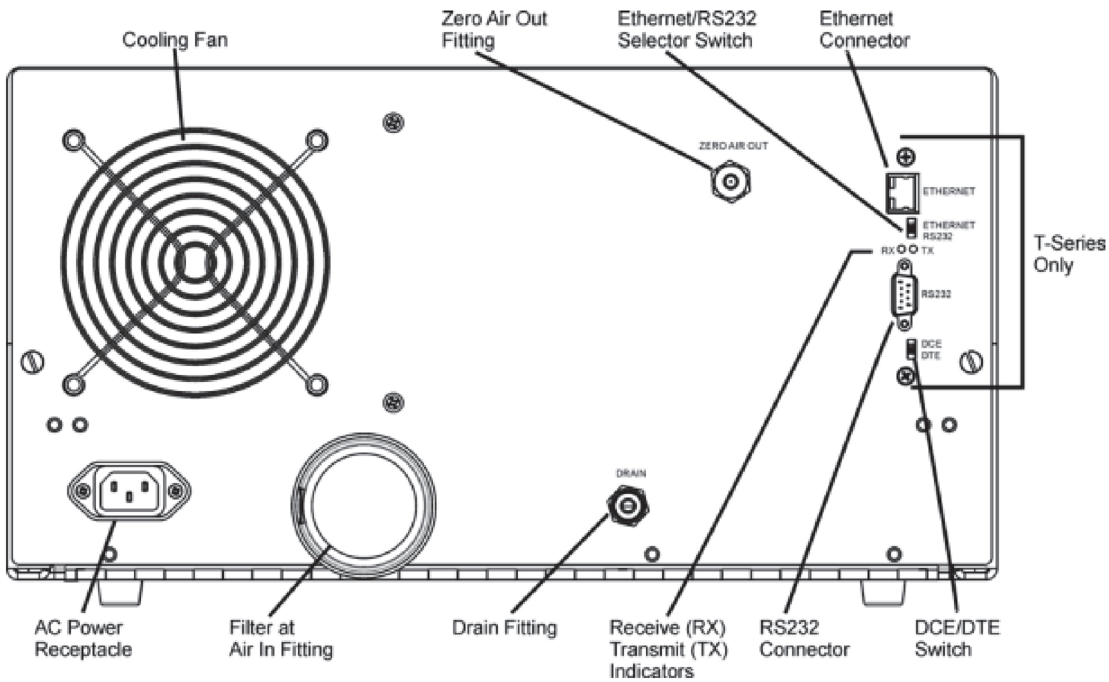
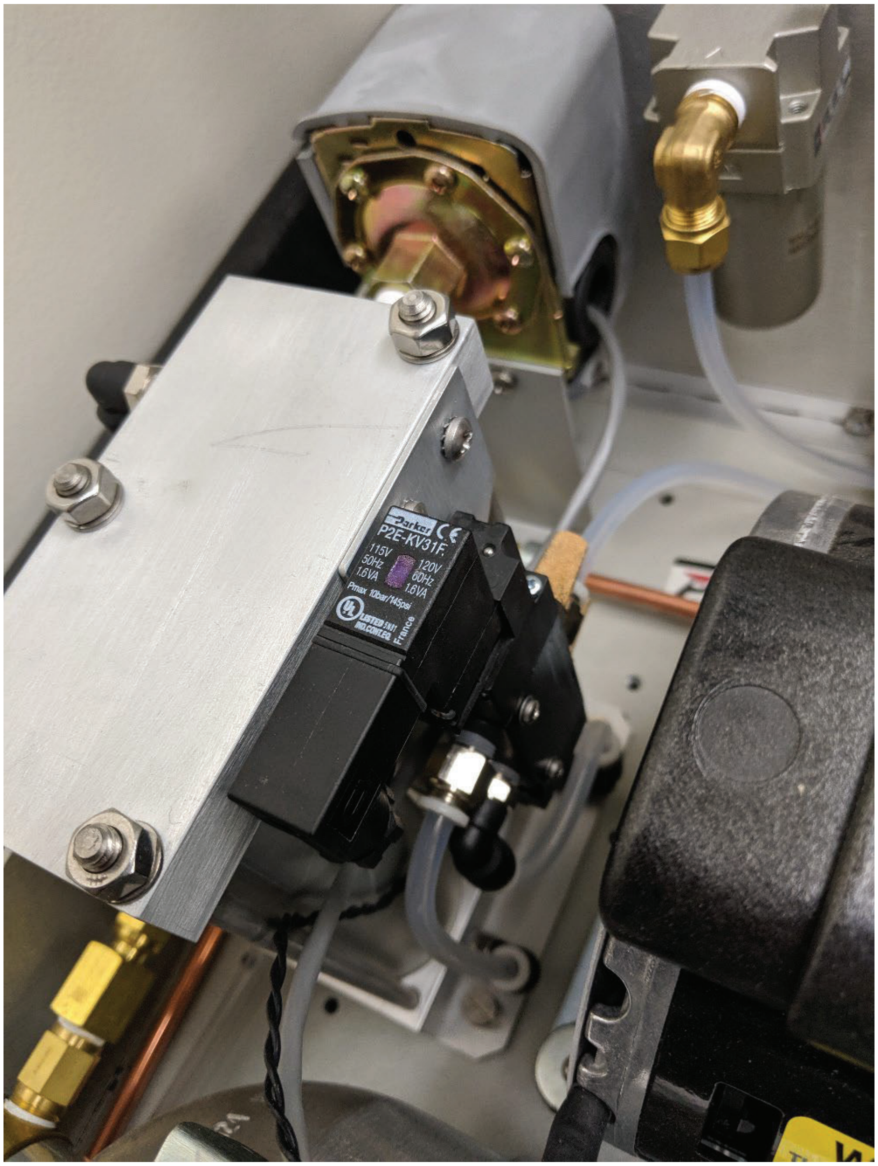


Figure 5 Solenoid Valve



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

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Jordan Volk

Title of Author: Air Quality Specialist

Signature: Jordan Volk Digitally signed by Jordan Volk Date: 2024.11.27 11:59:28 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.27 11:19:03 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.27 11:34:19 -08'00' 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
AQMD	Northern Nevada Public Health Air Quality Management Division
b	Intercept
ccm	Cubic Centimeters per Minute
CO	Carbon Monoxide
CPU	Central Processing Unit
ºC	Degrees Celsius
EPA	Environmental Protection Agency
FEP	Fluorinated Ethylene Propylene
GPT	Gas Phase Titration
LPM	Liters per Minute
m	Slope
MFC	Mass Flow Controller
N_2	Nitrogen
nm	Nanometer
NIST	National Institute of Standards and Technology
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NV	NumaView
O_2	Oxygen
O_3	Ozone
ppb	Parts per Billion
ppm	Parts per Million
ppt	Parts per Thousand
PSI	Pounds per Square Inch
R^2	Correlation
RSD	Relative Standard Deviation
sccm	Standard Cubic Centimeters per Minute
SD	Standard Deviation
SLPM	Standard Liters per Minute
SO_2	Sulfur Dioxide
SOP	Standard Operating Procedures
SRM	Standard Reference Materials
UV	Ultra-violet

List of Figures

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 NO_2 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 NO_2 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.

Currently, AQMD employs Model T700 & T700U series calibrators with two different operating systems, the older operating system called Legacy (Figure 1) and the newer system called NumaView or NV (Figure 2). This document will act as the SOP for both operating systems and differences in processes between the two will be explained in the corresponding sections below.

Figure 1 Legacy Instrument Front Screen

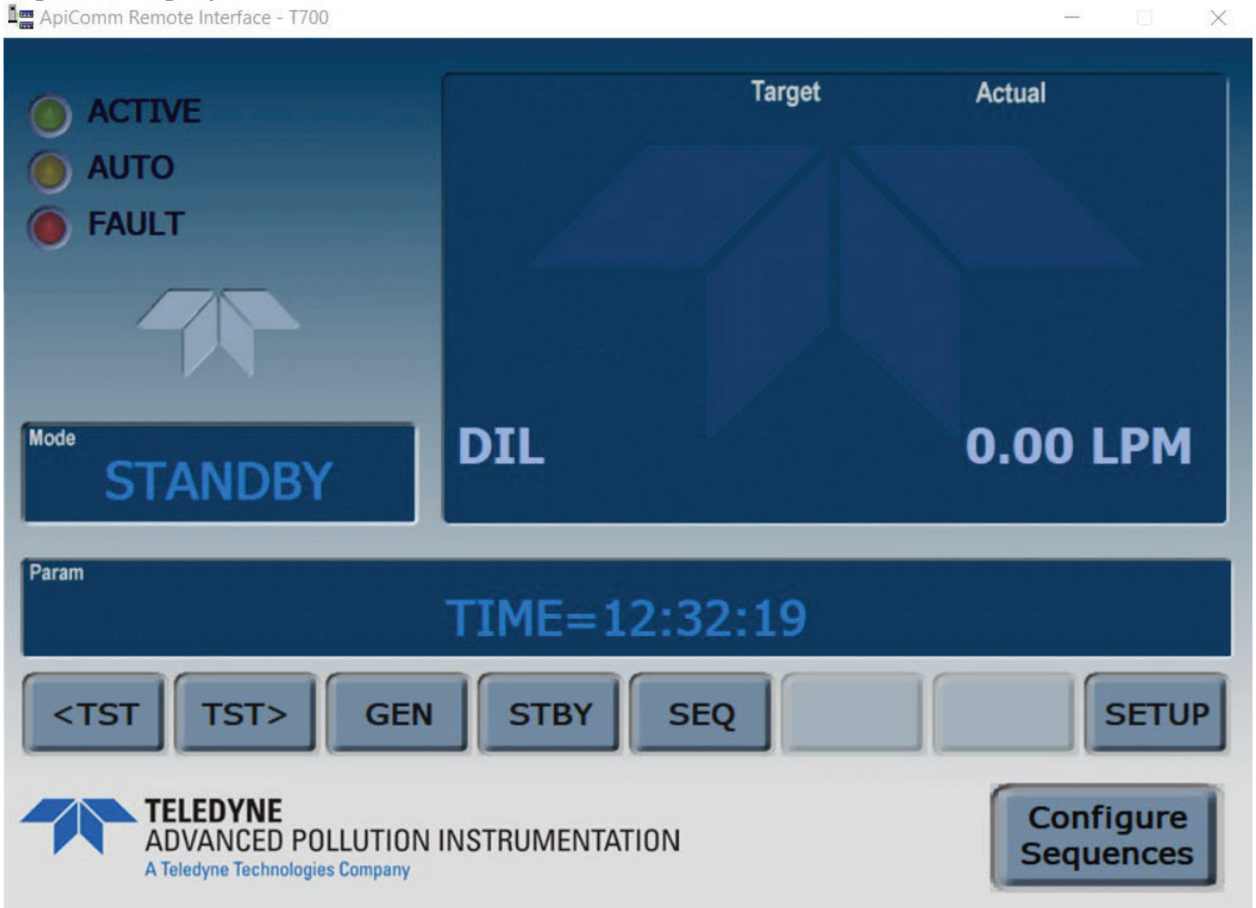
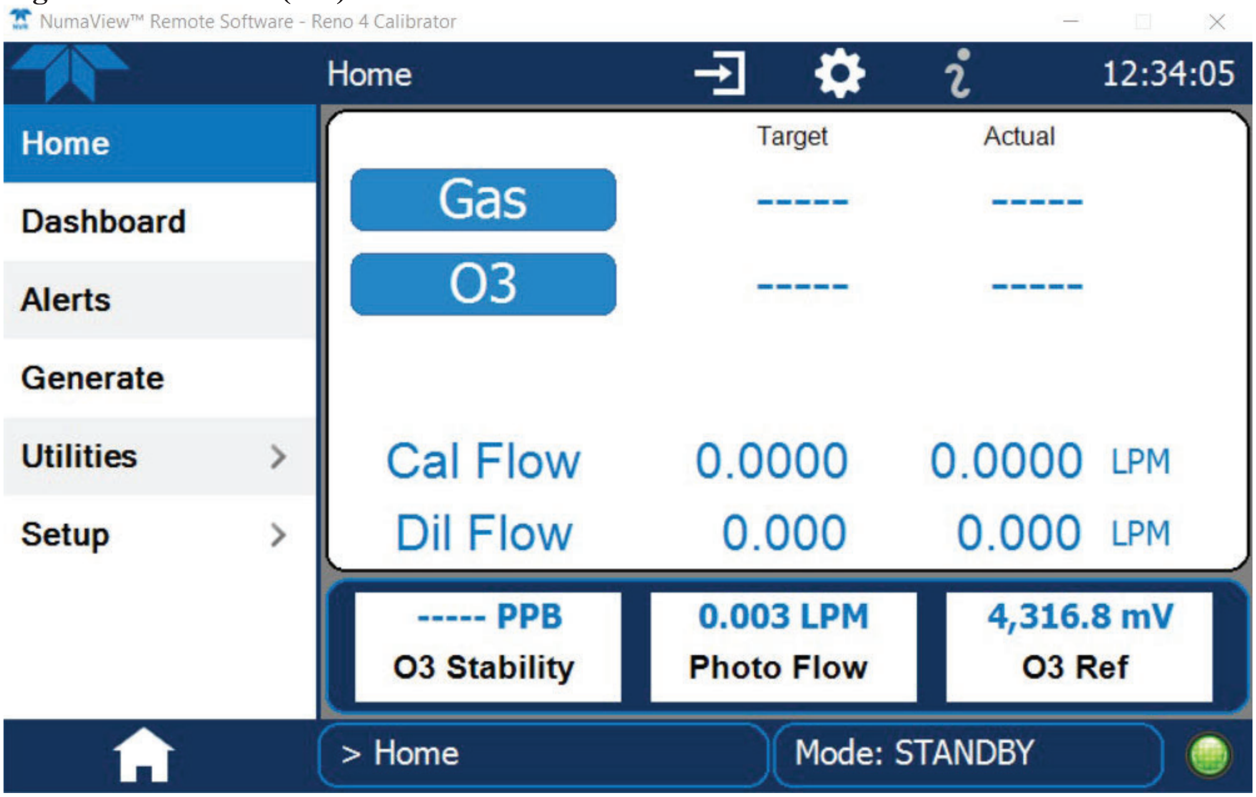


Figure 2 Numaview (NV) Instrument Front Screen



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 (O_3) instead of the two found in oxygen (O_2) 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 is 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 O_2 in the gas into individual oxygen atoms that attach to other existing oxygen molecules (O_2), forming O_3.

LL.2.3 Photometer Operation

The calibrator's optional photometer determines the concentration of O_3 in a sample gas drawn through it. Sample and calibration gases must be supplied at ambient atmospheric pressure to establish a stable gas flow through the absorption tube where the gas' ability to absorb UV radiation of a certain wavelength (in this case 254 nm) is measured. Gas bearing O_3 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 O_3 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 O_3 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 O_3 generators installed require that the zero air source supply gas that flows 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 3).
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 N_2 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

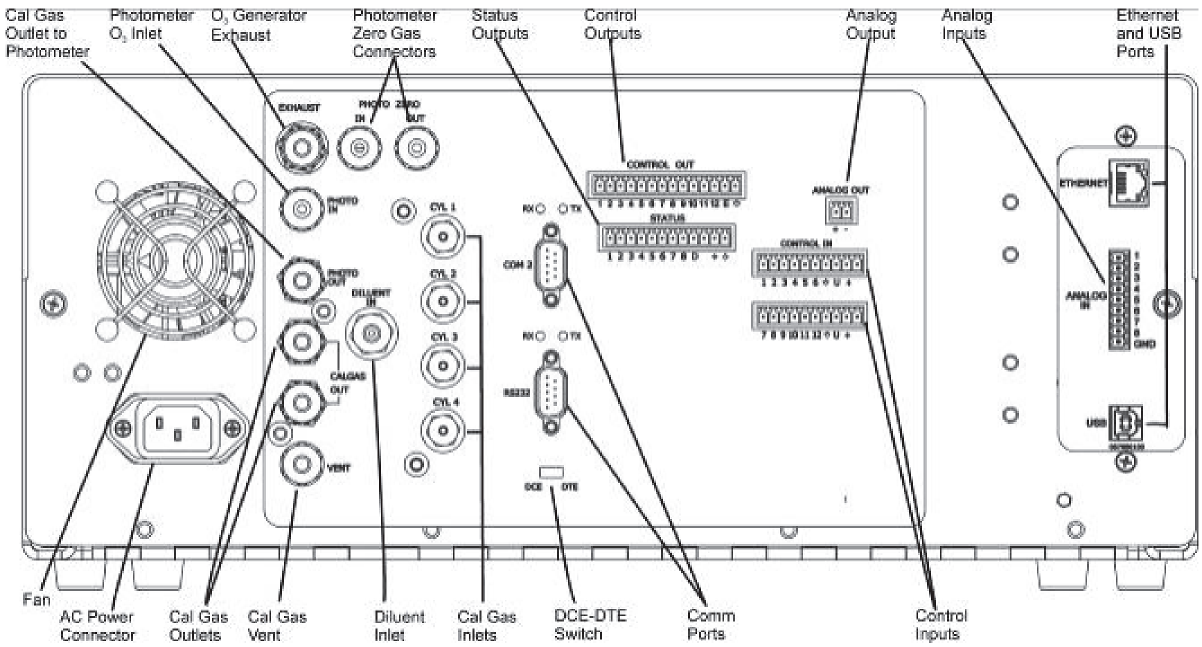
Connect the source gas line(s) to the ports labeled CYL 1 through CYL 4 on the back of the calibrator (see Figure 3).

- 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 3).
2. The other CALGAS OUT port and the VENT port should be plugged with a 1/4 inch brass cap. 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 3 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 4 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 on Legacy instruments, press the <TST TST> buttons on the calibrator's front panel. On NV instruments, touch/click Dashboard on the touchscreen display. The arrows on the bottom of the screen will scroll through pages of different parameters. Remember that until the unit has completed its warm-up, these parameters may not have stabilized.

Figure 4 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	1.006	-	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

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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 O_3 generator and photometer, it can also use the gas phase titration method for generating very precise concentrations of NO_2.

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 in Legacy, press:

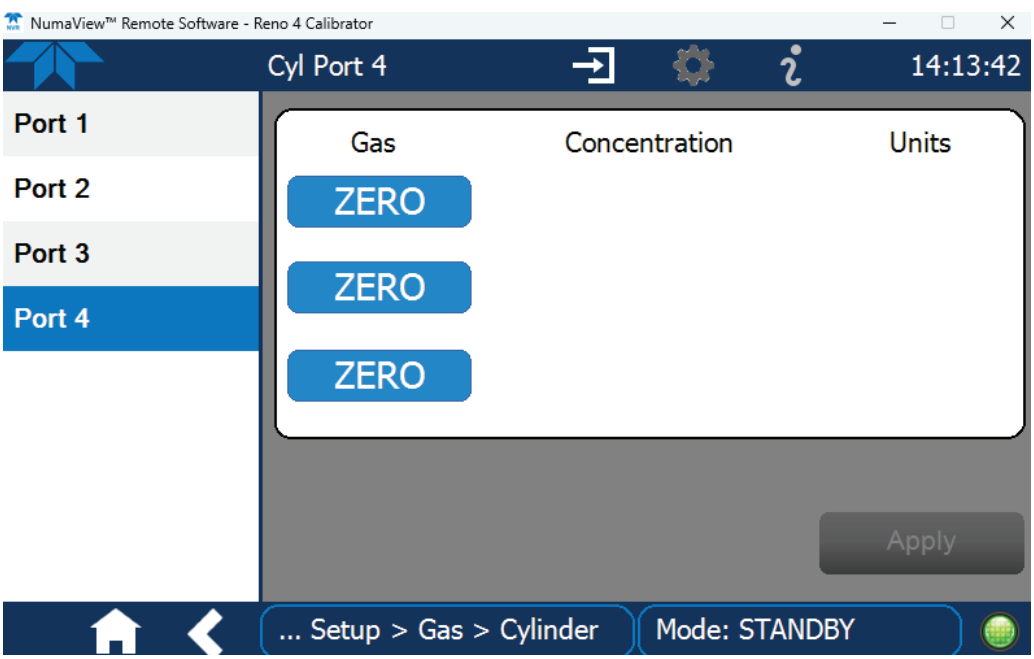
1. SETUP>GAS>CYL>PRT1>EDIT>NONE. Continue pressing the NONE button until the desired gas type is reached (ex, CO, SO2, or NO).
2. Toggle the concentration buttons to match the concentration in the cylinder.
3. Toggle the units of measure button to match the cylinder concentration units (ex, PPM or PPT).
4. ENTR accepts the new gas name, EXIT discards it.

To program the calibrator's source gas input ports for multiple gas cylinders in Legacy:

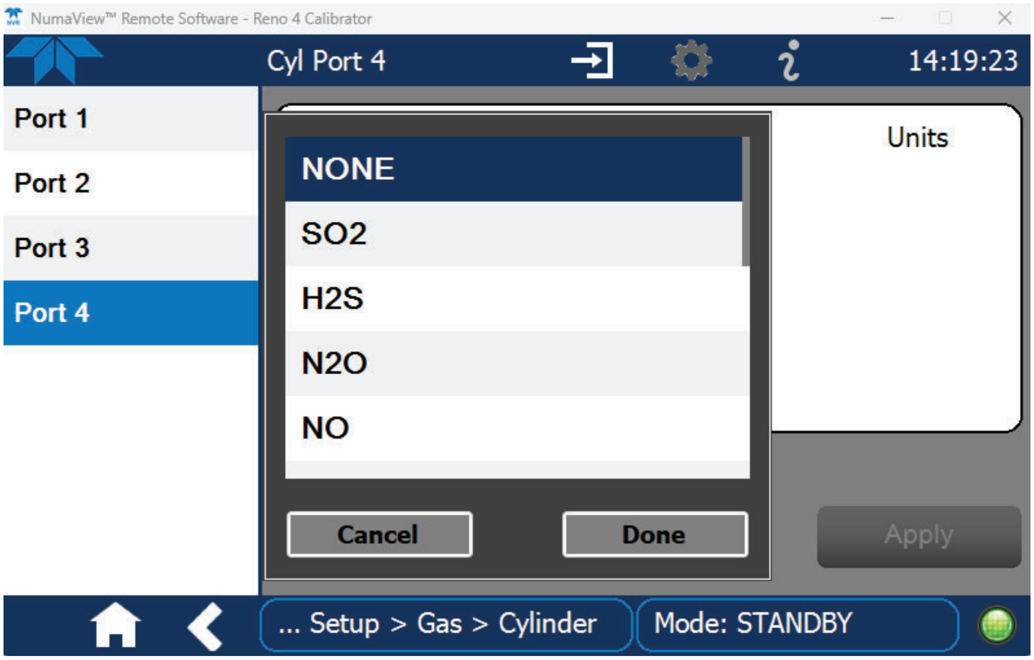
1. Follow instructions above, then press ADD after selecting PRT1.
2. Follow instructions above to add desired gas type and gas concentration.
3. Repeat until all gases and concentrations in the cylinder are entered.

To program the calibrator's source gas input ports for a single gas cylinder in NV, using the touchscreen display click:

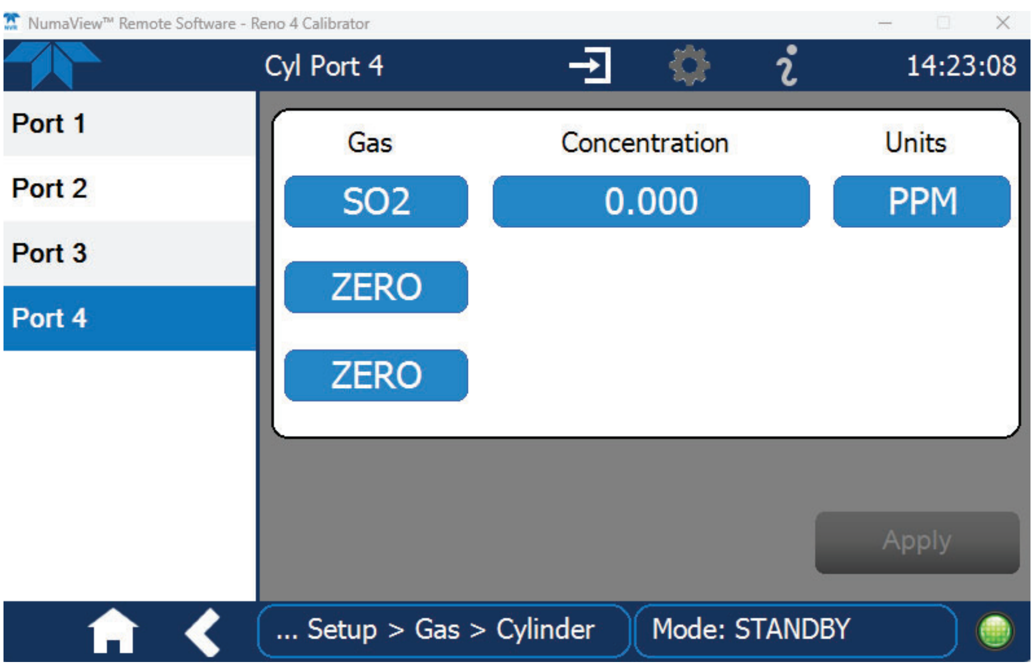
1. SETUP>GAS>CYLINDER>PORT1.
2. From here, click on the blue box that says "ZERO" underneath "GAS"



3. This will bring up a dropdown menu of gases. Click on the desired gas (ex, CO, SO2, or NO).



4. After the desired gas has been chosen you now can enter the concentration and units.



5. Enter these by clicking on the blue boxes below CONCENTRATION and UNITS. Enter the concentration and units that were provided on the cylinder paperwork.
6. Once the concentration and units have been entered the APPLY button should show up in blue on the bottom right corner. Click it.

7. The gas cylinder has now been programmed into the calibrator. You can exit to the home screen using the HOME button on the bottom left corner.

To program the calibrator's source gas input ports for multiple gas cylinders in NV, complete all the above steps but add more than one cylinder when on the Cylinder Port Screen.

LL.4.3.3 Selecting an Operating Mode for the Ozone Generator

The O_3 concentration control loop will use the photometer's O_3 measurement as input. To select this as the default O_3 generator mode:

For Legacy:

1. SETUP>GAS>O3>MODE>BNCH (Bench).
2. ENTR accepts the new setting, EXIT discards it.

For NV:

1. SETUP>VARS
2. Scroll down the VARS menu until you see "O3 Gen Mode" and click it. Then EDIT.
3. From the dropdown choose BNCH. DONE accepts the new setting, CANCEL 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 O_3 photometers installed, ensure to account for the 800 ccm flow it requires.
- Example: If the calibrator will be expected to supply calibration gas mixtures simultaneously to a system composed of three analyzers, each requiring 2 LPM, and the calibrator will be running the O_3 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 on a Legacy 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.

To set the total flow on a NV calibrator, click:
1. SETUP>VARS.
2. Scroll down until you see "Target Flow" and then click it.
3. Click EDIT on the right
4. Enter the flow, ENTER accepts the flow and CANCEL 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 O_3 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, NO_2, SO_2, CO, or ZERO gas based on the source gas concentration entered during initial setup. If the unit has an optional O_3 generator installed, various concentrations of O_3 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.

LL.5.3.2.1 Generate Mode Legacy

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.5.3.2.2 Generate Mode NV:

1. Make sure the calibrator is in STANDBY mode.
2. Click GENERATE>AUTO> blue box next to GAS.
3. Choose pollutant from the dropdown menu.
4. DONE accepts, CANCEL discards.
5. Click the number next to pollutant to enter your concentration amount.
6. Click units next to concentration amount to enter your unit.
7. Click the number under flow to enter your TOTAL FLOW.
8. Click GENERATE.

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.

For Legacy:

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.

For NV:

1. GENERATE>GPT.
2. Click number next to NO to enter your NO concentration.
3. Click units next to the NO number to enter your NO units.
4. Click the number next to O3 to enter your O3 concentration.
5. Click units next to the O3 number to enter your O3 units.
6. Click number next to TOTAL FLOW to enter your Total Flow (see Section LL.4.3.4 regarding total flow).
7. Click GENERATE.
8. Press STANDBY to Cancel GENERATE>GPT mode.

LL.6 Calibration and Verification

LL.6.1 Calibrating MFC Output

NOTE: Before completing an 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 6).

Equipment needed:

- NIST traceable MFC flow meter.
- MFC Certification Worksheet (Figure 6)
- Zero Air Generator

Each of the MFC's in each of the calibrators will need to be recertified and recalibrated annually. The instrument set up for both operating systems are the same and are as follows:

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 5).
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 3).

Calibrating the MFCs for Legacy:

1. Press SETUP>MORE>DIAG>929>ENTR>NEXT. Continue pressing NEXT until MFC CONFIGURATION.
2. Press ENTR. Toggle <SET SET> buttons to choose a MFC to calibrate (ex, DIL1, CAL1, or CAL2).
3. Press EDIT. Press OFF to toggle the flow to ON.
4. Record Point #0 (0 mV Drive Voltage, 0 LPM) from the flow meter in the "Meas. Flow" column on the MFC worksheet (Figure 6).
5. 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.
6. 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.
7. 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.
8. Repeat steps 6 and 7 for the rest of the 20 points programmed into the MFC calibration table.
9. 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.
10. 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).
11. 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.
12. Repeat steps 1 – 11 for each of the MFCs in the calibrator.

Calibrating the MFCs for NV:

1. Click UTILITIES>DIAGNOSTICS.
2. Click which MFC to calibrate (ex. DILUENT MFC CFG, CAL1 MFC CFG, or CAL2 MFC CFG).
3. Click FLOW TABLE.
4. Click the check box labeled ENABLE DRIVE.
5. Record Point #0 (0 mV Drive Voltage, 0 LPM) from the flow meter in the "Meas. Flow" column on the MFC worksheet (Figure 6).
6. Click EDIT FLOW and enter in the value from the flow meter. ENTER accepts the value, CANCEL discards it.
7. Click the next calibration point underneath the #0 (0 mV Drive Voltage, 0 LPM). 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.
8. Click EDIT FLOW and enter the value recorded from the flow meter. ENTER accepts the value, CANCEL discards it.
9. Repeat steps 7 and 8 for the rest of the 20 points programmed into the MFC calibration table.
10. Once all calibration points have been entered click APPLY.
11. Click DONE. The instrument will ask if you wish to apply the changes before leaving, choose YES to save, NO will return you to the calibration table.
12. 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).
13. 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.
14. Repeat steps 1 – 13 for each of the MFCs in the calibrator.

Figure 5 Location of MFC Outlet Ports

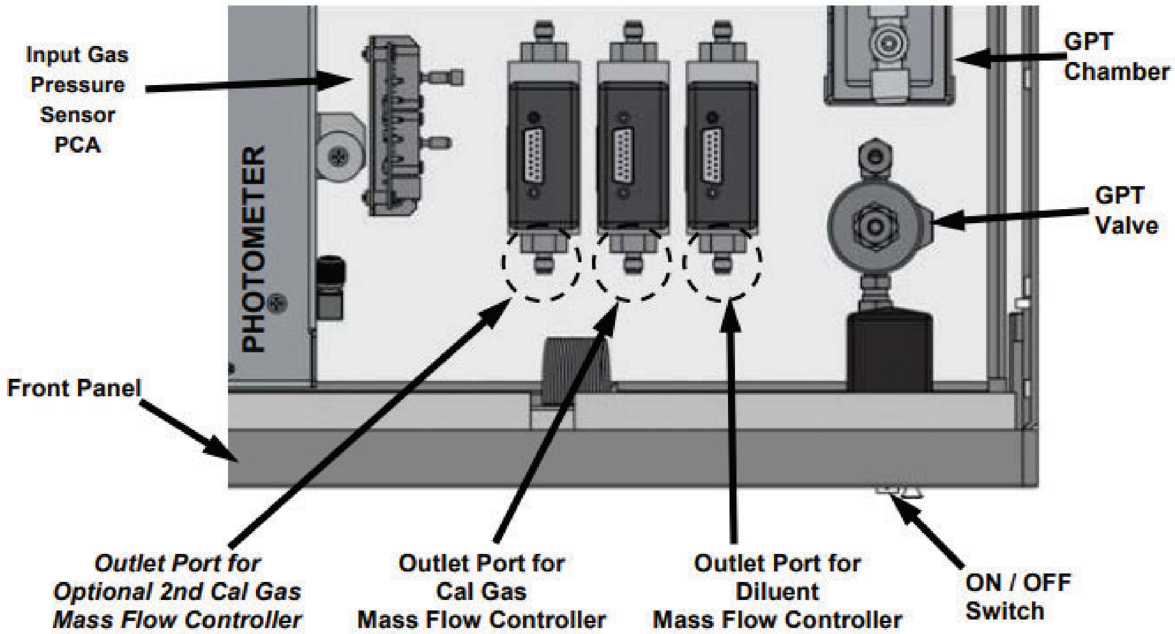


Figure 6 Example MFC Certification Worksheet

Northern Nevada Public Health - Air Quality Management Division
Mass Flow Controller Certification

Date: 07/10/24
Operator: JRV

Multi-Gas Calibrator: TAPI
Model: T700
S/N: 1037
Site: So. Reno

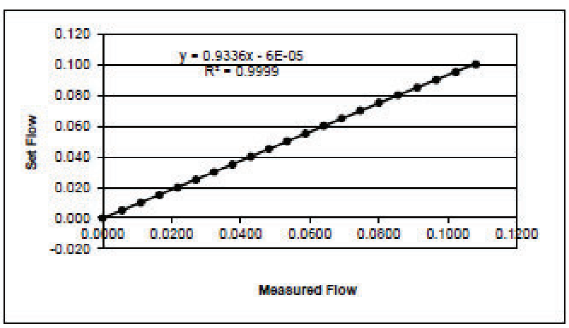
Primary Flow Device: Alicat
Model: MB-100SCCM-D
S/N: 156312

Pre-Cert. Leak Test:
Starting PSI: 30.3
Ending PSI: 29.5
[1]Difference: 0.8 PSI

MFC #: CAL1
MFC Range: 100 ccm

Last Certification: 07/14/23

Point #	Drive Voltage (mV)	Set Flow (LPM)	[2]Meas. Flow (std. ccm)	**Meas. Flow (std. LPM)**
0	000	0.000	0.0	**0.0000**
1	250	0.005	5.6	**0.0056**
2	500	0.010	11.0	**0.0110**
3	750	0.015	16.4	**0.0164**
4	1000	0.020	21.7	**0.0217**
5	1250	0.025	27.0	**0.0270**
6	1500	0.030	32.3	**0.0323**
7	1750	0.035	37.6	**0.0376**
8	2000	0.040	42.9	**0.0429**
9	2250	0.045	48.1	**0.0481**
10	2500	0.050	53.4	**0.0534**
11	2750	0.055	58.7	**0.0587**
12	3000	0.060	64.0	**0.0640**
13	3250	0.065	69.2	**0.0692**
14	3500	0.070	74.6	**0.0746**
15	3750	0.075	80.0	**0.0800**
16	4000	0.080	85.5	**0.0855**
17	4250	0.085	91.1	**0.0911**
18	4500	0.090	96.6	**0.0966**
19	4750	0.095	102.3	**0.1023**
20	5000	0.100	108.1	**0.1081**



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: PASS

File Name: 20240710 sn 1037 mfc CAL1
Last Revision: 11/27/24

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 the initial performance of the calibrator’s internal photometer, perform the following steps:

For Legacy:

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 7.
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 8).
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.

For NV:

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 7.
2. Make sure the calibrator is in STANDBY mode.
3. Click GENERATE>AUTO> blue box next to GAS.
4. Choose O3 from the pollutant drop-down menu.
5. Click the blue box to the right of O3 to enter the concentration. Enter 450. Click ENTER.
6. Click the blue box to the right of the concentration to enter the units. Enter PPB. Click ENTER.
7. Click the blue box to the right of TOTAL FLOW and enter 5.0 LPM. Click ENTER.
8. Click GENERATE

9. Press <TST TST> keys on the primary O3 standard until STABIL is displayed.
10. Wait a minimum of 10 minutes and until the STABIL reading is <0.5 ppb.
11. Record the actual concentration from the calibrator display and the primary O3 concentration on the Photometer Verification Worksheet (Figure 8).
12. Repeat steps 3 – 11 above for the following points:
    - 350 ppb O3
    - 250 ppb O3
    - 150 ppb O3
    - 50 ppb O3
    - 0 ppb O3
13. All points must be within +/- 4 ppb or 4%, whichever is greater, to meet qualification.
14. This process must be repeated 6 times on 6 different days.
15. Ensure that the calculated relative standard deviation (RSD) of the 6 slopes is ≤ 3.7%.
16. Ensure that the calculated standard deviation (SD) of the 6 intercepts is ≤ 1.5 ppb.

Figure 7 Ozone Photometer Verification Set-up

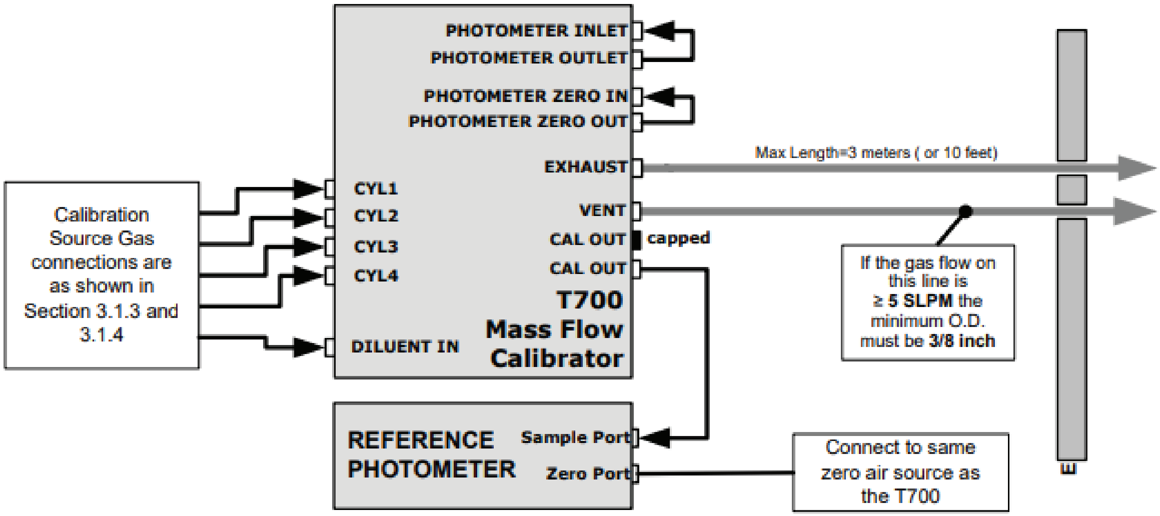


Figure 8 Example Ozone Transfer Standard Initial 6x6 Verification Worksheet

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:	645	Serial Number:	1397
Site:	Reno 4		

Test (#)	Date (mm/dd/yy)	Set Point (ppb)	Transfer Standard (ppb)	Primary Standard (ppb)	Difference[1] (ppb)	Difference[1] (%)	Slope (m)	Intercept (b)
1	05/11/21	450	450	452	-2	-0.4		
		350	350	350	0	0.0		
		250	250	250	0	0.0		
		150	151	151	0	0.0		
		50	50	50	0	0.0		
		0	0	0	0	---	1.00318	-0.33
2	05/12/21	450	450	453	-3	-0.7		
		350	350	352	-2	-0.6		
		250	250	252	-2	-0.8		
		150	149	150	-1	-0.7		
		50	49	50	-1	-2.0		
		0	0	0	0	---	1.00574	0.31
3	05/13/21	450	451	454	-3	-0.7		
		350	349	351	-2	-0.6		
		250	251	252	-1	-0.4		
		150	151	151	0	0.0		
		50	51	51	0	0.0		
		0	0	0	0	---	1.00690	-0.44
4	05/14/21	450	451	454	-3	-0.7		
		350	350	352	-2	-0.6		
		250	250	252	-2	-0.8		
		150	151	151	0	0.0		
		50	50	51	-1	-2.0		
		0	0	0	0	---	1.00612	0.06
5	05/17/21	450	450	453	-3	-0.7		
		350	350	353	-3	-0.8		
		250	251	253	-2	-0.8		
		150	150	152	-2	-1.3		
		50	50	52	-2	-3.8		
		0	0	1	-1	---	1.00389	1.36
6	05/18/21	450	450	454	-4	-0.9		
		350	351	354	-3	-0.8		
		250	250	253	-3	-1.2		
		150	151	153	-2	-1.3		
		50	50	52	-2	-3.8		
		0	0	0	0	---	1.00712	0.85

	m	b	Pass[2,3,4]	Fail[2,3,4]
Average:	1.00549	0.30	---	---
Previous Average:			---	---
Difference (m):	1.01	---	X	
RSD (m):	0.16%	---	X	
Std. Dev. (b):	---	0.70	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: 20210507_T700U__645_initial6x6
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 the performance of the calibrator's internal photometer, perform the following steps.

For Legacy:

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 7
2. Locate and open the Initial Photometer Verification Worksheet (Figure 8) or the most recent Photometer Reverification Worksheet (Figure 9) 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 (Figure 9).
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.

For NV:

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 7.
2. Locate and open the Initial Photometer Verification Worksheet (Figure 8) or the most recent Photometer Reverification Worksheet (Figure 9) 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. Click GENERATE>AUTO> blue box next to GAS.
8. Choose O3 from the pollutant drop-down menu.
9. Click the blue box to the right of O3 to enter the concentration. Enter 450. Click ENTER.
10. Click the blue box to the right of the concentration to enter the units. Enter PPB. Click ENTER.
11. Click the blue box to the right of TOTAL FLOW and enter 5.0 LPM. Click ENTER.
12. Click GENERATE
13. Press <TST TST> keys on the primary O3 standard until STABIL is displayed.
14. Wait a minimum of 10 minutes and until the STABIL reading is <0.5 ppb.
15. Record the actual concentration from the calibrator display and the primary O3 concentration on the Photometer Verification Worksheet (Figure 9).
16. Repeat steps 7-15 above for the following points:
    - 350 ppb O3
    - 250 ppb O3
    - 150 ppb O3
    - 50 ppb O3
    - 0 ppb O3
17. The average slope of the new comparison must be +/- 0.05 of the previous average slope.
18. All points must be within +/- 4 ppb or 4%, whichever is greater, to meet qualification.
19. Ensure that the calculated relative standard deviation (RSD) of the 6 slopes is ≤ 3.7%.
20. Ensure that the calculated standard deviation (SD) of the 6 intercepts is ≤ 1.5 ppb.

Figure 9 Example Ozone Transfer Standard Reverification Worksheet

Northern Nevada Public Health - Air Quality Management Division
Ozone Transfer Standard

Initial (6x6) Verification ______ Reverification X

	Transfer		Primary
Manufacturer:	TAPI	Manufacturer:	TAPI
Model:	T700	Model:	T400
Serial Number:	2925	Serial Number:	1397
Photo. Slope:	0.988		
Photo. Offset:	0.3		
Site:	Incline		

Test (#)	Date (mm/dd/yy)	Set Point (ppb)	Transfer Standard (ppb)	Primary Standard (ppb)	Difference[1] (ppb)	Difference[1] (%)	Slope (m)	Intercept (b)
1	05/05/22	450	450	444	6	1.4		
		350	350	345	5	1.4		
		250	250	247	3	1.2		
		150	150	148	2	1.4		
		50	50	49	1	2.0		
		0	0	-1	1	---	0.98816	-0.53
2	11/01/22	450	450	446	4	0.9		
		350	350	347	3	0.9		
		250	250	248	2	0.8		
		150	150	149	1	0.7		
		50	50	50	0	0.0		
		0	0	1	-1	---	0.98932	0.73
3	05/24/23	450	450	447	3	0.7		
		350	350	347	3	0.9		
		250	250	248	2	0.8		
		150	150	149	1	0.7		
		50	50	50	0	0.0		
		0	0	0	0	---	0.99227	0.11
4	11/29/23	450	449	449	0	0.0		
		350	350	349	1	0.3		
		250	250	250	0	0.0		
		150	150	149	1	0.7		
		50	50	50	0	0.0		
		0	0	1	-1	---	0.99807	0.23
5	06/05/24	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	50	0	0.0		
		0	1	1	0	---	0.99599	0.00
6	11/14/24	450	450	442	8	1.8		
		350	350	345	5	1.4		
		250	250	247	3	1.2		
		150	150	148	2	1.4		
		50	50	49	1	2.0		
		0	1	1	0	---	0.98359	0.25

	m	b	Pass[2,3,4]	Fail[2,3,4]
Average:	0.99124	0.13	---	---
Previous Average:	0.99275	0.23	---	---
Difference (m):	0.00	---	X	
RSD (m):	0.53771%	---	X	
Std. Dev. (b):	0.00533	0.41	X	

Comments: Pass

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: 20241114_T700_2925_reverification
Last Revision: 11/27/24

LL.6.3 Photometer Calibration

LL.6.3.1 Photometer Zero Calibration

To set a zero-point offset for the calibrator's photometer the calibrator must have a zero-gas generator

For Legacy:

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.

For NV:

1. Click UTILITIES>DIAGNOSITCS>BENCH CAL.
2. Click ZERO.
3. Wait a minimum of 10 minutes, then press CALIBRATE.
4. Click YES to change the offset, press NO to leave unchanged.

LL.6.3.2 Photometer Span Calibration

To set the response slope for the calibrator's photometer.

For Legacy:

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.

For NV:

1. Click UTILITIES>DIAGNOSTICS>BENCH CAL.
2. Click SPAN.
3. Set the GEN TARGET to 450ppb.
4. Wait a minimum of 10 minutes, then click CALIBRATE.
5. Click YES to change the offset. Click NO to leave the 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.

For Legacy:

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.
5. If the back pressure compensation passes you may exit the screen. If it fails, verify that the calibrator system is hooked up correctly and that all fittings are tight.
6. Once you have verified that the system is setup correctly, attempt the back pressure compensation again. If it fails again troubleshooting/repairs maybe needed. Consult the manual and contact Teledyne Technical Services for guidance.

For NV:
1. Set the calibrator to generate ozone at the flow rate intended for operation (see Section LL.5.2.1 for generating ozone).
2. Click UTILITIES>DIAGNOSTICS>BACK PRESSURE COMP.
3. Click CALIBRATE.
4. The backpressure compensation will run automatically for approximately 10 to 15 minutes. When finished, the “STATUS” will display either “PASS” or “FAIL” and the BPC Gain will show the new back pressure compensation gain number.
5. If the back pressure compensation passes you may exit the screen. If it fails, verify that the calibrator system is hooked up correctly and that all fittings are tight.
6. Once you have verified that the system is setup correctly, attempt the back pressure compensation again. If it fails again troubleshooting/repairs maybe needed. Consult the manual and contact Teledyne Technical Services for guidance.

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.

For Legacy:
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.

For NV:
1. Make sure the calibrator is in STANDBY mode.
2. Click UTILITIES>DIAGNOSTICS>O3 GEN CAL.

3. Click CALIBRATE to begin the automatic calibration program. The program will run automatically for approximately 1 hour. Wait until the "STATUS" reads "SUCCESS" 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. Bypassing the Flow/Pressure sensor board is the same for both operating systems:

1. Remove the cover from the calibrator.
2. Remove the brass hexagonal nut located at the top of the photometer gas outlet (see Figure 10).
3. Remove the brass hexagonal nut located on the fitting on the back side of the Flow/Pressure sensor board (see Figure 10).
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 10).
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 and the DILUENT IN port.

To perform an auto leak check on Legacy:

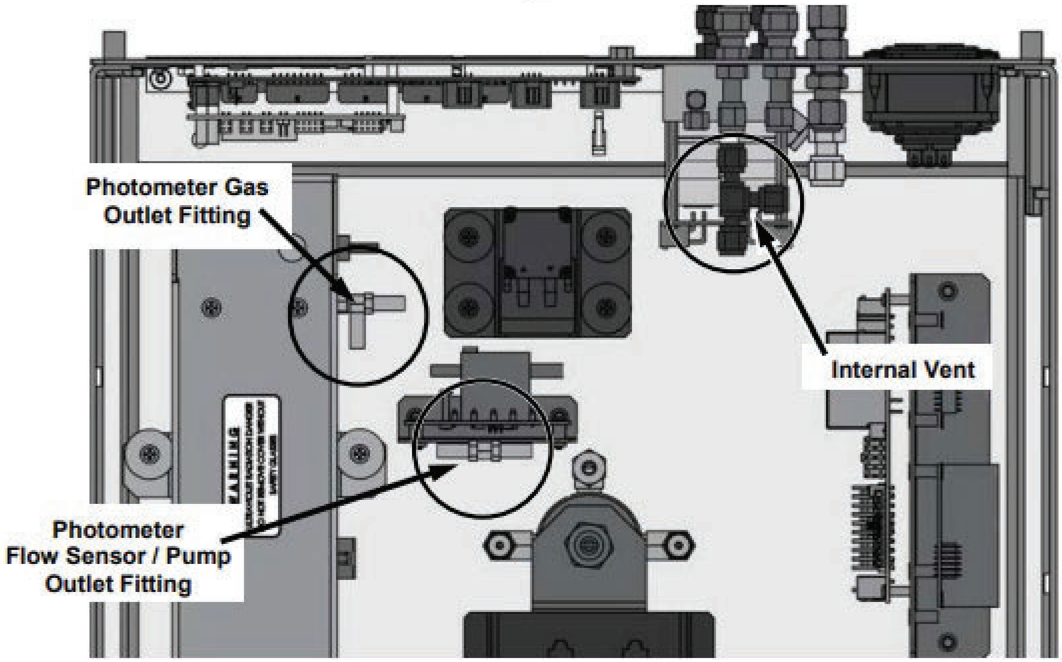
1. Make sure the calibrator is in STANDBY mode.
2. Press SETUP>MORE>DIAG>929>ENTR.
3. Continue pressing NEXT until AUTO LEAK CHECK is displayed. Press ENTR. The test will run automatically.
4. At 17% of elapsed time, the program shuts the DILUENT IN an CYL 1 port valves and begins measuring the drop in internal gas pressure. At this time, record the displayed PSI reading in the "Starting PSI" cell on the MFC Certification Worksheet (Figure 6) and/or in the calibrator's instrument logbook.
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.

To perform an auto leak check on NV:

1. Make sure the calibrator is in STANDBY mode.

2. Click UTILITIES>DIAGNOSTICS>AUTO LEAK CHECK.
3. Click Calibrate. **Note:** Unlike Legacy instruments, NV instruments do not require you to record the pressure at 17%. Instead the instrument will only have a progress bar shown during the test and will tell you at the end of the test what the results were.
4. The test will run approximately 5 minutes.
5. Once the test has finished, the instrument will display “PRESSURE DROP”, “MEASURED PRESSURE” AND “STATUS”. Verify that the PRESSURE DROP is <2 PSI from the MEASURED PRESSURE and that the STATUS says “SUCCESS”.
6. Record the MEASURED PRESSURE reading in the “Starting PSI” cell on the MFC Verification Worksheet (Figure 6) and record the PRESSURE DROP in the “Ending PSI” cell.
7. If the PRESSURE DROP is >2PSI, then the test fails.

Figure 10 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.

To adjust the UV source on a Legacy instrument:

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 11).
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.

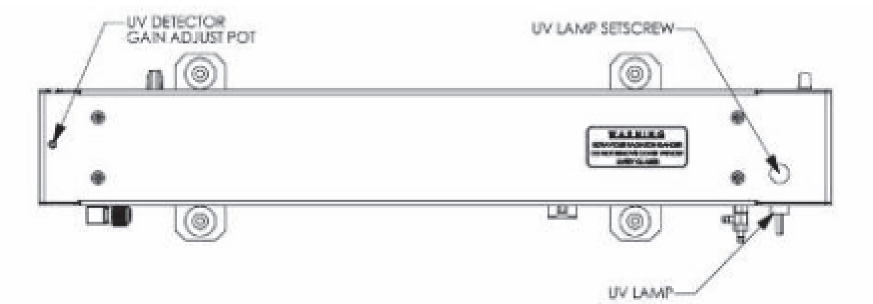
For NV:

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 11).
4. Click UTILITIES>DIAGNOSTICS>ANALOG INPUTS.
5. Scroll down until you see PHOTO DETECTOR.

6. 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 11 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

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Michael Crawford

Title of Author: Air Quality Specialist

Signature: MICHAEL CRAWFORD Digitally signed by MICHAEL CRAWFORD Date: 2024.11.27 09:02:16 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.27 08:34:38 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.27 08:42:16 -08'00' 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	Northern Nevada Public Health 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
µg	Microgram(s)
mg	Milligram(s)
NIST	National Institute of Standards and Technology
NRD	Nuclear Radiation Development Corporation
PDF	Portable Document Format
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
QAPP	Quality Assurance Project Plan
QC	Quality Control
RH	Relative Humidity
SD	Standard Deviation
SOP	Standard Operating Procedures
USB	Universal Serial Bus

List of Figures

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. Utilize flat tipped, uncoated forceps to handle filters. 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 (every pre weigh batch will have a designated lab blank to be used for the post weigh session) 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 black 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 remains with the batch filters for the post weigh session.

Figure 1 Teflon Filter Inspection/Conditioning Log

Teflon Filter Inspection/Conditioning Log

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

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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°C to meet acceptance criteria.
5. Remove determined quantity of filters from the conditioning tray with the longest amount of conditioning time (Filters must be utilized and sampled in the field within 30 days of Pre-Weigh session, view EPA Filter Sampling Schedule to calculate quantity of filters).
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 (300 mg) onto the static master using the coated, pointed tipped forceps.
9. Open the door to the Sartorius balance.
10. Pick up the mass standard using the coated, pointed tipped 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 500 mg mass standard, Lab Blank filter, and all the pre-weigh filters.
14. Complete the weighing process by re-weighing the mass standards.
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

Air Quality Management Division
PM Filter Weigh Log

Balance:		**Date:**	
S/N:		**Time (PST):**	
Cert. Date:		**Analyst:**	
StaticMaster Due:			

Weigh Room Conditions

RH 24-hr Avg (%):		SD:		Criteria Passed? [1]	NO
Temp 24-hr Avg (^{o}C):		SD:		Criteria Passed? [2]	NO

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]	YES	Criteria Passed? [3]	YES

Sample	Filter ID	Weight (mg)	Verified Weight (mg)	Difference	Criteria Passed? [4]	Comments
500 mg				0.000	YES	
300 mg				0.000	YES	
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
500 mg				0.000	YES	
300 mg				0.000	YES	
Reweigh				0.000	YES	

Sample	Filter ID	Weight (mg)	Verified Weight (mg)	Difference	Criteria Passed? [4,5]	Date	Initials
300 mg QC				0.000	YES		
Filter QC				0.000	YES		

<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^{o}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: PM Filter Weigh Log Master Blank
Reviewed: 11/07/24

QC Check/PDF:__________

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 uncoated, flat tipped 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 7 to10 filters is ready for post weight. Note: filters must be removed from the refrigerator and weighed within 30 days.
8. Note the staff initials, date and time of refrigeration on the Field Sample Report (Figure 3).

M.2.2.2 Exposed (Post) Filter Weighing

1. Remove the batch of 7 to 10 filters from refrigeration.
2. Place the filters in the post-filter conditioning tray located in the laboratory between the two balances. Partially 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. Open the PM Filter Weigh Log Excel file (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°C 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 (300 mg) onto the static master utilizing the coated, pointed tipped forceps.
12. Open the door to the Sartorius balance.
13. Pick up the mass standard using the coated, pointed tipped 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 500 mg mass standard, Lab Blank filter, and all 7 to 10 post-filters.
17. Complete the weighing process by re-weighing the mass standard and 1 of the 7 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

Air Quality Management Division
Field Sample Report

Sampler: *MET ONE SEQUENTIAL*
Model: *E-SEQ-FRM*

Filter Number: ____

S/N: ID:	*B13407* *PM 2.5*	*B13408* *PM 10*	*FB*

Sample Date: ____
Su M T W Th F Sa

Lab Blank: ____

Weigh by: ____

Transport:

STAFF	DATE	TIME

Pre Weighed on: ____

Field Fridge Temp: ____ °C
Max Transport Temp: ____ °C

Post Weighed on: ____

Chain of Custody

Action	Date	Time (PST)	SEQ RUN	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: ____

Operator Comments:

Filter Loading and Concentration

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

Concentration: . $\mu g/m^3$

PM_{10}		$PM_{2.5}$ Designated		PM_{COARSE}
. $\mu g/m^3$	-	. $\mu g/m^3$	=	. $\mu g/m^3$

Laboratory Comments:

File Name: FIELD SAMPLE REPORT 5
Reviewed: 11/07/2024

M.3 QC Procedures

M.3.1 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. Place the mass standard (300 mg) onto the static master located next to the coated, pointed tipped forceps.
3. Open the door to the Sartorius balance.
4. Pick up the mass standard using the coated, pointed tipped forceps. Swipe the mass standard through the static masters on the stand before placing the standard on the pan inside the balance.
5. Place the mass standard on the pan and close the balance door.
6. 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.
7. Remove the mass standard. Close the balance door to allow balance to come back to 0 mg.
8. Choose a filter for the QC process (1 filter per 10 filters requires a QC filter) 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.
9. The QC weight must be within 15 µg of the initial weight to pass.
10. 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.
11. 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.
12. Place the weigh log in the PM Filter Log binder located in the laboratory and give the field forms to the Data Manager.
13. 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 in accordance with the retention period found on Table 9-2 Documentation and Record Retention of the QAPP.

M.4 Laboratory Audits

M.4.1 Quarterly Weight Standard Verification

1. Zero the Sartorius balance by using the Tare key.
2. Open the Sartorius balance door.

3. Using the coated, pointed tipped forceps, gently place the 300 mg working standard (*w*) on the static master for at least 20 seconds. Remove and then place into balance on the scale.
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 Mass Standard Verifications form (Figure 5) as Observation 1 (O_1).
5. Open the balance door and remove the mass standard using the coated, pointed tipped 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 500 mg primary (p) and working standard (w) weights in the order outlined on the Quarterly Mass Standard Verifications form (Figure 5) 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 500 mg standard.
10. Calculate C_w (see Figure 4 for equation) for both the 500 and 300 mg mass standards. The Quarterly Mass Standard Verification form will calculate the equation. Enter data into the form and the Mass Correction Calculation will be automatically calculated.

M.4.2 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 4 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 7). 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 5 Quarterly Mass Standard Verification

Air Quality Management Division
Quarterly Mass Standard Verifications

Microbalance:			**Date:**	
Model:			**Time (PST):**	
S/N:			**Analyst:**	
Certification:				

500 mg Test

Meas. No.	Weight	Serial No.	C_p (mg)[1]	Observation (mg)
1	Working Standard (w)			O_1=
2	Primary Standard (p)			O_2=
3	Primary Standard (p)			O_3=
4	Working Standard (w)			O_4=

Apparent working standard correction (C_w) =		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)			O_1=
2	Primary Standard (p)			O_2=
3	Primary Standard (p)			O_3=
4	Working Standard (w)			O_4=

Apparent working standard correction (C_w) =		µg
Initial C_w[2] =		µg
Difference =	0.0	µg
Criteria Passed?[3]	Y	

<u>Notes</u>

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_audit_BLANK FORM
Last Revision: 11/07/2024

QC Check/PDF:__________

M.5 Relative Humidity and Temperature Audits

M.5.1 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 6) 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 7) 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.5.2 QA Manager Laboratory Inspection

The QA Manager will complete a laboratory inspection on a quarterly basis as part of the data validation process. The inspection will include the following:

1. Laboratory logbook review.
2. Microbalance logbook review.
3. Review 24-hour average and standard deviation calculations of relative humidity and temperature on PM Filter Weigh Log spreadsheets.

M.5.3 QA/QC Worksheet Review and PDF Finalization

After completing the QA/QC worksheet or a PM Weigh Log, it needs to be reviewed by an Air Quality Specialist and then saved as a read only PDF to lock the worksheet from editing, creating the official record.

1. Once a QA/QC worksheet or PM Weigh Log is completed, the dedicated QC person will review and PDF the document. For the PM Weigh Logs, the QC person will be the Senior Air Quality Specialist. The QA Manager will be responsible for reviewing and creating a PDF for all audit QA/QC worksheets.
2. It is the responsibility of the dedicated QC person to monitor lab activity for new QA/QC worksheets or PM Weigh Logs to review and PDF. When a new worksheet is completed, the QC person will review the worksheet for errors, including content and calculations.
    a. If an error is found, contact should be made to the operator to get the issue fixed.

3. After completing the review, click the Acrobat tab on the top ribbon. Click Create PDF. Click Convert to PDF, Yes, and Save. Save the PDF with the same naming convention, and notating "_RECORD" at the end of the file name.
4. The PDF will now be opened in Adobe. On the toolbar on the right, click the Fill & Sign option. On the top of the page, click Sign yourself.
5. If initials have not already been created, click Add Initials, and save your initials. If your initials have been saved, click on them in the dropdown menu and place them on the QC Check/PDF line at the bottom of the worksheet.
6. To create a read only copy, the QC person needs open Adobe Acrobat Pro DC with the Adobe Sign Add-In. After placing the initials, the QC person will click Next on the right of the Fill and Sign ribbon. Click Save as a Read Only. Save the record with the same naming convention and click yes to replace existing file with the Read Only version.

M.5.4 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 with NIST certification.
2. Unplug old sensor from data logger.
3. Plug new sensor in to data logger.
4. Scan the Certificate of Instrument Calibration (Figure 8) and 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 located in the AQMD Lab maintained by the senior air quality specialist.
6. Update the Traceability/Maintenance Schedule (Figure 9) with the new sensor's serial number and calibration date.

Figure 6 PM Filter Weigh Lab Temperature and RH Audit Worksheet

Air Quality Management Division
PM Filter Weigh Lab Temperature and RH Audit

Lab Logger:		**Date:**	
Model:		**Time (PST):**	
S/N:		**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: 11/07/2024

Figure 7 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 07/19/2024

Figure 8 Certificate of Instrument Calibration

CERTIFICATE OF INSTRUMENT CALIBRATION

10076297

Certificate report shall not be reproduced, except in full, without written authorization from Dickson

Dickson Model Number	RTRH
Dickson Serial Number	19215591
Calibration Date	10/02/2024
Issue Date	10/03/2024
Calibration Type	3 Pt NIST New Unit
Calibration Procedure	AQWI 7.1

Environmental Conditions: 75 ±10 °F, 45 ±15% RH

Calibration Standards

Hart Scientific Fluke-1502A Ser. B79488
EdgeTech DewMaster Ser. 41562

Customer Name: 143271 WASHOE COUNTY HEALTH DISTRICT - AQMD

Customer Notes

DICKSON OFFICIAL SEAL OF AUTHENTICITY

TEMPERATURE °F (°C)

CALIBRATION STANDARD READING	CUSTOMER INSTRUMENT READING	DIFFERENCE	UNIT SPECIFICATION
9.7 (-12.4)	8.5 (-13.1)	1.2 (0.7)	± 1.8 (1.0) from -40.0 to 20.0, ± 0.8 (0.4) from 20.0 to 122.0, ± 1.8 (1.0) from 122.0 to 185.0.
74.6 (23.7)	73.8 (23.2)	0.8 (0.4)	
109.9 (43.3)	109.1 (42.8)	0.8 (0.4)	

HUMIDITY (%RH) %RH

CALIBRATION STANDARD READING	CUSTOMER INSTRUMENT READING	DIFFERENCE	UNIT SPECIFICATION
8.0	7.3	0.7	± 2.0 from 5.0 to 95.0.
48.0	49.4	-1.4	
87.8	87.9	-0.1	

The customer instrument was compared to the calibration standard. All known sources of uncertainty, present at the time of calibration, were combined into one uncertainty and reported "as received" or "adjusted" to a standard traceable to the SI through the National Institute of Standards and Technology (NIST). The Dickson calibration system conforms to the requirements of MIL-STD-45662A, ANSI/NCSL Z540-1, and ISO/IEC 17025:2017, as appropriate.

This certificate relates to this specific unit. This certificate number is unique to this specific Model Number, Serial Number, and Calibration/Issue Date.

NOTE: Dickson brand product and accessories are required to achieve stated accuracy.

Steve Thompson

Approved By
Steve Thompson

N300

DICKSON
Environmental Monitoring + Compliance Experts

930 S. Westwood Ave, Addison, IL 60101
CALL 630.543.3747 FAX 630.543.0498
DicksonData.com
PAGE 1 OF 1

CERTIFICATE #10076297

10

Figure 9 Traceability/Maintenance Schedule

Annual Traceability/Maintenance Schedule **Year: 2024**

Standard	Instrument	Model	Serial #	Date Completed Last	Due	Actual
Primary Ozone	TAPI	T400	1397	05/03/23	May-24	04/03/24
Audit Ozone	TAPI	T750U	72	05/02/23	May-24	
Audit MFC	TAPI	T750U	72	05/02/23	May-24	
Audit Ozone	Environics	6103	4259		Dec-00	Backup
Audit MFC	Environics	6103	4259		Dec-00	Backup
Flow (MFC)	Alicat	MB-100SCCM-D	156312	12/05/23	Dec-24	
	Alicat	MB-20SLPM-D	156313	12/05/23	Dec-24	
Flow/Temp/Press	Alicat	FP-25BT	157522	09/19/23	Sep-24	09/11/24
	Alicat	FP-25BT	157523	11/07/23	Nov-24	
	Alicat	FP-25BT	157524	11/07/23	Nov-24	
Temperature/RH	Dickson (Lab)	RTRH	19157706	10/12/23	Oct-24	10/10/24
	Dickson (Handheld)	R250	19155193	10/13/23	Oct-24	10/10/24
	Cole Parmer	20250-21	221477012	07/10/23	Jul-24	08/05/24
Balance (Lab)	Sartorius	MSE6.6S	27602434	04/11/23	Apr-24	04/15/24
	Sartorius	ME-5	16210916	04/11/23	Apr-24	04/15/24
Mass	Primary	400 mg	78453	03/25/23	Mar-24	04/02/24
	Primary	300 mg	78462	03/25/23	Mar-24	04/02/24
Staticmasters (Semi-Annual)	NRD	(4) 2U500 & (1) 1U400	---	12/27/23	Jun-24	07/05/24
Staticmasters (Semi-Annual)	NRD	(4) 2U500 & (1) 1U400	---	12/27/23	Jun-24	07/05/24
NO_x Scrubber	TAPI	200EU	213	06/24/23	Jun-24	06/04/24
NOy Scrubber	TAPI	T200U	404	01/03/23	Jan-24	01/02/24
						Sites
WSP/WDR	Met One	30.5	D17588		Jun-00	Spare
	Met One	30.5	E10674		Jun-00	Spare
	Met One	30.5	D13265		Dec-00	Spare
	Met One	30.5	D13281	10/05/23	Oct-24	Spanish Springs
	Met One	30.5	D17589	12/13/23	Dec-24	Toll
	Met One	30.5	D12864	12/13/23	Dec-24	Sparks
	Met One	30.5	D14346	12/13/23	Dec-24	So. Reno
	Met One	30.5	D14353	05/16/24	Nov-24	Reno 4
Zero Air/Ultrapure	TAPI	751H	132	09/21/23	Sep-24	
BAM Zero Tests	Met One (Reno4)	BAM 1020 (PM2.5)	C16694	03/27/23	Mar-24	03/21/24
	Met One (Reno4)	BAM 1020 (PM10)	C16695	03/27/23	Mar-24	03/21/24
	Met One (SS)	BAM 1020 (PM2.5)	N10985	06/16/23	Jun-24	07/15/24
	Met One (SS)	BAM 1020 (PM10)	N10986	06/16/23	Jun-24	07/15/24
	Met One (Sparks)	BAM 1020 (PM2.5)	C16684	03/27/23	Mar-24	05/13/24
	Met One (Sparks)	BAM 1020 (PM10)	C16691	03/27/23	Mar-24	Still need
	Met One (Toll)	BAM 1020 (PM2.5)	M7605*	09/29/23	Sep-24	01/25/24
	Met One (Toll)	BAM 1020 (PM10)	M7649*	09/29/23	Sep-24	01/25/24

Manifolds	Site	Tubing	Length	Date Completed Last	Due	Completed
	Incline	1/4" OD, 1/8" ID	296"	05/26/23	May-24	04/16/24
	Lemmon Valley	1/4" OD, 1/8" ID	218"	05/24/23	May-24	04/05/24
	Reno 4 CO,O3,SO2	3/8" OD, 1/4" ID	207"	05/25/23	May-24	
	Reno 4 CO,O3,SO2	1/4" OD, 1/8" ID	38"	05/25/23	May-24	
	Reno 4 NOx	1/4" OD, 1/8" ID	171"	05/25/23	May-24	
	Reno 4 NOy	1/4" OD, 1/8" ID	600"	05/25/23	May-24	
	South Reno	1/4" OD, 1/8" ID	133"	05/24/23	May-24	05/23/24
	Spanish Springs	1/4" OD, 1/8" ID	126"	05/25/23	May-24	04/08/24
	Sparks	1/4" OD, 1/8" ID	205"	05/25/23	May-24	04/09/24
	Toll	1/4" OD, 1/8" ID	150"	05/25/23	May-24	05/23/24

Zero Air Maintenance	Site	Instrument	Serial Number	Last	Due	Completed
	Spanish Springs	TAPI	1948	09/21/23	Sep-24	
	South Reno	TAPI	1949	12/29/23	Dec-24	
	Reno 4	TAPI	1199*	01/18/23	Jan-24	*2/26/2024
	Toll	TAPI	2497*	05/23/23	May-24	*01/8/2024
	Incline	TAPI	2137	09/19/23	Sep-24	
	Sparks	TAPI	2498*	05/22/23	May-24	*01/10/2024
	Lemmon Valley	TAPI	2499	06/02/23	Jun-24	*01/12/2024

Fire Extinguishers	Site	Date Completed Last	Due	Completed
	Incline	11/07/23	Nov-24	
	Lemmon Valley			
	Repair Room			
	Lab Room			
	Reno 4			
	South Reno			
	Spanish Springs			
	Sparks			
	Toll			

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.
    i. Insert the USB flash drive into laptop USB port.
    j. An "Auto Play" window will pop up. Click "Open folder to view files".
    k. Right click the file corresponding to the download date.
    l. Copy and Paste the file onto the Monitoring drive: Save file in the following folder sequence: "Dickson", "Download", current year (20xx), "Weekly Downloads".
    m. After file is saved in proper folder, open file to make sure download is complete.
    n. Safely remove hardware on start bar to remove USB flash drive.
5. Download data from the Accucold Logger on the filter storage refrigerator:
    a. Use Accucold USB flash drive stick located in the AQMD lab.
    b. Insert USB flash drive in the fridge in the repair room.
    c. Press the Rec/Stop Button. Rec flashing should stop flashing.
    d. Press DL Button to start download.
    e. "CPL" will be displayed once download is complete.
    f. Remove USB flash drive stick.
    g. Press Rec/Stop Button to resume data logging. Rec should be flashing.
    h. Insert USB flash drive into laptop USB port.
    i. Open Thumb drive location and find recently downloaded file.
    j. Rename file w/ SF_Temp_year, month, day; IE: SF_Temp_20241015
    k. Open location in another J: Dickson_Storage Fridge Logger_Filter Fridge_Current Year
    l. Copy new file over to this location and open file to verify is present.
6. When weekly maintenance items have been completed, document their completion in the "Lab" Station Logbook.

M.6.2 Semi-Annual Maintenance

Anti-static Polonium strips (Staticmasters) are replaced every six months. Replacement includes:

1. Order four NRD 2U500 Staticmaster Ionizing Cartridges and one NRD 1U400 1"x1" Staticmaster Ionizing Cartridge from an authorized dealer.
2. Replace two NRD 2U500 Staticmaster Ionizing Cartridges on the horizontal weighing surface next to the microbalance in the laminar flow hood.
3. Replace two NRD 2U500 Staticmaster Ionizing Cartridges in the stand next to the microbalance in the laminar flow hood.
4. Replace two NRD 1U400 1"x1" Staticmaster Ionizing Cartridge on the inside of the microbalance weigh chambers using foam double-sided tape.
5. Return five used Staticmasters to NRD using the return address on the package.
6. Document the Staticmaster replacement in the "Lab" Station Logbook.

Appendix N: Meteorology

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Matthew McCarthy

Title of Author: Senior Air Quality Specialist

Signature: Matthew McCarthy Digitally signed by Matthew McCarthy Date: 2024.11.27 13:16:44 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.27 13:11:30 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.27 13:42:04 -08'00' 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	Northern Nevada Public Health, Air Quality Management Division
^{o}C	Degrees Celsius
MQO	Measurement Quality Objectives
NCore	National Core Multi-Pollutant Monitoring Station
NIST	National Institute of Standards and Technology
PDF	Portable Document Format
QA	Quality Assurance
QC	Quality Control
RH	Relative Humidity
SLAMS	State and Local Air Monitoring Station
T_A	Ambient Temperature
WDR	Wind Direction
WSP	Wind Speed

List of Figures

N.1 Introduction

N.1.1 Wind Speed and Wind Direction

The Met One Instruments 30.5 Wind Sensor provides measurements of wind speed and wind direction in a single, compact, rugged unit. It integrates a folded-path, low-power sonic anemometer. It also includes an internal compass that allows for automatic alignment of wind direction to magnetic north, regardless of the sensor's orientation.

N.1.2 Relative Humidity

The Met One Instruments 083F relative humidity sensor is an extremely accurate microprocessor-controlled instrument. It responds to the full range of 0 to 100% humidity.

N.1.3 Ambient Temperature

The Met One Model 063-1 is a precision thermistor temperature sensor with a temperature range of -50 to 50 degrees Celsius (ºC).

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 083F 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 are temperature-dependent resistors that change resistance with changes in temperatures. They are very sensitive and react to very small changes in temperature. The Met One 063-1 exhibits high resistance sensitivity and has a time constant of 160 seconds. Since thermistors output resistance, the sensor signal needs to be processed into a voltage using the Agilaire MSC-82 Met Signal Conditioner box so that the datalogger can process an analog connection. For information on how to wire MSC-82, please refer to the manufacturers' manual.

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, magnetic declination, and installation of aviary deterrents. The sensor will be operated per the measurement quality objectives (MQO) described in the QA Handbook, Volume IV.

The 30.5H 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. There is no audit procedure for the 30.5H, the sensor is sent back to the factory for recertification/calibration annually.

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 NCore 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 NCore Meteorological Worksheet.
4. The site T_A reading must be within +/- 0.5ºC 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 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 NCore 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.6.2 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 40-50ºC.

3. Log into the 8872 data logger using your Northern Nevada Public Health username and password. Once logged in, log into AV Trend on the data logger.
4. Once logged into AV Trend, click on Utilities on the left side of the screen. Then choose Site Node Logger Toolbox option.
5. Put the sensor in maintenance by clicking on the maintenance flag button on the right side of the Site Node Logger Toolbox screen for the ATEMP parameter. This will change the maintenance flag from saying, “False” to “True” and will also darken out the maintenance flag button that was clicked.
6. Log “Start Time” on the NCore Meteorological Worksheet (Figure 1) or SLAMS Meteorological Worksheet (Figure 1a).
7. Leaving T_A sensor in its gill shield, insert the probe of the “Audit” temperature standard into the gill shield.
8. Wait approximately 2 minutes for stabilization.
9. Record the temperature readings from the site instrument and the audit standard in the Ambient Temperature section of the appropriate Meteorological Worksheet.
10. 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.
11. Record the temperature readings from the site instrument and the audit standard in the Ambient Temperature section of the appropriate Meteorological Worksheet.
12. Repeat steps 6 and 7 using the Thermos containing the hot water.
13. All three points must be within +/- 1.0ºC at SLAMS and +/- 0.5ºC at the NCore station to pass.
14. To take the sensor out of maintenance mode, unclick the maintenance flag button on the right side of the Site Node Logger Toolbox screen for the ATEMP parameter. The button will go from saying “True” to “False” and will no longer be darkly shaded.
15. Log “End Time” on the appropriate Meteorological Worksheet.
16. Record the Date, Start Time, End Time, and Parameter on the respective digital Data Exception Log (Figure 3). Data Exception Logs are maintained on the AQMonitoring drive. Check the appropriate error code.
17. After the worksheet has been checked by the QA Manager and finalized, file a copy in the Quarterly Audit folder made by the monitoring Senior Air Quality Specialist.

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.6.3 QA/QC Worksheet Review and PDF Finalization

After completing the QA/QC worksheet, it needs to be reviewed by an Air Quality Specialist and then saved as a read only PDF to lock the worksheet from editing, creating the official record.

1. Once a QA/QC worksheet is completed, the dedicated QC person will review and PDF the worksheet. For verifications, the Senior Air Quality Specialist and the Air Quality Specialists have each been assigned sites that they are not the normal site operator of to

review and PDF. The QA Manager will be responsible for reviewing and creating a PDF for all audit QA/QC worksheets.

2. It is the responsibility of the dedicated QC person to monitor the QA/QC folder on the AQMonitoring drive for new QA/QC worksheets to review and PDF. When a new worksheet is completed, the QC person will review the worksheet for errors, including content and calculations.
    a. If an error is found, contact should be made to the operator to get the issue fixed.
3. After completing the review, click the Acrobat tab on the top ribbon. Click Create PDF. Click Convert to PDF, Yes, and Save. Save the PDF with the same naming convention, and notating "_RECORD" at the end of the file name.
4. The PDF will now be opened in Adobe. On the toolbar on the right, click the Fill & Sign option. On the top of the page, click Sign yourself.
5. If initials have not already been created, click Add Initials, and save your initials. If your initials have been saved, click on them in the dropdown menu and place them on the QC Check/PDF line at the bottom of the worksheet.
6. To create a read only copy, the QC person needs to open Adobe Acrobat Pro DC with the Adobe Sign Add-In. After placing the initials, the QC person will click Next on the right of the Fill and Sign ribbon. Click Save as a Read Only. Save the record with the same naming convention and click yes to replace existing file with the Read Only version.

N.7 Annual Calibration

N.7.1 Wind Speed and Wind Direction

Every 12 months, every 30.5 sensor in the network will be replaced with a factory-calibrated sensor. The wind sensor at Reno4 will be replaced every 6 months to meet NCore requirements. 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.7.2 Relative Humidity

Every 12 months, the 083F relative humidity sensor needs to be removed from operation and sent back to the factory for a factory 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 NCore Meteorological QA/QC Worksheet

Air Quality Management Division
NCore Meteorological QA/QC Worksheet

Verification: ______ Audit: ______

Date: ______ Operator: ______ Site: ______

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

Ambient Temperature

	Site Instrument	Audit Instrument
Manufacturer:		
Model:		
Serial No.		

	Site T_A (°C)	Audit T_A (°C)	Difference (°C)			
Ambient:				+/- 0.5°C?	Yes____	No____
Low:				+/- 0.5°C?	Yes____	No____
High:				+/- 0.5°C?	Yes____	No____

Relative Humidity

	Site Instrument	Audit Instrument
Manufacturer:		
Model:		
Serial No.		

Site RH (%)	Audit RH (%)	Difference (%)			
			+/- 7 %?	Yes____	No____

Sonic Anemometer

	Site Instrument	Audit Compass
Manufacturer:		
Model:		
Serial No.		

WSP Zero Test	Site WSP (m/s)	Reference WSP (m/s)	Difference (m/s)			
		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		+/- 2.5 m/s?	Yes____	No____
East-West		50.0		+/- 2.5 m/s?	Yes____	No____
Both		50.0		+/- 2.5 m/s?	Yes____	No____

WDR Blocked Axis Test	Site WDR (Deg)	Reference WDR (Deg)	Difference (Deg)			
North-South		10.0		+/- 5 Deg?	Yes____	No____
East-West		160.0		+/- 5 Deg?	Yes____	No____
Both		170.0		+/- 5 Deg?	Yes____	No____

Crossarm Compass Check True North Alignment +/- 5 Deg? Yes____ No____

Comments: ____________________

Master_Template_Met NCORE
Last Revision: 11/27/2024

QC Check/PDF:________

Figure 1a SLAMS Meteorological QA/QC Worksheet

Air Quality Management Division
SLAMS Meteorological QA/QC Worksheet

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:				+/- 1.0°C?	Yes____	No____
Low:				+/- 1.0°C?	Yes____	No____
High:				+/- 1.0°C?	Yes____	No____

Relative Humidity

	Site Instrument		**Audit Instrument**
Manufacturer:		Manufacturer:	
Model:		Model:	
Serial No.		Serial No.	

Site RH (%)	Audit RH (%)	Difference (%)			
			+/- 10 %?	Yes____	No____

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		+/- 0.25 m/s?	Yes____	No____

WSP Blocked Axis Test	Site WSP (m/s)	Reference WSP (m/s)	Difference (m/s)			
North-South		50.0		+/- 2.5 m/s?	Yes____	No____
East-West		50.0		+/- 2.5 m/s?	Yes____	No____
Both		50.0		+/- 2.5 m/s?	Yes____	No____

WDR Blocked Axis Test	Site WDR (Deg)	Reference WDR (Deg)	Difference (Deg)			
North-South		10.0		+/- 5 Deg?	Yes____	No____
East-West		160.0		+/- 5 Deg?	Yes____	No____
Both		170.0		+/- 5 Deg?	Yes____	No____

Crossarm Compass Check True North Alignment +/- 5 Deg? Yes____ No____

Comments: ________________________________

Master_Template_Met SLAMS
Last Revision: 11/27/2024

QC Check/PDF:________

Figure 2 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 08/23/24

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

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Jordan Volk

Title of Author: Air Quality Specialist

Signature: Jordan Volk Digitally signed by Jordan Volk Date: 2024.11.27 07:35:20 -08'00' Date: ____________

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.25 15:01:50 -08'00' Date: ____________

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.26 10:34:27 -08'00' 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	Northern Nevada Public Health Air Quality Management Division
EPA	U.S. Environmental Protection Agency
LPU	Local Processing Unit
NAREL	National Air and Radiation Environmental Laboratory
NNPH	Northern Nevada Public Health
Pu	Plutonium
U	Uranium
UTC	Coordinated Universal Time

List of Figures and Tables

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 140 radiation air monitors in 50 states.[1] 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).

[1] United Stated Environmental Protection Agency. RadNet. https://www.epa.gov/radnet. Date Accessed November 22, 2024

Figure 1 RadNet Sampler

O.3 Instrument Operation

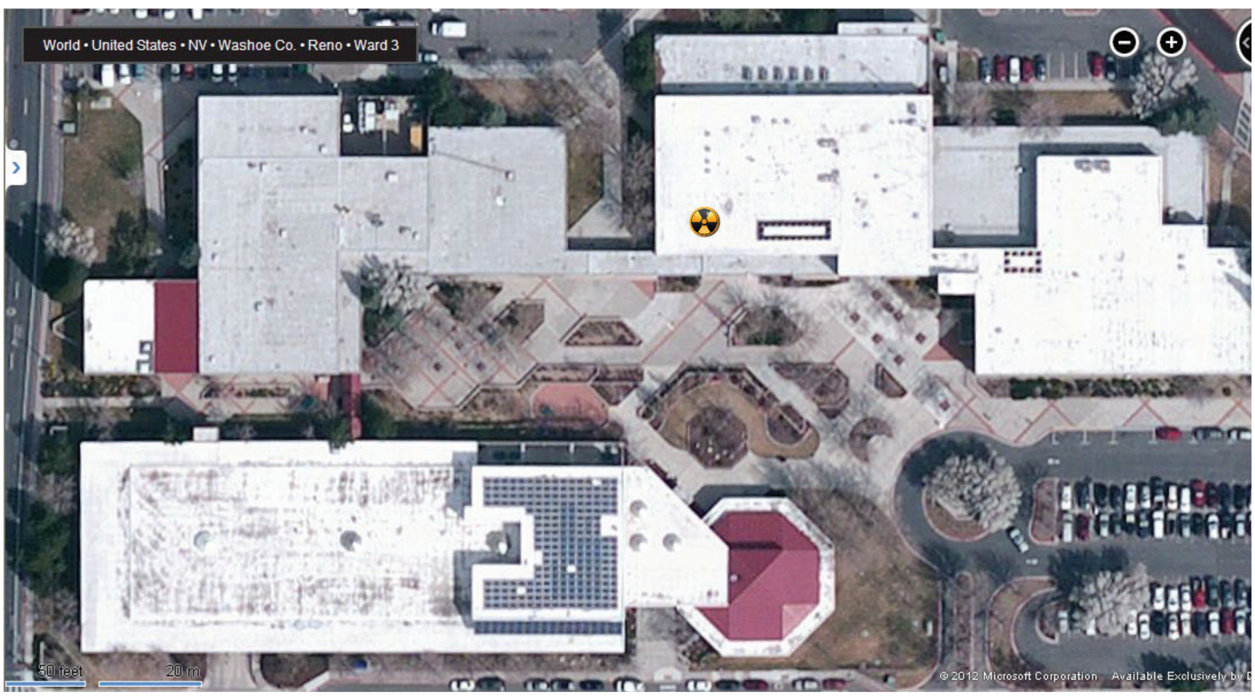
O.3.1 Sampling Procedure – Pulling and Installing a Clean Filter

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.
6. Record the Universal Time Coordinated (UTC) Sampling Start & Stop date and time.
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 Northern Nevada Public Health 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 place it in the envelope with the filter.
24. Mail the envelope. The mailbox is located on the 9th street sidewalk in front of building A.

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.4 Routine Procedures

O.4.1 Annual RadNet Calibration

NAREL will perform annual calibrations on the RadNet Sampler.

O.4.2 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.5 Troubleshooting

Contact the NAREL for troubleshooting and repair of the RadNet Sampler.

Contact Information:

- Dan Askren- (334) 270-3422, Askren.Dan@epa.gov
- Scott Telofski- (334) 270-3412 or (334) 270-7047, telofski.scott@epa.gov

Appendix P: Data Retrieval

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Ben McMullen

Title of Author: Air Quality Specialist (Data Manager)

Signature: Ben McMullen Digitally signed by Ben McMullen Date: 2024.11.25 15:06:42 -08'00' Date: 11/25/2024

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.25 14:56:46 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.26 14:07:00 -08'00' 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	Northern Nevada Public Health 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

List of Figures

P.1 Purpose

The purpose of this Standard Operating Procedure (SOP) is to establish uniform procedures for the retrieval, all data collected by the Northern Nevada Public Health Air Quality Management Division (AQMD) Ambient Air Monitoring Program.

P.2 Summary of Method

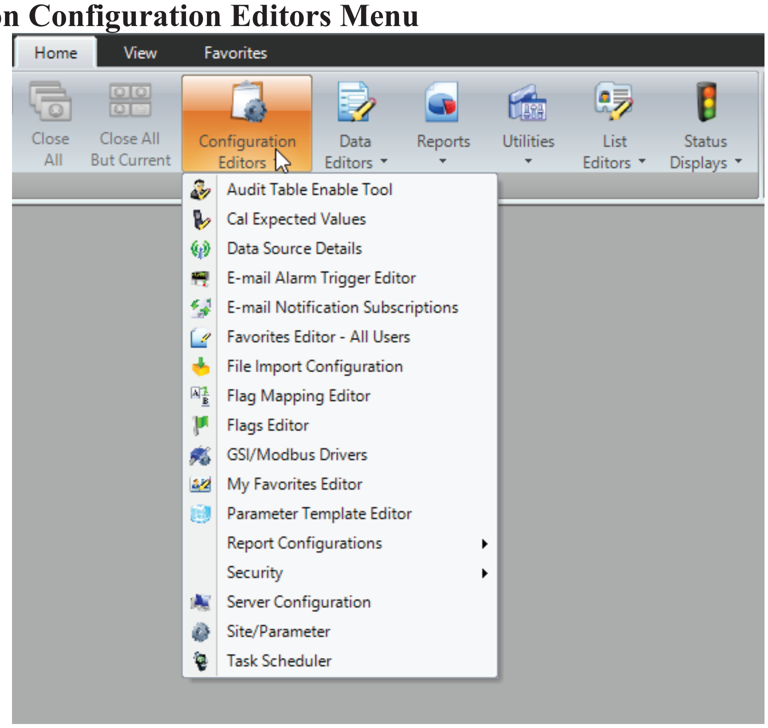
The AQMD collects data for both continuous and manual methods. Agilaire LLC is the data acquisition software and data logger vendor. AirVision software is used to communicate with the Model 8872 Agilaire data loggers and Met-One Beta Attenuation Monitors (BAMs) via direct polling that are located at 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 within the Configuration Editor of the AirVision application.

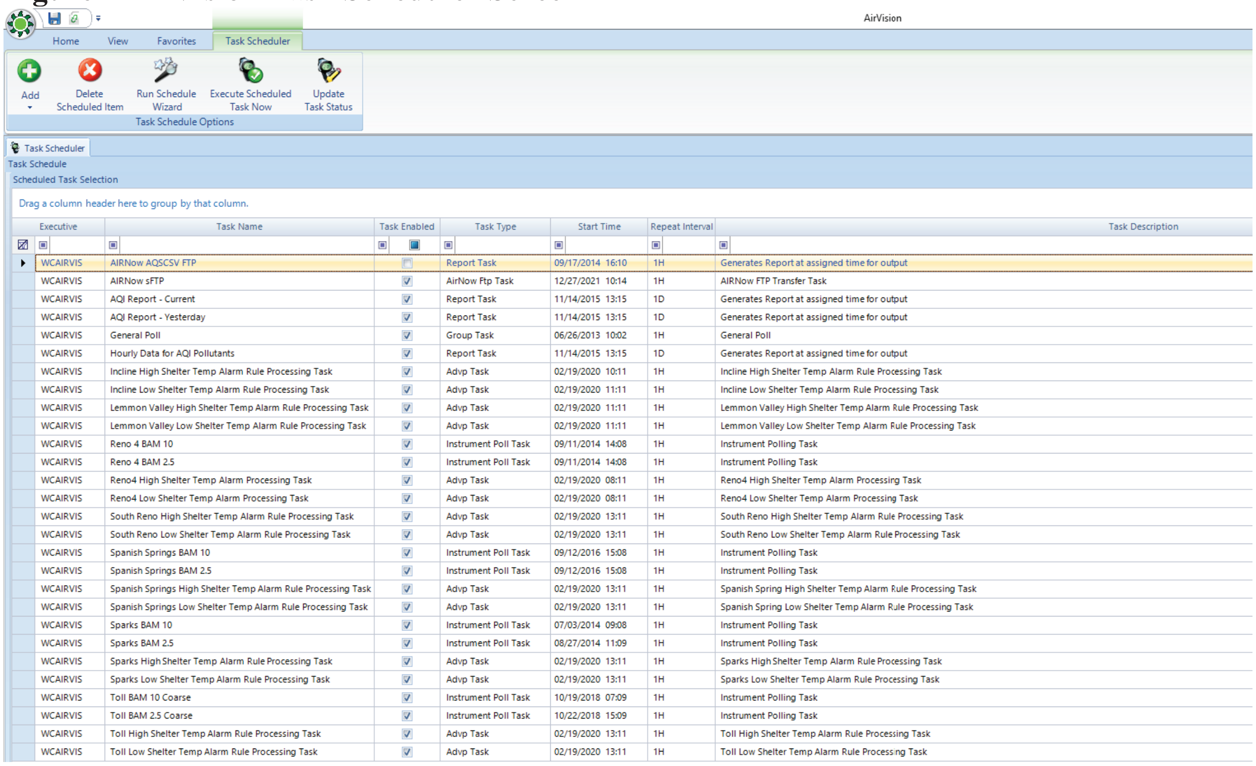
1. To configure the polling schedule, launch AirVision and select the Configuration Editor. See Figure 1.

Figure 1 AirVision Configuration Editors 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	AIRNow sFTP	☑	AirNow Ftp Task	12/27/2021 10:14	1H	AIRNow FTP Transfer Task
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	General Poll	☑	Group Task	06/26/2013 10:02	1H	General Poll
WCAIRVIS	Hourly Data for AQI Pollutants	☑	Report Task	11/14/2015 13:15	1D	Generates Report at assigned time for output
WCAIRVIS	Incline High Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 10:11	1H	Incline High Shelter Temp Alarm Rule Processing Task
WCAIRVIS	Incline Low Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 11:11	1H	Incline Low Shelter Temp Alarm Rule Processing Task
WCAIRVIS	Lemmon Valley High Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 11:11	1H	Lemmon Valley High Shelter Temp Alarm Rule Processing Task
WCAIRVIS	Lemmon Valley Low Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 11:11	1H	Lemmon Valley Low Shelter Temp Alarm Rule Processing Task
WCAIRVIS	Reno 4 BAM 10	☑	Instrument Poll Task	09/11/2014 14:08	1H	Instrument Polling Task
WCAIRVIS	Reno 4 BAM 2.5	☑	Instrument Poll Task	09/11/2014 14:08	1H	Instrument Polling Task
WCAIRVIS	Reno4 High Shelter Temp Alarm Processing Task	☑	Advp Task	02/19/2020 08:11	1H	Reno4 High Shelter Temp Alarm Processing Task
WCAIRVIS	Reno4 Low Shelter Temp Alarm Processing Task	☑	Advp Task	02/19/2020 08:11	1H	Reno4 Low Shelter Temp Alarm Processing Task
WCAIRVIS	South Reno High Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 13:11	1H	South Reno High Shelter Temp Alarm Rule Processing Task
WCAIRVIS	South Reno Low Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 13:11	1H	South Reno Low Shelter Temp Alarm Rule Processing 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	Spanish Springs High Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 13:11	1H	Spanish Spring High Shelter Temp Alarm Rule Processing Task
WCAIRVIS	Spanish Springs Low Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 13:11	1H	Spanish Spring Low Shelter Temp Alarm Rule Processing 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	Sparks High Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 13:11	1H	Sparks High Shelter Temp Alarm Rule Processing Task
WCAIRVIS	Sparks Low Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 13:11	1H	Sparks Low Shelter Temp Alarm Rule Processing 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
WCAIRVIS	Toll High Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 13:11	1H	Toll High Shelter Temp Alarm Rule Processing Task
WCAIRVIS	Toll Low Shelter Temp Alarm Rule Processing Task	☑	Advp Task	02/19/2020 13:11	1H	Toll Low Shelter Temp Alarm Rule Processing 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 including calibrations, alarms, and data polls. Hourly and sub-hourly data poll tasks are setup for each site (Figure 6). Set the schedule for time and how often the system will perform data polling. Click Save.

Figure 3 AirVision General Poll Task Detail

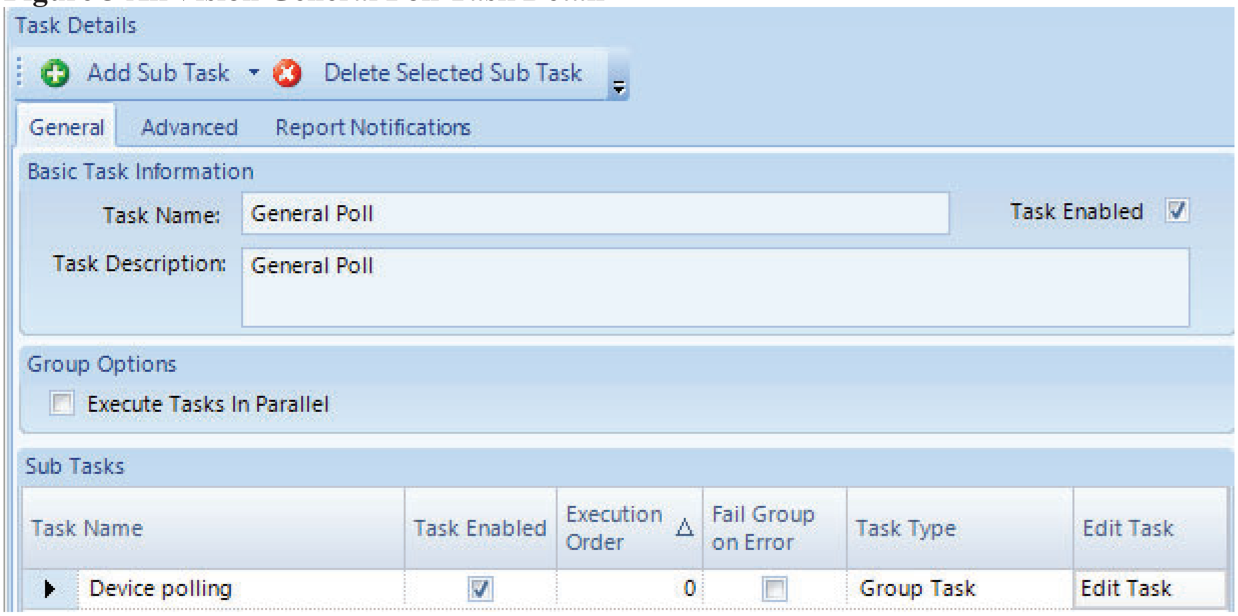
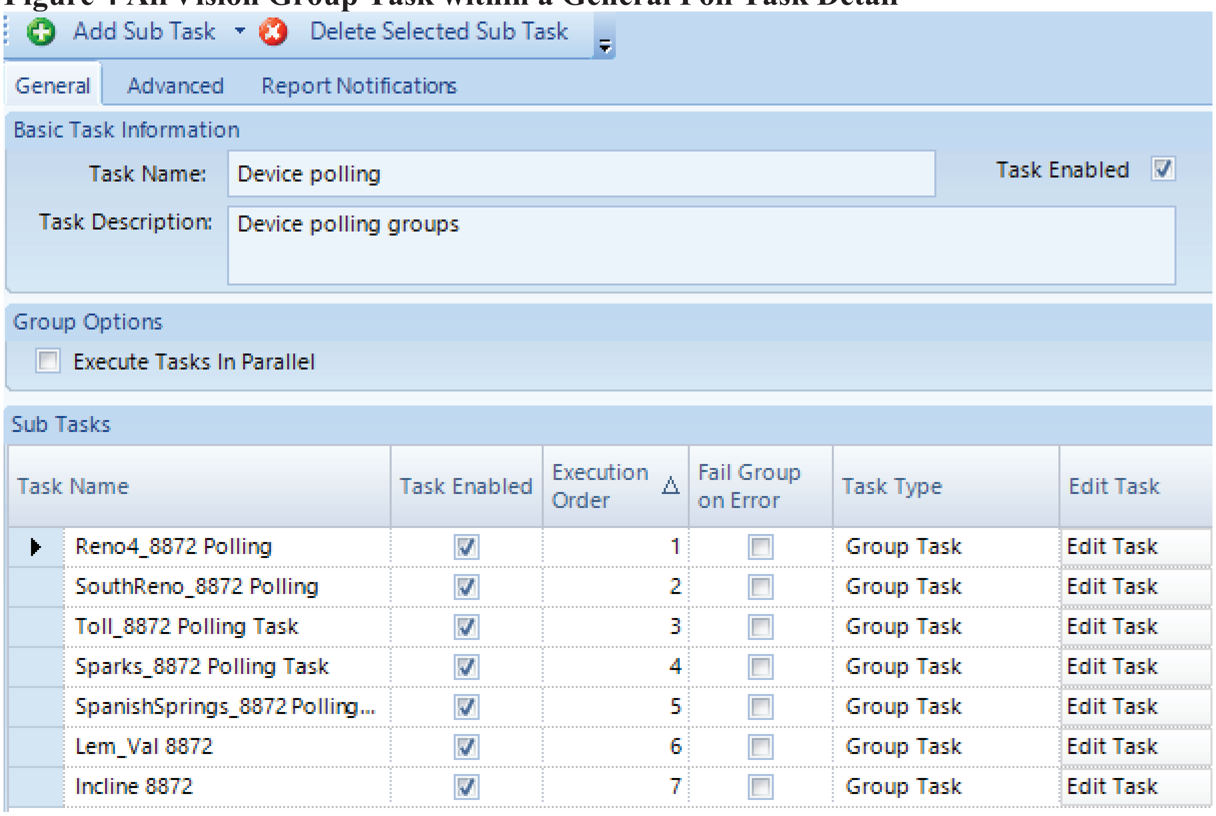
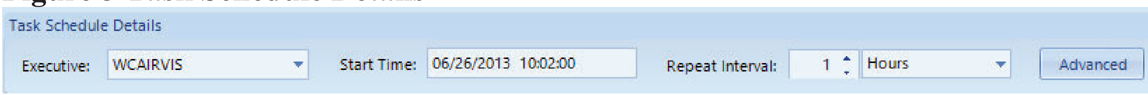


Figure 4 AirVision Group Task within a General Poll Task Detail



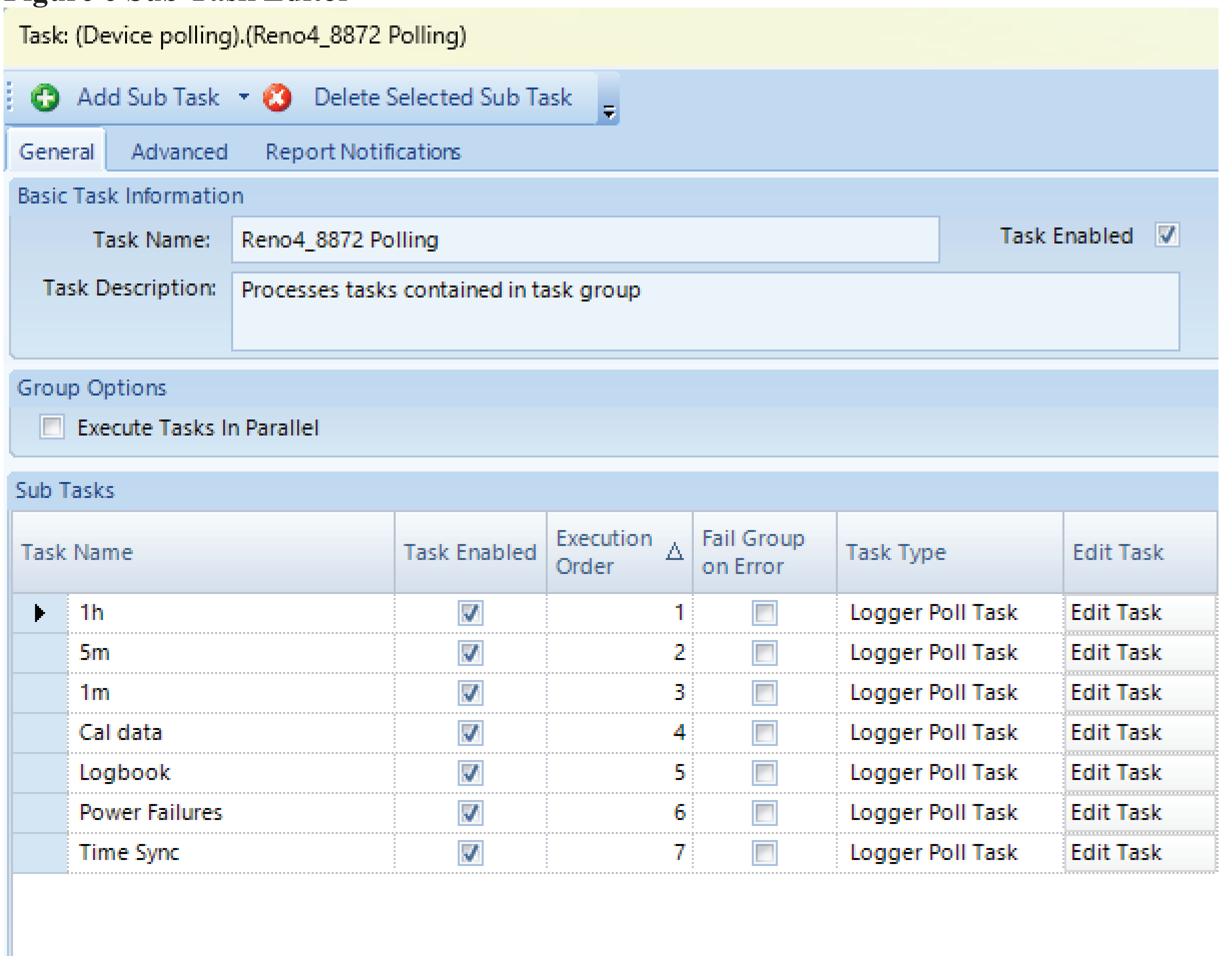
5. To edit an existing schedule, launch the Task Scheduler and make the necessary changes to the start time and interval in the Task Schedule Details. Once the changes are complete, click on Save.

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.

Figure 6 Sub Task Editor



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

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Ben McMullen

Title of Author: Air Quality Specialist (Data Manager)

Signature: Ben McMullen Digitally signed by Ben McMullen Date: 2024.12.02 07:38:33 -08'00' Date: 12/2/2024

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.25 15:02:41 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.26 14:09:29 -08'00' 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	Northern Nevada Public Health Air Quality Management Division

List of Figures

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 Northern Nevada Public Health, Air Quality Management Division (AQMD) Ambient Air Monitoring Program.

Q.2 Summary of Method

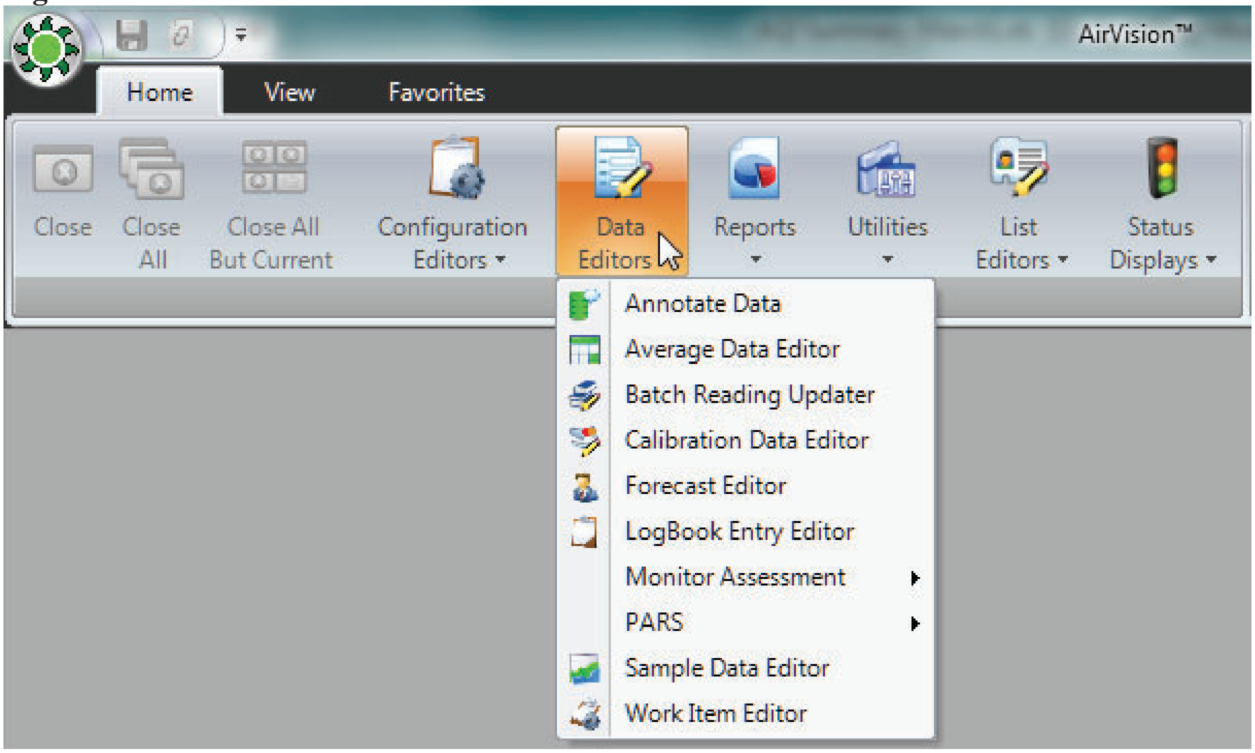
AQMD collects data for both continuous and manual methods. The AV data management system is used to review and edit all data collected from the individual monitoring sites. All the data is stored on an off-site secure server operated by Agilaire, LLC. All manual methods are collected in the field by the air monitoring staff and returned to the lab located in the AQMD office. Each monitoring site has an Agilaire 8872 Data Logger that stores all of the sample values from the continuous 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 spreadsheet for the corresponding site to be edited located from the shared monitoring drive.

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

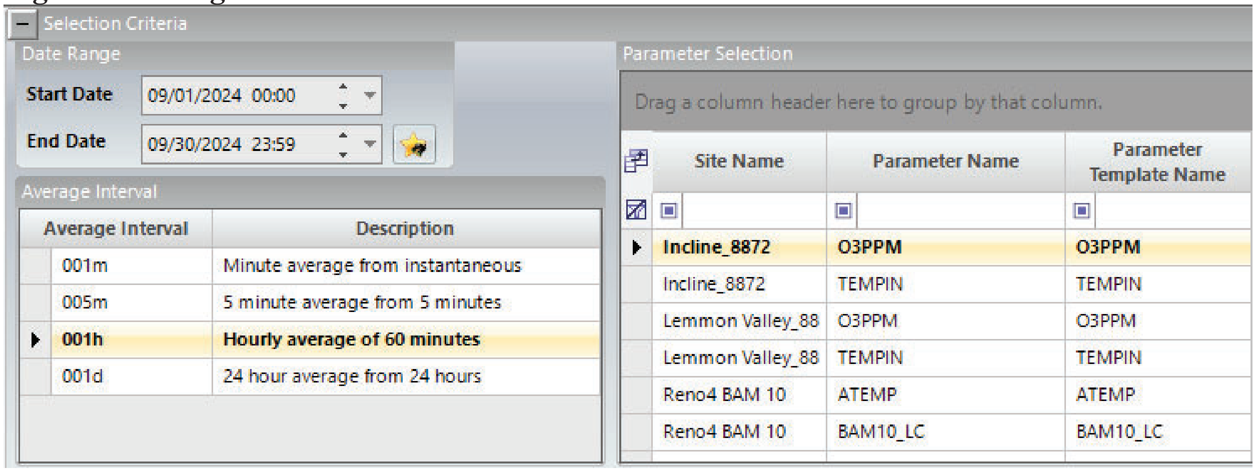


3) From the Data Editor drop down choose the Average Data Editor to edit continuous data, the Sample Data Editor to edit filter data, and Monitor Assessment to edit precision & accuracy data.

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 for editing one single parameter at a time and Cross-Tab Data presentation is preferred for editing multiple parameters at a time.

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

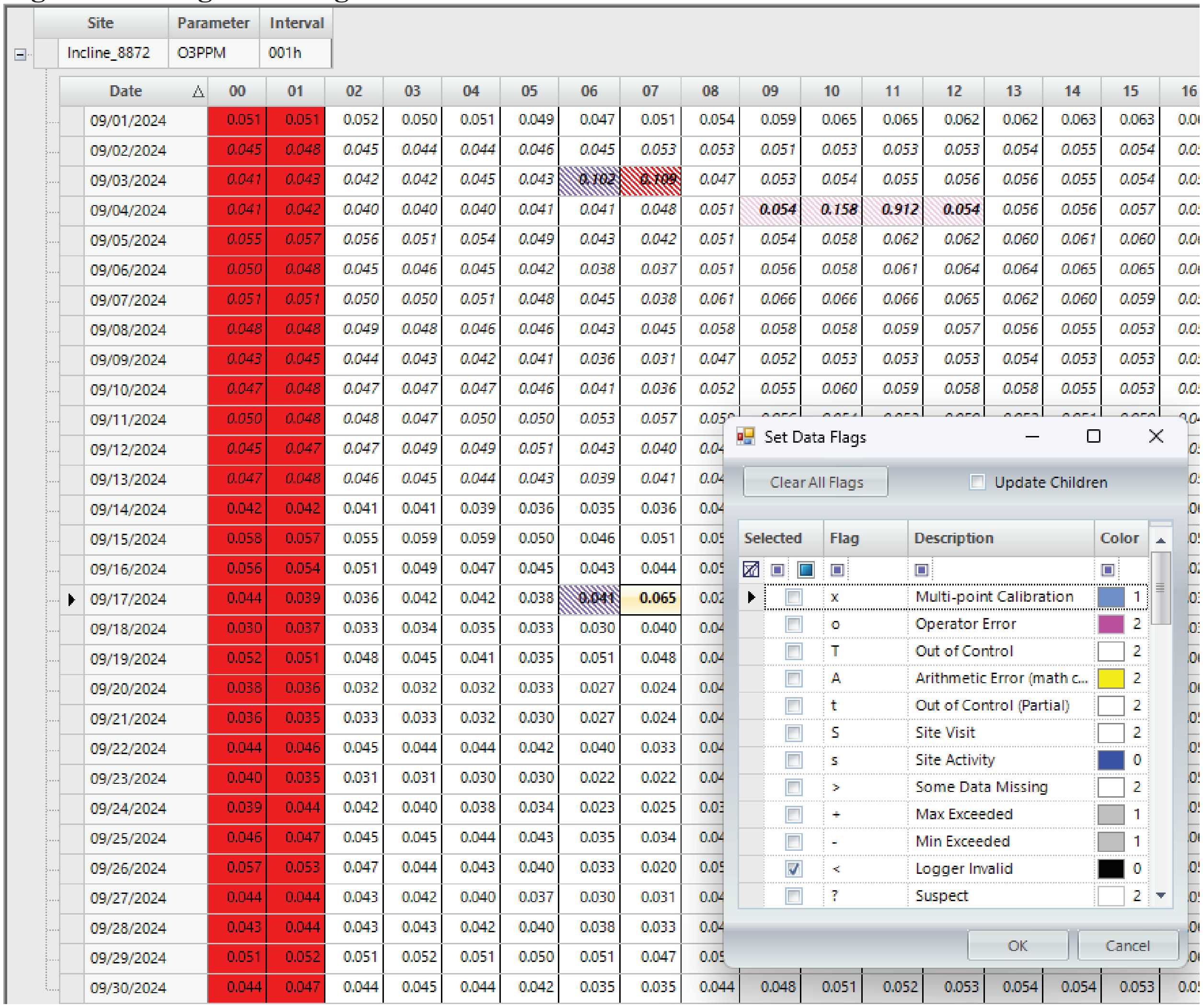
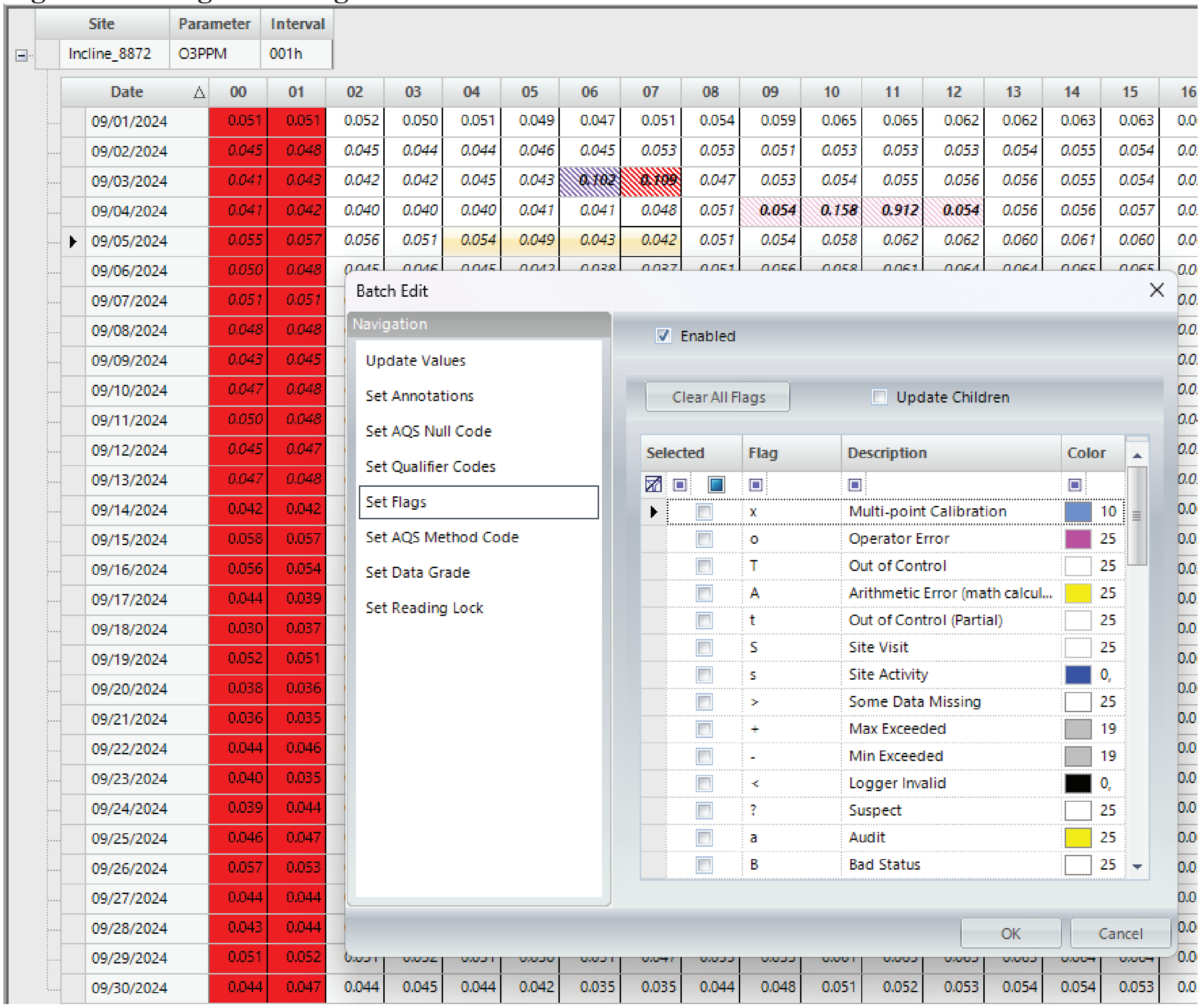


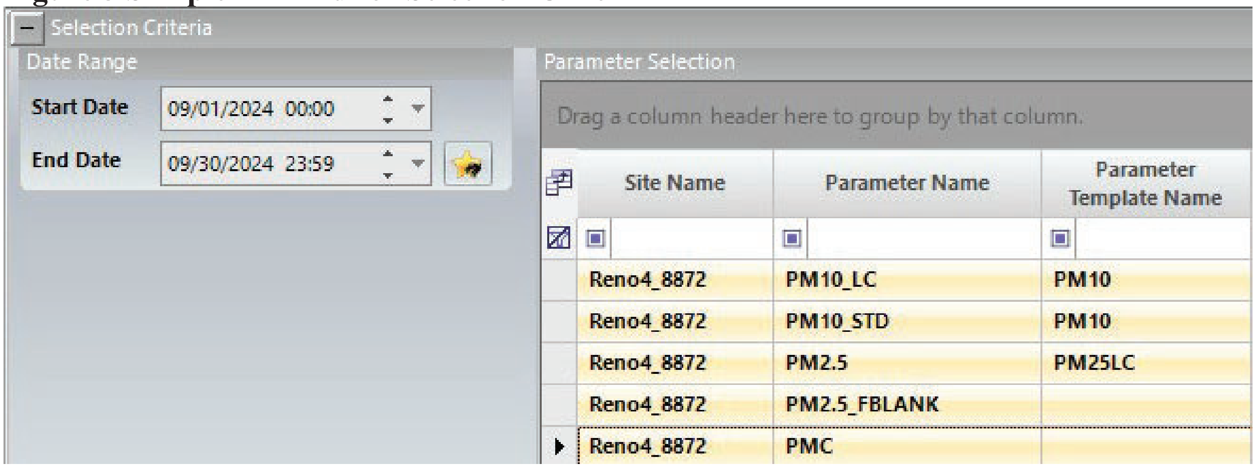
Figure 4 Setting Data Flags for More Than One Cell



Sample Data Editor

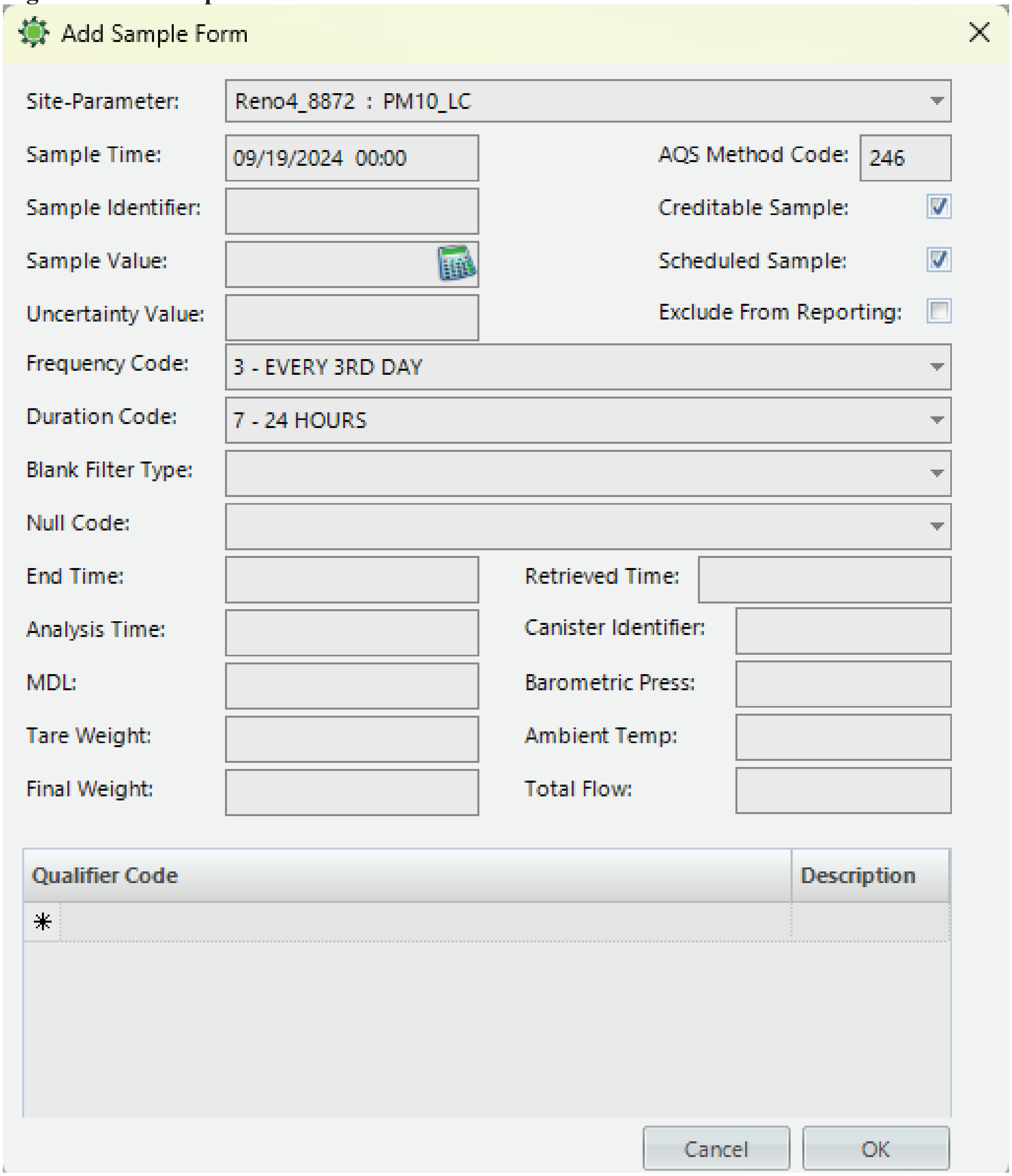
1) For the Sample Data Editor, maximize the Selection Criteria and choose the desired date and hour ranges and parameter.
2) Click Retrieve Data.
3) Sample Data Editor defaults to the Linear Data Presentation Option. Change to other presentation formats if desired
   a) Linear Data presentation is the 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 EE Met One E-SEQ-FRM; 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

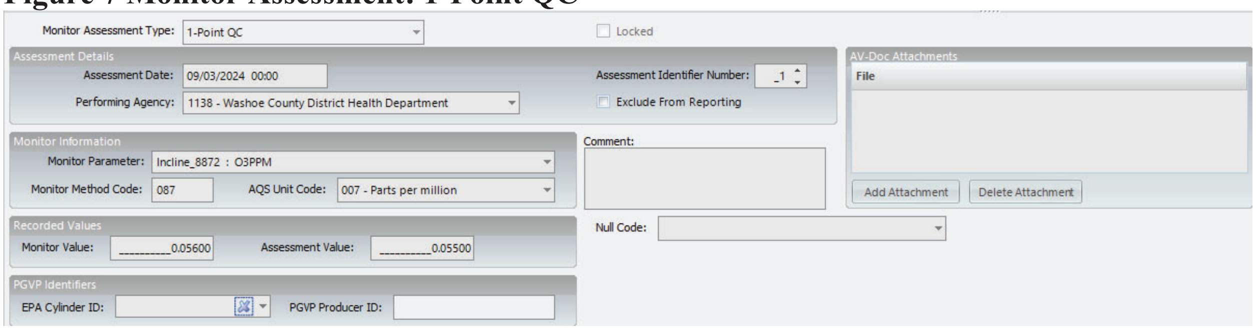


Figure 8 Monitor Assessment: Annual Performance Evaluation

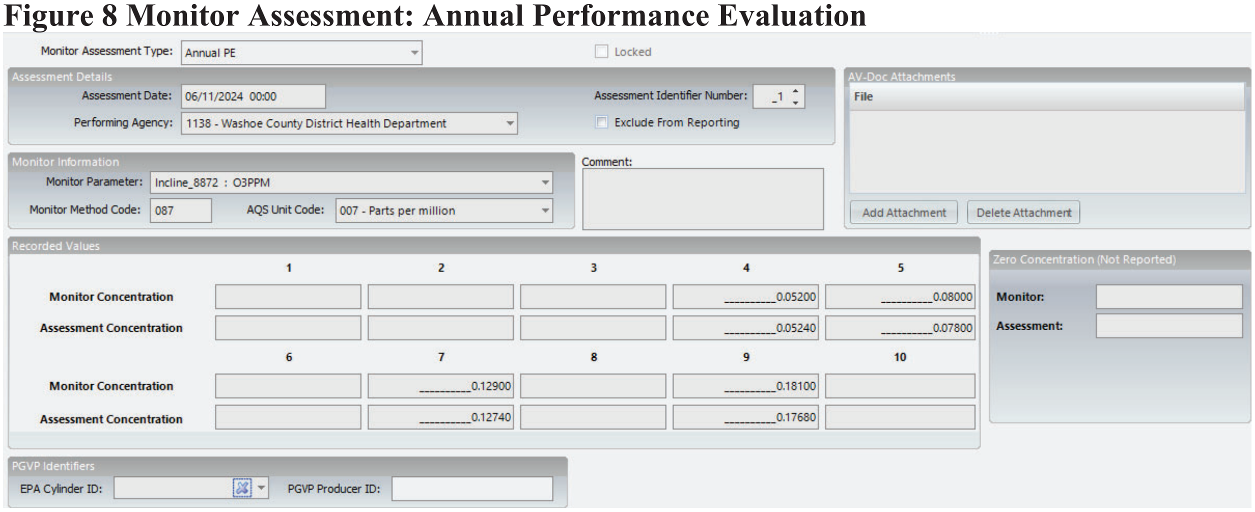


Figure 9 Monitor Assessment: Flow Rate Verification

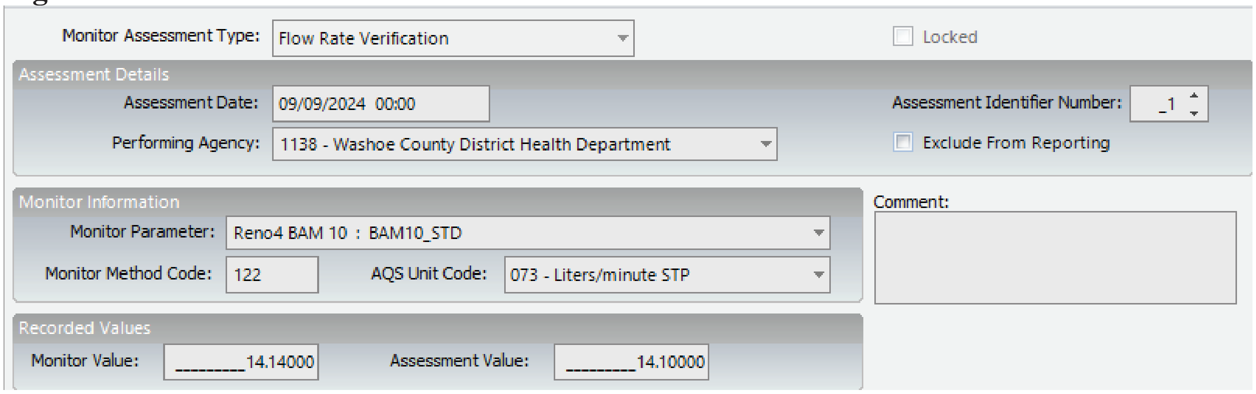
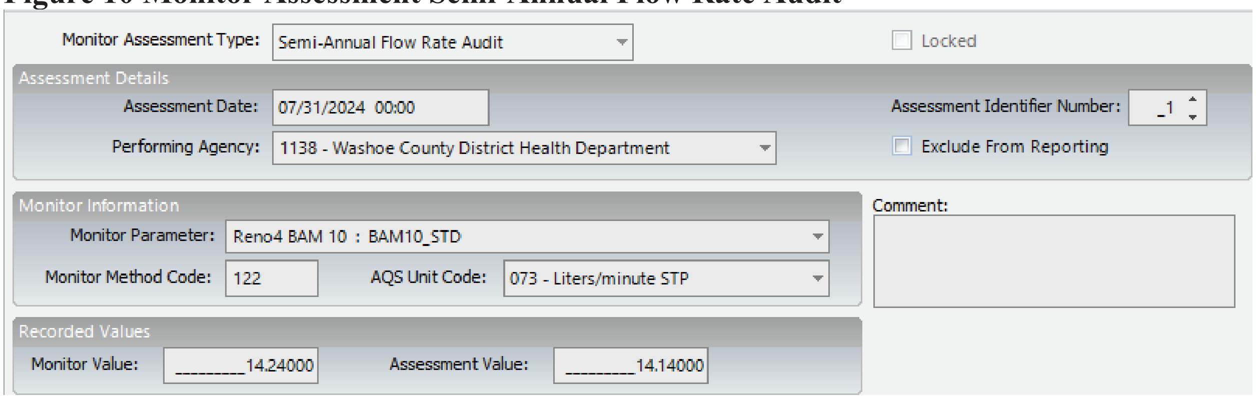

Monitor Assessment Type: Flow Rate Verification
Locked
Assessment Details
Assessment Date: 09/09/2024 00:00
Assessment Identifier Number: _1
Performing Agency: 1138 - Washoe County District Health Department
Exclude From Reporting
Monitor Information
Monitor Parameter: Reno4 BAM 10 : BAM10_STD
Monitor Method Code: 122
AQS Unit Code: 073 - Liters/minute STP
Comment:
Recorded Values
Monitor Value: _________14.14000
Assessment Value: _________14.10000

Figure 10 Monitor Assessment Semi-Annual Flow Rate Audit


Monitor Assessment Type: Semi-Annual Flow Rate Audit
Locked
Assessment Details
Assessment Date: 07/31/2024 00:00
Assessment Identifier Number: _1
Performing Agency: 1138 - Washoe County District Health Department
Exclude From Reporting
Monitor Information
Monitor Parameter: Reno4 BAM 10 : BAM10_STD
Monitor Method Code: 122
AQS Unit Code: 073 - Liters/minute STP
Comment:
Recorded Values
Monitor Value: _________14.24000
Assessment Value: _________14.14000

Q.4 Quality Control and Quality Assurance

Once the monthly data has been edited a monthly data matrix report for each site is emailed 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 Statistical Report should be reviewed monthly for statistical anomalies of reported sub-hourly data (5-minute SO2T).

Statistical Report Generation Procedure
1) To create the report in AV, go to the Reports Task and select Statistical Reports > Statistical Report.
2) Select relevant parameters (SO2T).
3) Select averaging interval (5-minute).
4) Click Generate Report.
5) Click PDF to export for post-processing.
6) Click OK.
7) Save in the Data Review folder.

The Senior Air Quality Specialist takes an inventory of the 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.

Q.5 Sub-hourly Data Review Procedures

Using the Data Analysis Report in AirVision, sub-hourly data will be reviewed for all sites as needed to validate calibrations, completeness, and data anomalies. See Figures 12 and 13 for examples of one- and five-minute data analysis reports, respectively.

Figure 11 Monthly Data QC Parameter Checklist

Clear Form

Monthly Data QC Parameter Checklist

Month/Year: /

Incline
- ☐ O3

Reno 4
- ☐ COT
- ☐ O3
- ☐ SO2T
- ☐ NO
- ☐ NO2
- ☐ NOX
- ☐ NOT
- ☐ NO2Y
- ☐ NOY
- ☐ BAM10_STD
- ☐ BAM10_LC
- ☐ BAM2.5
- ☐ BAM10-2.5
- ☐ WSP
- ☐ WSPVECT
- ☐ WDR
- ☐ WDRVECT
- ☐ ATEMP
- ☐ RELHUM
- ☐ 5 MIN SO2

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

South Reno
- ☐ O3
- ☐ WSP
- ☐ WDR
- ☐ ATEMP

Sparks
- ☐ O3
- ☐ BAM10_STD
- ☐ BAM10_LC
- ☐ BAM2.5
- ☐ BAM10-2.5
- ☐ WSP
- ☐ WDR
- ☐ ATEMP

Previous Month(s) Data Affected? Y ☐ N ☐

If Yes, Site / Parameter / Month(s) ______ / ______ / ______

Data Package Completeness Check

Date: ______ Initials: ______

Last Revision: 10/24 BSM

Figure 12 One-minute data analysis report

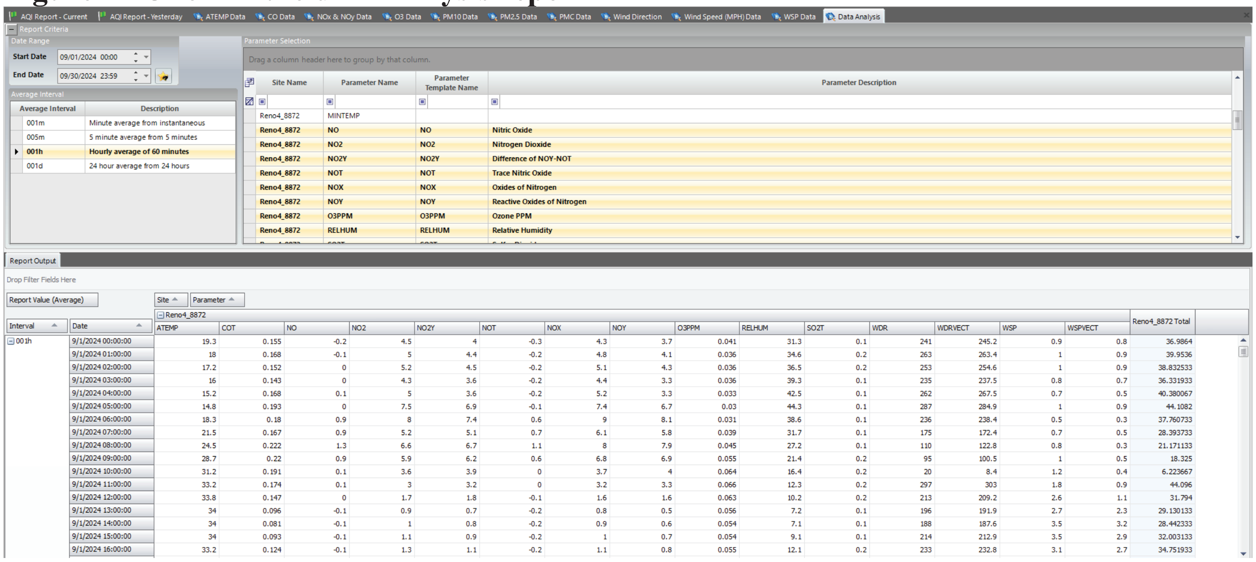
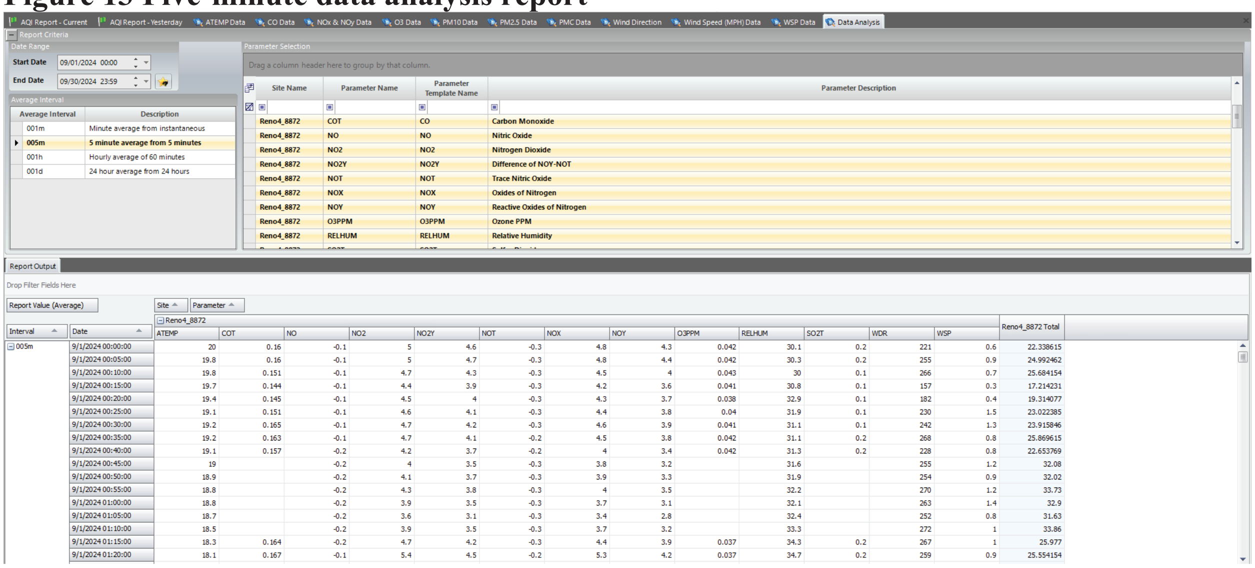


Figure 13 Five-minute data analysis report



Appendix S: File Generation for Continuous, Manual, and Quality Assurance Data

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Ben McMullen

Title of Author: Air Quality Specialist (Data Manager)

Signature: Ben McMullen Digitally signed by Ben McMullen Date: 2024.12.02 07:41:26 -08'00' Date: 12/2/2024

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.25 15:03:05 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.27 08:12:13 -08'00' 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	Northern Nevada Public Health, Air Quality Management Division
AQS	Air Quality System
CO	Carbon Monoxide
EPA	U.S. Environmental Protection Agency
FRM	Federal Reference Method
NCore	National Core multipollutant 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

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. Agilaire 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.

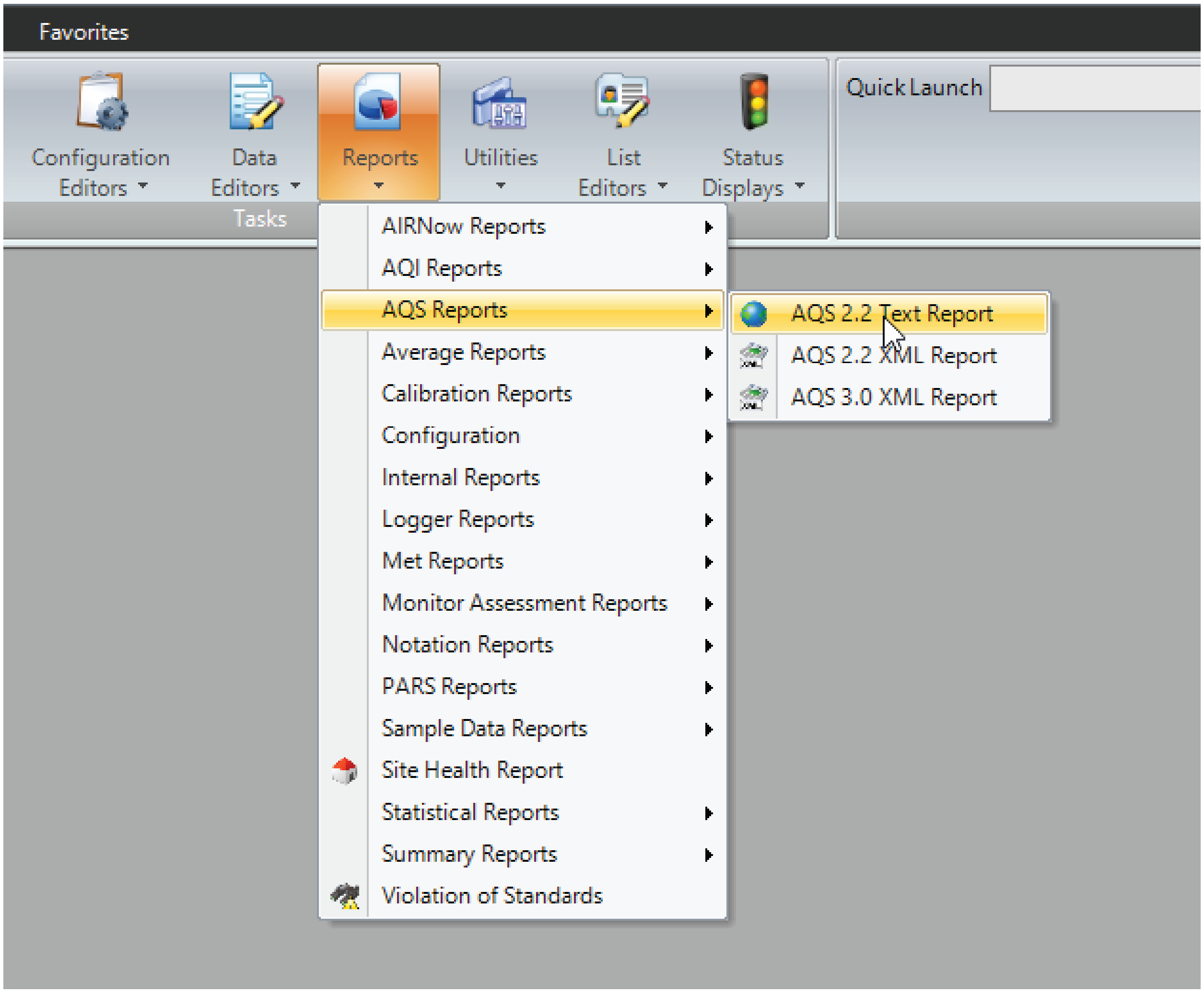
In order to meet the EPA's requirements of loading the continuous, manual, and QA monitoring data into AQS every quarter before the end of the following quarter, the Northern Nevada Public Health, Air Quality Management Division (AQMD) generates data files and loads the previous quarter data a month 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.

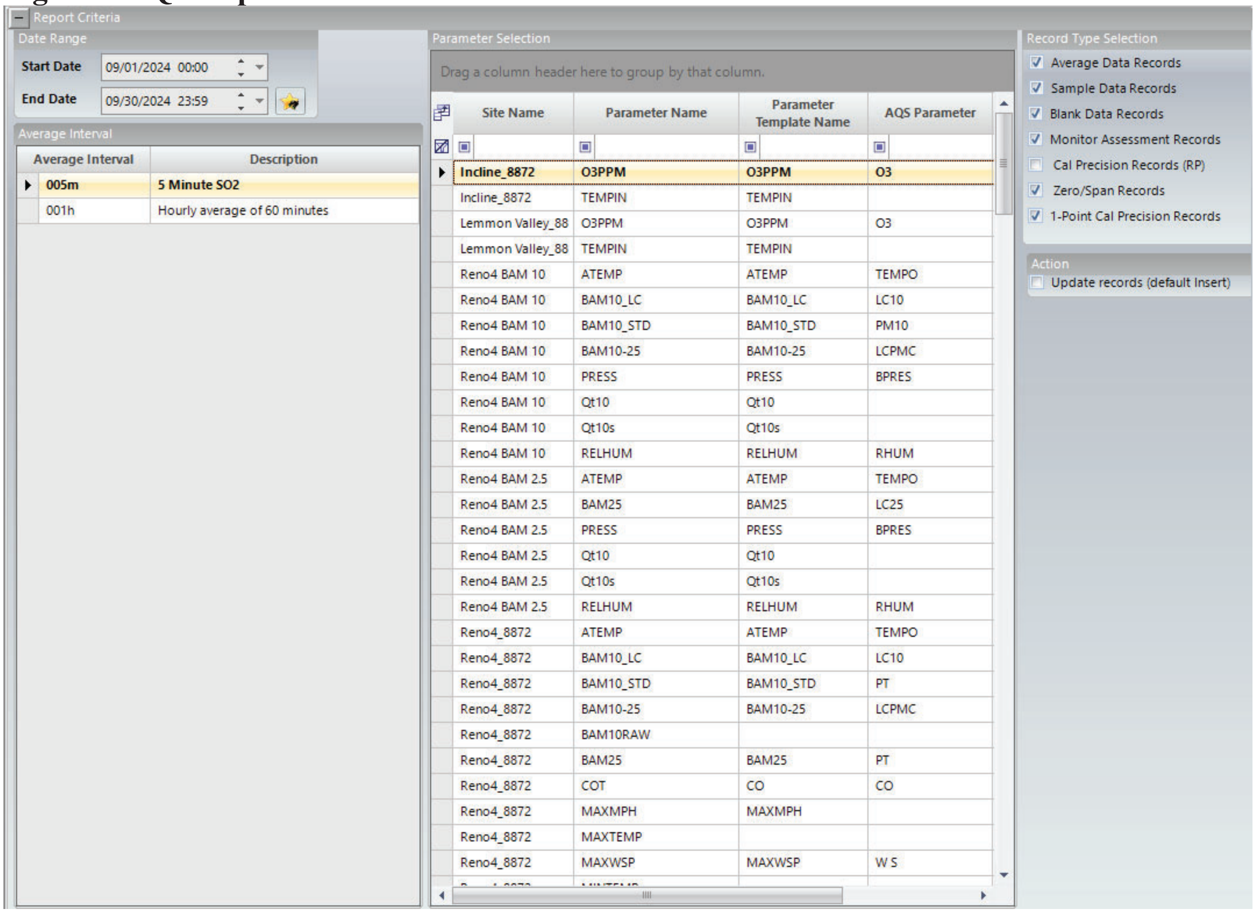
1. To generate files for the continuous monitoring methods, launch AirVision.

Figure 1 AirVision Report Menu



2. Select Reports followed by AQS Reports and then AQS 2.2 Text Reports.

Figure 2 AQS Report Main Menu



3. Deselect all except for "Average Data Records" in the Record Type Selection.
4. Select the appropriate range from the first day of the month to the last day, e.g. 01 Dec 2024 00:00 to 31 Dec 2024 23:59.
5. Select the "Hourly average of 60 minutes" in the Average Interval field
   a. Select 5-minute SO_2 for 5-minute SO_2 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. REN_COT_DEC24: Sample file name for Reno4 Trace Carbon Monoxide (COT) for December 2024.
8. Click Save.

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	AQS Code Description
Power Failure	P	AV	Power Failure.
Calibration	C	AT	Calibration.
Malfunction	e	AN	Machine Malfunction.
Misc. Error	i	AM	Miscellaneous Void.
Maintenance	m	BA	Maintenance/Routine Repairs.
Operator Error	o	BJ	Operator Error.
Audit	a	AZ	QC Audit.
Zero/Precision/Span	s	BF	Precision/Zero/Span.
Multi-point	x	BC	Multi-point Calibration.
Precision Check	g	AX	Precision Check.
Max/Min Exceeded	+ or -	AN	Machine Malfunction.
Failed Audit/Precision	f	AS	Poor Quality Assurance Results.

S.4 Manual Data Procedure

Manual data is collected every three days at NCore. 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 first day of the quarter to the last day of the quarter, e.g. 01 Oct 2024 00:00 to 31 Dec 2024 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_Q4_2024: Sample file name for Reno4 Particulate Matter for 4th Quarter 2024.
9. Click Save.

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 first day of the quarter to the last day of the quarter, e.g. 01 Oct 2024 00:00 to 31 Dec 2024 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_2024: Sample file name for Sparks 1st Quarter QA data of 2024
8. Click Save.

Appendix U: Uploading Data to AirNow

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Ben McMullen

Title of Author: Air Quality Specialist (Data Manager)

Signature: Ben McMullen Digitally signed by Ben McMullen Date: 2024.12.02 08:14:27 -08'00' Date:

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.11.25 15:03:42 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.11.27 08:13:28 -08'00' 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
DMC	Data Management Center
EPA	U.S. Environmental Protection Agency
FTP	File Transfer Process
QC	Quality Control
SOP	Standard Operating Procedure
AQMD	Northern Nevada Public Health Air Quality Management Division

List of Figures

Sub-Appendices

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 Northern Nevada Public Health, Air Quality Management Division (AQMD) submits hourly data to the AirNow website in an effort to provide the public with real time Air Quality Index (AQI) 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

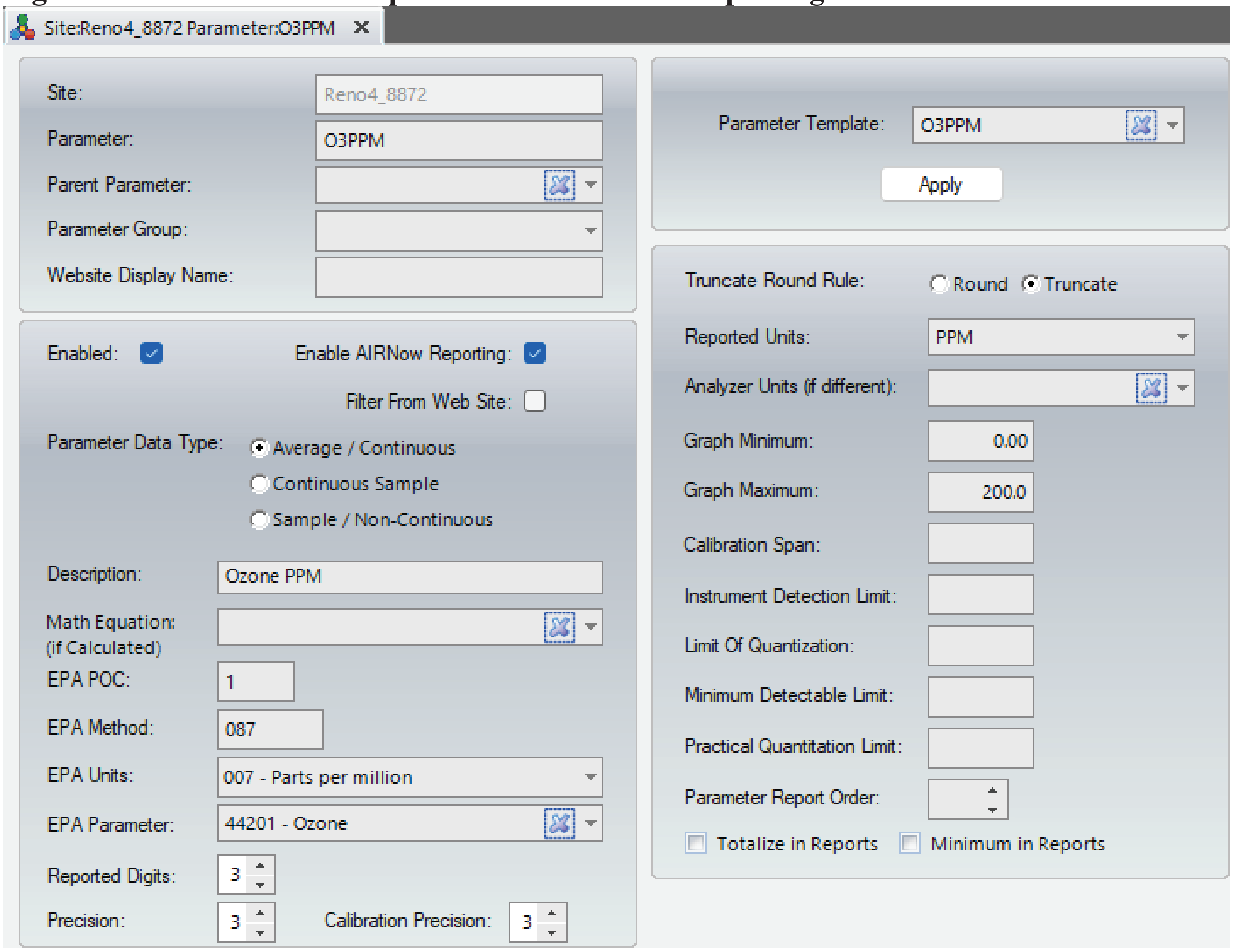
U.3.1 Initial Set up

1. Open AirNow/FTP Setup from the Configuration Editors menu under Report Configurations.
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 NV2 or otherwise provided by EPA.
   - Agency – Agency Code NV2 or otherwise provided by EPA.
   - Enable – Enables the transfer program to function.
   - AirNow – Submits the report being transferred in AirNow format.
   - Port – Port 22 or otherwise 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

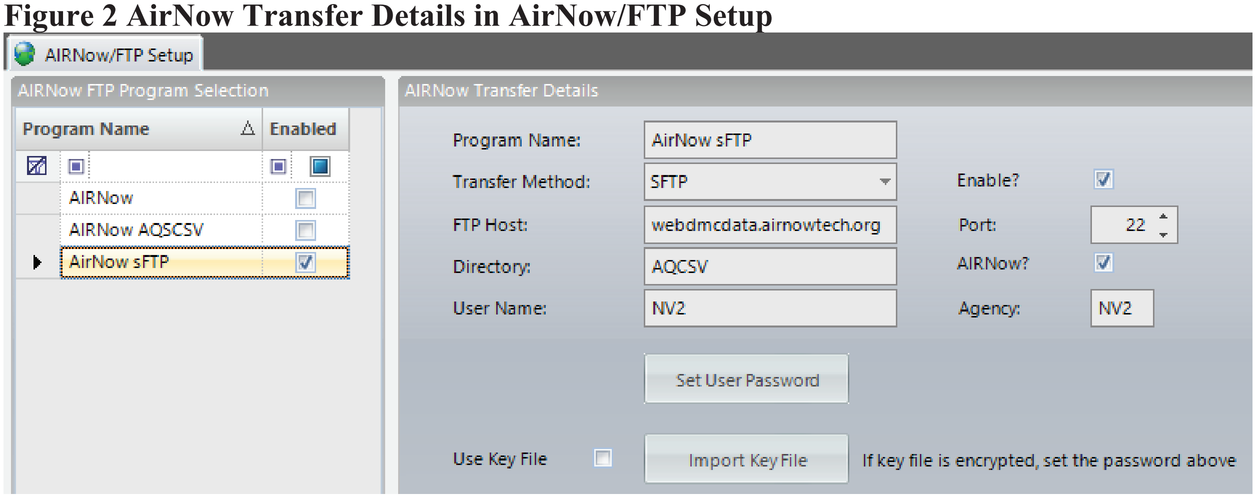
1. Check the Enable AirNow Reporting box in the Site/Parameter setup (Configuration Editors) for all continuous data.

Figure 1 Site/Parameter setup enabled for AirNow Reporting



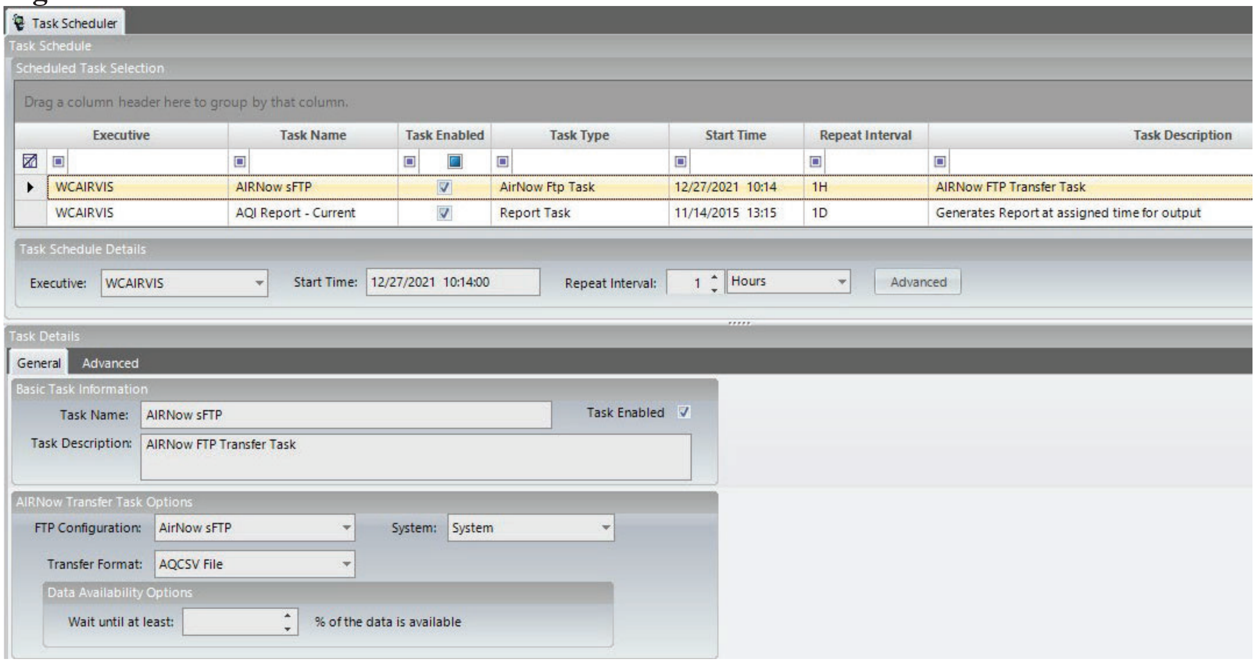
2. Enter AirNow Transfer Details in AirNow/FTP Setup (Configuration Editors)

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) Criteria.

Appendix U1

AirNow Quality Control (QC) Criteria

Appendix VV: Agilaire Digital Site Platform 8872

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Matthew McCarthy

Title of Author: Senior Air Quality Specialist

Signature: Matthew McCarthy Digitally signed by Matthew McCarthy Date: 2024.12.03 11:14:49 -08'00' Date: ____________

Name: Brendan Schnieder

Title: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.12.03 10:23:44 -08'00' Date: ____________

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.12.03 10:41:38 -08'00' 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	Northern Nevada Public Health, Air Quality Management Division
DAS	Data Acquisition System
GB	Gigabytes
IP	Internet Protocol
NOx	Oxides of Nitrogen
NOy	Reactive Oxides of Nitrogen
PC	Personal Computer
QA	Quality Assurance
QC	Quality Control
RAM	Random-Access Memory
SSD	Solid State Drive
TCP	Transmission Control Protocol
WSP	Wind Speed

List of Figures

VV.1 Introduction

The Model 8872 is a Windows-based data logger, based on Windows Professional. The 8872 includes a number of hardware and software features to ensure that the device matches the field reliability of the 8832, while offering the convenience of a Windows-based platform and integration with Agilaire's AirVision software. The core of the 8872 is a fanless PC, with 8 GB of RAM. The device is equipped with a 128 GB solid state drive (SSD).

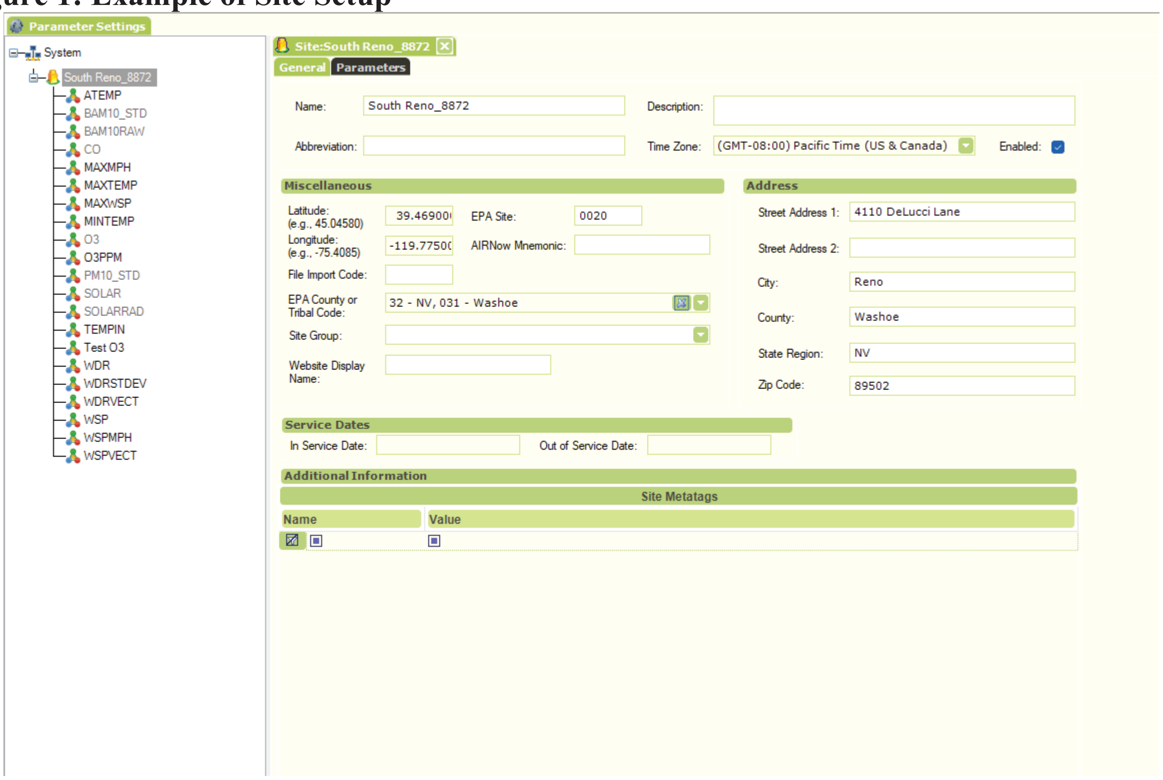
VV.2 Instrument Operation

VV.2.1 Datalogger Setup

VV.2.1.1 Adding a Site

1. On the Main Navigation screen, click Configuration Editors. Under Configuration Editors, click Parameter Settings.
2. Highlight the system in the tree diagram and click the Add Site button on the top of the screen.
3. On the Site Setup Screen, fill in the Name, Time Zone, Longitude (in decimal format), Latitude (in decimal format), EPA Site, County Code, and Address. Be sure to name the site exactly the same as it is named on the WCAIRVIS server (AirVision). See Figure 1 for example site.
4. Click the "Enabled" button and click the save on the top left of the window.

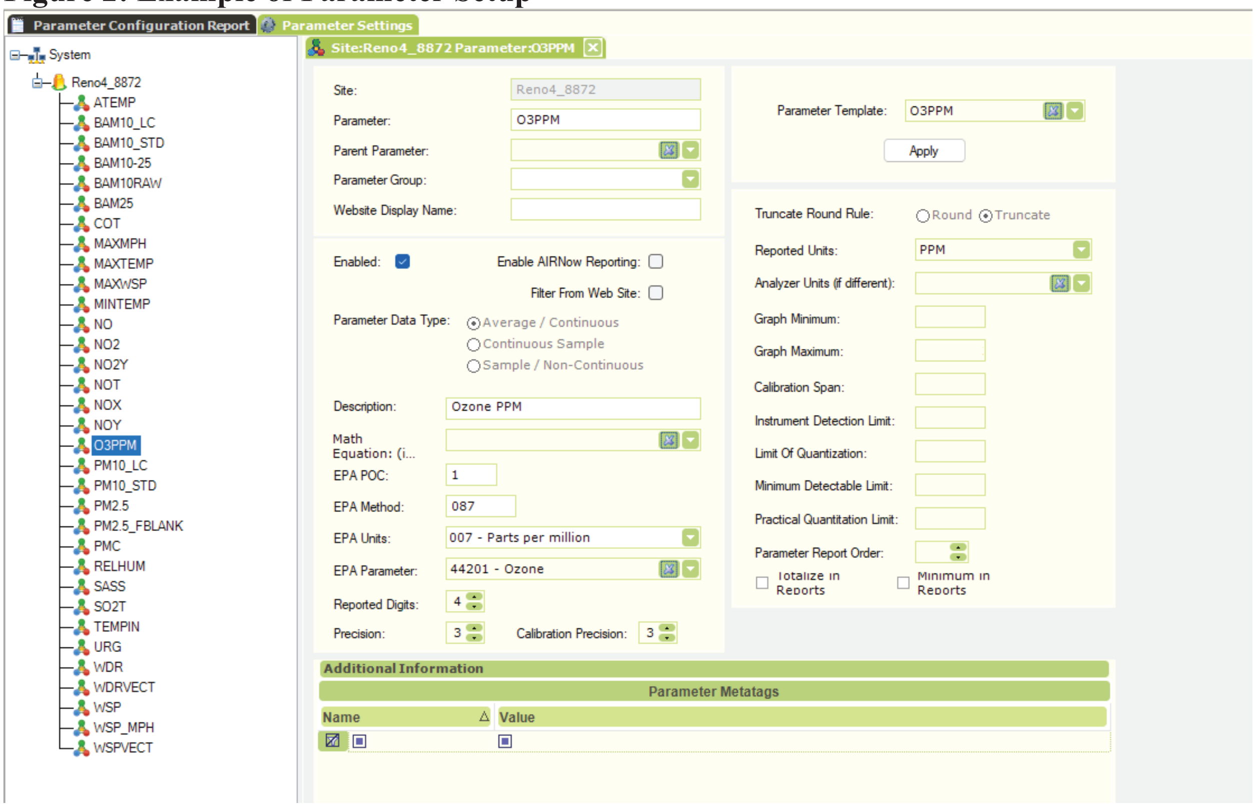
Figure 1: Example of Site Setup



VV.2.1.2 Adding Parameters

1. On the Main Navigation screen, click Configuration Editors. Under Configuration Editors, click Parameter Settings.
2. Highlight the site in the tree diagram and click the Add Parameter button on the top of the screen.
3. On the Parameter Setup screen, name the parameter, find the parameter template most relevant in the Parameter Template drop down, click apply. See Figure 2 for example of Parameter Setup Screen.
4. The 8872 will then fill in most of the information for that parameter via the parameter template. Section VV.4.1 includes a Parameter Configuration Report from Reno4 to serve as a guide for the parameters that AQMD uses.
5. Click the "Enabled" button and click save on the top left of the window.

Figure 2: Example of Parameter Setup



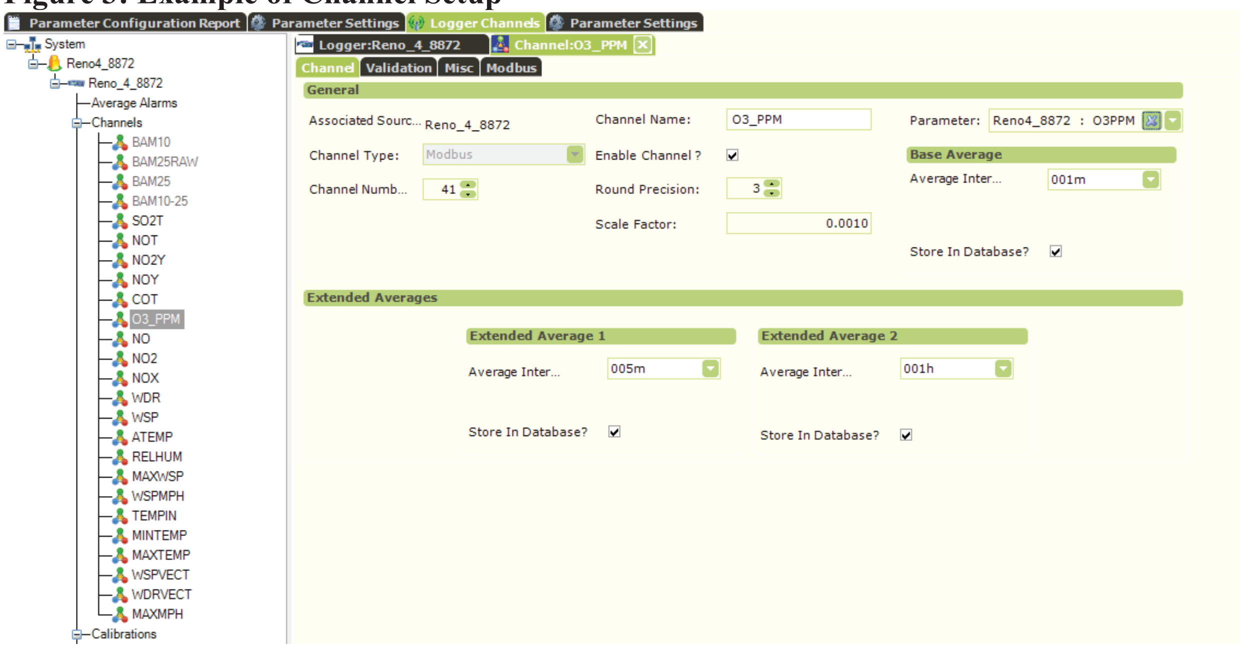
VV.2.1.3 Adding Channels

"Channels" are the entities that tell an 8872 how to acquire data in real-time from an instrument to form averages, that are then passed on to Parameters in AirVision to store the data. Channels represent the physical side (instruments, wires, RS-232 connections, etc.), while Parameters represent the logical side or "slots in the database."

1. On the Main Navigation screen, click Configuration Editors. Under Configuration Editors, click Logger Channels.

2. If a logger hasn't been set up for the site yet, highlight the site in the tree diagram and click Add Logger on the top of the screen. Be sure to name the Logger exactly the same as it is named on the WCAIRVIS server.
3. To add a channel, highlight the logger, and click Add, Add Channels, and choose the signal processing method that the parameter will be collected with (Analog In, Modbus, RS232, etc.).
4. Different inputs will be required to be programmed per parameter based on the channel type. There are four tabs per channel type that may require information to be programmed. See Figure 3 for example of an ozone channel that uses a Modbus connection.
5. Section VV.4.2 includes the Channel Configuration Reports from Reno4 to serve as a guide for how channels are configured by AQMD. For more information, refer to Agilaire's 8872 user manual.
6. After filling in relevant information for each channel, click save in the top left corner.

Figure 3: Example of Channel Setup



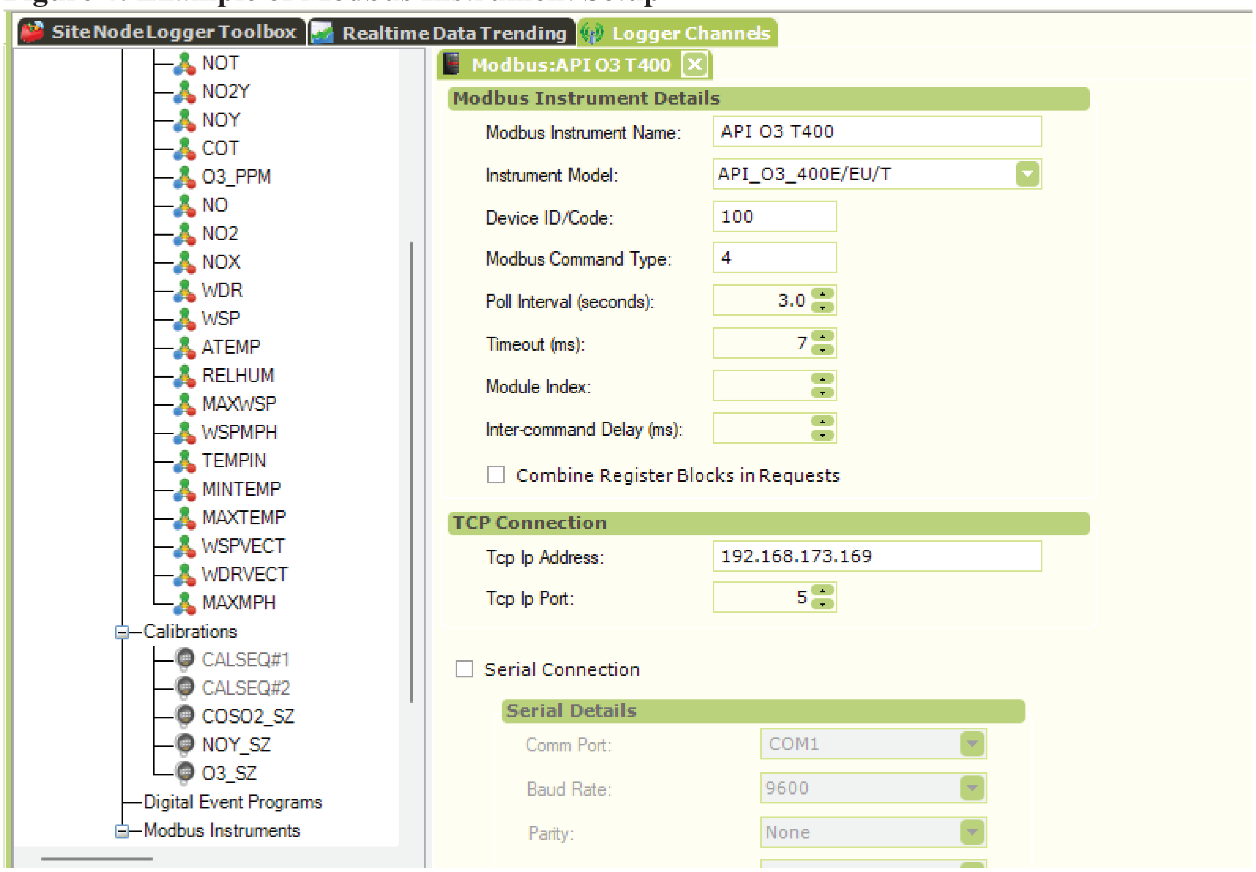
VV.2.1.4 Adding Modbus Instruments

When possible, AQMD uses the Modbus method for data collection. Modbus is a digital data collection method that only requires instrumentation to be connected to the site router via an ethernet cable.

1. On the Main Navigation screen, click Configuration Editors. Under Configuration Editors, click Logger Channels.
2. If a logger hasn't been set up for the site yet, highlight the site in the tree diagram and click Add Logger on the top of the screen. Be sure to name the Logger exactly the same as it is named on the WCAIRVIS server.

3. To add a Modbus instrument, highlight the logger, click add, add Logger Modbus Instrument.
4. Name the instrument under Modbus Instrument Name.
5. Find the instrument type through the dropdown menu under Instrument Model.
6. Input the IP address and TCP IP Port of the instrument. See Figure 4 for an example of a Modbus Instrument set up for an ozone analyzer.
7. Click save in the top left corner.
8. This Modbus instrument will be selected when setting up the channel for that instrument.
    a. **NOTE:** The 8872 has an analog to digital module that will convert any analog connections into a digital Modbus method. When setting up an analog channel, the 8872_AM_1 will be the “Modbus Instrument” under the Modbus tab. The driver number is 1 less than the Analog Input. For example, if WSP is connected to Analog Input 3, the Modbus driver will be channel 2.
9. Section VV.4.3 includes the Modbus Instrument Configuration Report for Reno4 to serve as a guide for how Modbus Instruments are configured by AQMD.

Figure 4: Example of Modbus Instrument Setup



VV.2.1.5 Setting up Nightly Automatic Calibration Checks (Autocals)

AQMD performs nightly autocals for every gas instrument in the network besides NOx. The autocals run every night for each instrument besides NOy which is every third night.

1. On the Main Navigation screen, click Configuration Editors. Under Configuration Editors, click Logger Channels.
2. If a logger hasn't been set up for the site yet, highlight the site in the tree diagram and click Add Logger on the top of the screen. Be sure to name the Logger exactly the same as it is named on the WCAIRVIS server.
3. To program an autocal sequence, a digital output to start and stop the autocal needs to be programmed. Double click the logger. Click the Discrete I/O tab. Under the Digital Output labels, create a line item for start sequence 1, choose the Modbus Instrument for the calibrator, and choose the associated Modbus Coil for starting sequence 1.
4. Add another line item for the calibrator standby, choose the Modbus Instrument for the calibrator, and choose the associated Modbus Coil for standby. See Figure 5 for example of Reno4 digital outputs. **NOTE**: Reno4 has autocals for multiple parameters.
5. Click save on the top left corner.
6. To add an autocal, highlight the logger, click add, add calibrations, Automatic.
7. Name the calibration, make the recovery time 1 second, make the repeat interval 1 day, and the start time as the next day at 00:46:00. The calibration should start at the 46th minute of an hour and last for less than 30 minutes so that hourly data is not lost.
8. Click Recovery Pattern and choose the T700 standby Digital Output that was created in step 4.
9. Under Affected Channels, select the channel that the autocalibration is for and any other channels that will be affected by the autocal (if the instrument shares a manifold line). This will make sure that the data is flagged when the autocal runs. For an example of the sequence page of an autocalibration setup, see Figure 6.
10. Click the Phase(s) tab. Click Add. Click Phase.
11. Name the Phase "Span" with a duration of 14 minutes and response time of 1 minute. The Status Pattern should be the digital output created in step 3 to start the autocal sequence.
12. Click add, Phase Channel. Under drop down, click the associated channel for the autocal. Input the Expected Value (the concentration that the calibrator will be generating during the span point) and input a number into the Warning Drift Limit in which the system should flag the autocal as outside of the drift limit.
13. Repeat step 13 for any other affected parameters that should have an expected value.
14. Click add, Phase.
15. Name the Phase "Zero" with a duration of 14 minutes and response time of 1 minute. Leave the "Status Pattern" as "Select Lines." The logger does not need to send a digital output to start the zero phase.
16. Repeat steps 13 and 14 for the zero phase. See Figure 7 for example of the phase page of an autocalibration setup.
17. The calibrator will need to be programmed with the autocal as well. See the calibrator manufacturer manual for how to set up autocalibrations on the calibrator.

18. Section VV.4.4 includes the Calibration Configuration Report for Reno4 to serve as a guide for how autocals are configured by AQMD.

Figure 5: Example of Digital Outputs Created for Autocalibrations

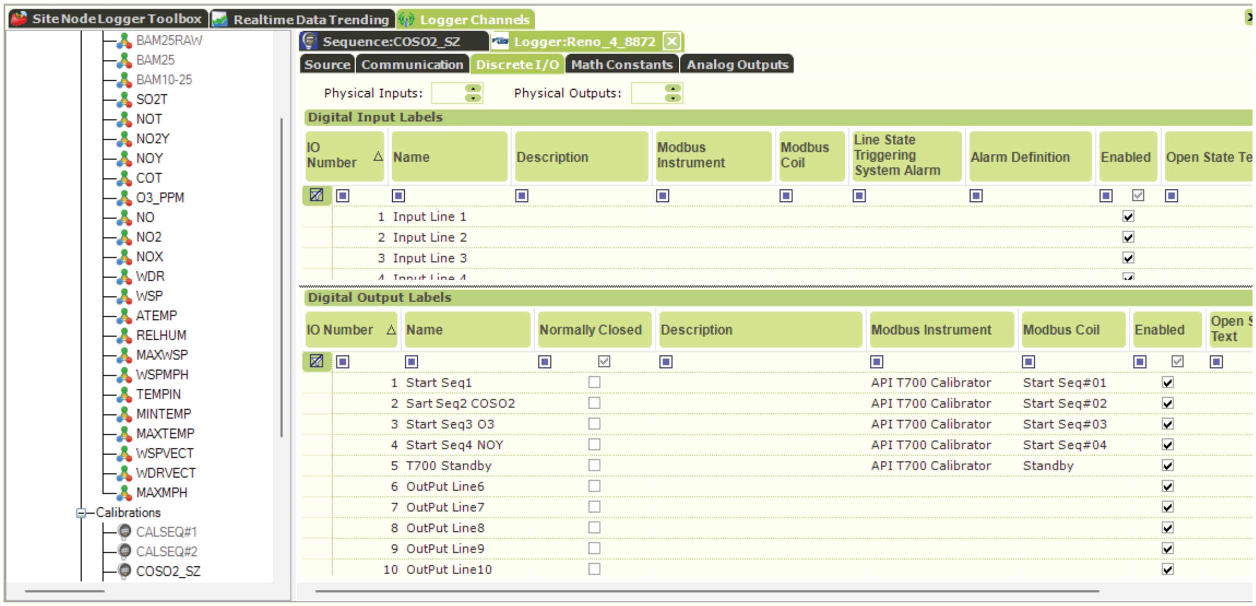


Figure 6: Example of Sequence Setup During Autocalibration Programming

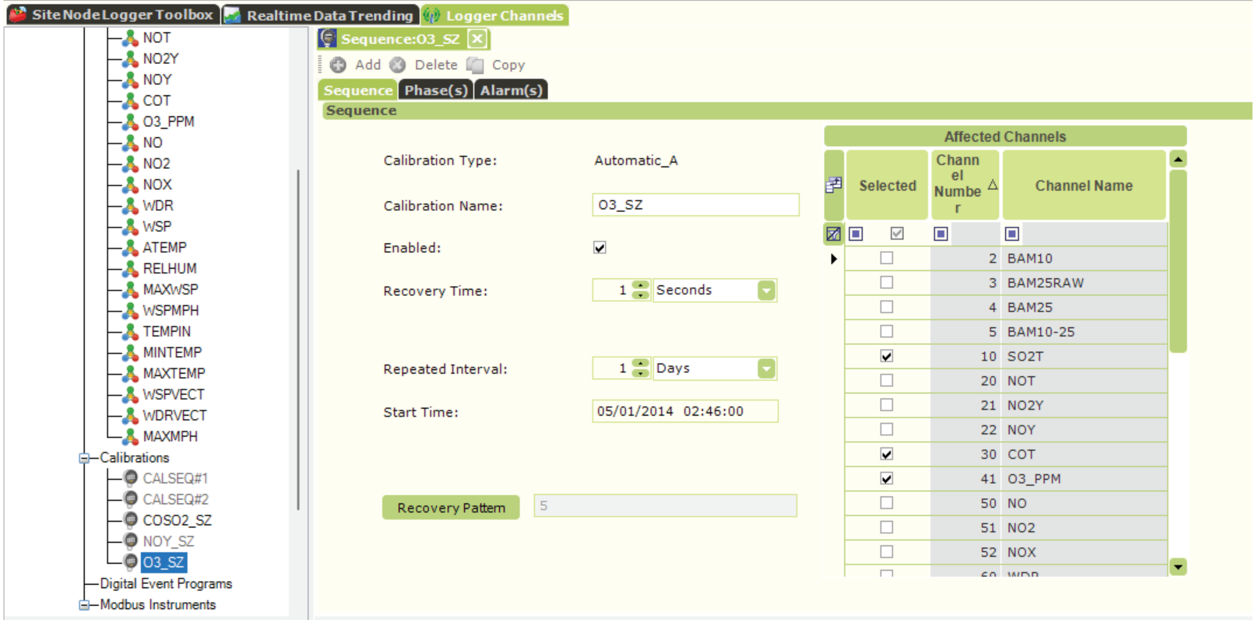
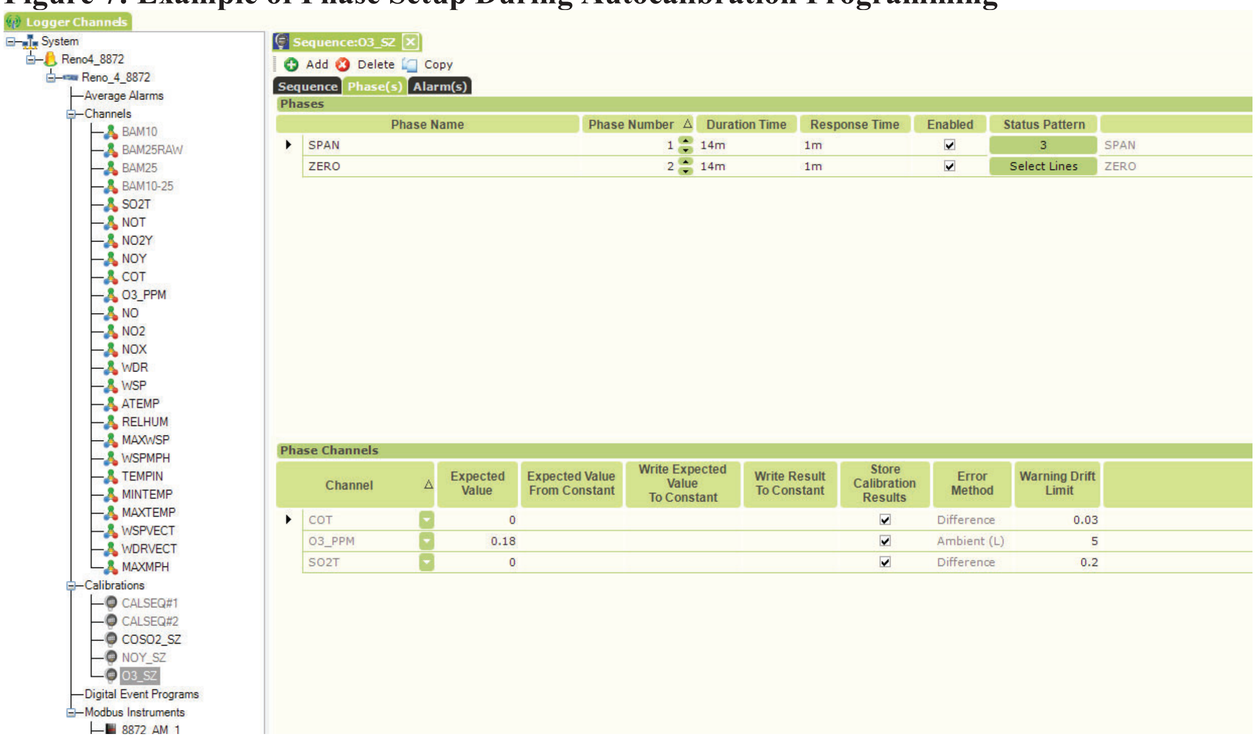


Figure 7: Example of Phase Setup During Autocalibration Programming



VV2.2 Datalogger Configuration Report Creation

It can be helpful to create reports on how an 8872 is configured, such as provided in Section VV.4. The following explains how to create these reports.

1. Open AVTrend on a computer or laptop connected to the county network.
2. Log in to the station site logger.
3. Under Main Navigation tab on the left, click on Reports.
4. Click on Configuration tab.
5. Click on desired report and click on Generate Report on the top left of the screen.
6. Click on the drop-down area under Report Output and choose file type to download report as.

VV.2.3 Remote Access to 8872

The 8872 dataloggers can be accessed remotely by a computer that is on the Washoe County network. The following explains how to remote into any of the 8872 dataloggers.

1. Open AirVision Client.
2. Click on "…"
3. Click New Profile and enter 8872's IP address into Server Name and press OK.
4. Under AirVision Profiles, highlight profile with IP address listed as the Profile Name.
5. Change Profile Name to the name of the site and click OK.
6. Scroll through dropdown and choose desired site.
7. Enter credentials and click OK.

VV.2.4 Maintenance Mode

When data for a certain channel is altered, the channel should be put in maintenance mode.

1. Open AVTrend and log in with credentials.
2. Under Main Navigation tab on the left, click on Utilities.
3. Click on Site Node Logger Toolbox.
4. To flag a parameter as in maintenance, click the False button underneath the Maintenance Flag column that corresponds to the affected parameter.

VV2.5 Real Time Data Trending

When completing QA or QC activities, it can be helpful to have rolling one-minute averages for one or more parameters displayed.

1. Open AVTrend and log in with credentials.
2. Under Main Navigation, click Status Displays, double click Realtime Data Trending.
3. Under Parameter Selection, highlight desired parameter. If more than one parameter is needed, hold the control key on the keyboard to highlight more than one parameter.

4. The Realtime Data Trending defaults to a four-hour lookback with an average interval of one minute. This can be changed to the left of the Parameter Selection box.
5. Click Auto Refresh on the top left. This will display the desired data and automatically refresh every time a new data point is available.

VV.3 Troubleshooting

Refer to the manufacturers’ operation manual for troubleshooting.

VV.4 Configuration Reports

VV.4.1 Parameter Configuration Report

Parameter Configuration Report

Reno4_8872

			AQS Codes							Graph							
Name	Description	Template	Method	Units	Parameter	Reported Digits	Prec.	Trunc. Rnd.	Units	Minimum	Maximum	Instrument Detection Limit	Totalize In Reports	Minimum In Reports	Report in AirNow	Enabled	POC
ATEMP	Ambient Temperature Deg C	ATEMP	040	017	62101	3	1	R	DEGC	-30	50		True	True	False	True	1
COT	Carbon Monoxide	CO	593	007	42101	4	3	R	PPM	0	50		False	False	False	True	1
MAXMPH	Maximum Wind Speed	MAXMPH		012		4	1	R	MPH	0	100		True	True	False	True	
MAXWSP	Maximum Wind Speed	MAXWSP		011	61101	4	1	R	M/SEC	0	100		False	False	False	True	
NO	Nitric Oxide	NO	099	008	42601	4	1	T	PPB	0	500		False	False	False	True	1
NO2	Nitrogen Dioxide	NO2	099	008	42602	4	1	T	PPB	0	500		False	False	False	True	1
NO2Y	Difference of NOY-NOT	NO2Y	699	008	42612	4	1	T	PPB	0	1000		False	False	False	True	1
NOT	Trace Nitric Oxide	NOT	699	008	42601	4	1	T	PPB	0	500		False	False	False	True	2
NOX	Oxides of Nitrogen	NOX	099	008	42603	4	1	T	PPB	0	500		False	False	False	True	1
NOY	Reactive Oxides of Nitrogen	NOY	699	008	42600	4	1	T	PPB	0	500		False	False	False	True	1
O3PPM	Ozone PPM	O3PPM	087	007	44201	4	3	T	PPM	0	200		False	False	False	True	1
RELHUM	Relative Humidity	RELHUM	061	019	62201	4	1	T	PERCENT	0	100		False	False	False	True	1
SO2T	Sulfur Dioxide	SO2T	600	008	42401	4	2	T	PPB	0	500		False	False	False	True	1
TEMPIN	Indoor Temperature DegC	TEMPIN	040	017	62107	4	1	T	DEGC	0	150		False	False	False	True	1
WDR	Scalar Wind Direction	WDR	061	014	61102	4	0	R	DEG	0	360		False	False	False	True	1
WDRVECT	Vector Wind Direction	WDRVECT	061	014	61104	4	1	T	DEG	0	360		False	False	False	True	1

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Parameter Configuration Report

Reno4_8872

			AQS Codes							Graph							
Name	Description	Template	Method	Units	Parameter	Reported Digits	Prec.	Trunc. Rnd.	Units	Minimum	Maximum	Instrument Detection Limit	Totalize In Reports	Minimum In Reports	Report in AirNow	Enabled	POC
WSP	Scalar Wind Speed	WSP	061	011	61101	4	1	T	M/SEC	0	100		False	False	False	True	1
WSP_MPH	Scalar Wind Speed	WSPMPH				4	1	T	MPH	0	100		True	True	False	True	1
WSPVECT	Vector Wind Speed	WSPVECT	061	011	61103	4	1	T	M/SEC	0	100		False	False	False	True	1

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VV.4.2 Channel Configuration Reports

Channel Configuration Report

Reno4_8872

Parameter Name	Source Name	Logger Id	#	Channel Name	Units	Type	Intervals Base	Intervals Ext 1	Intervals Ext 2	Storage Base	Storage Ext 1	Storage Ext 2	Analog Input Channel	Input Channel	Input High	Input Low	Output High	Output Low	Hold Between Updates	Secondary Input Channel	Input Interval Name	Rolling Interval Name	General Value Duration Interval	General Value Storage Interval
WSPVECT	Reno_4_8872	04	72	WSPVECT	M/SEC	Vector Wind Speed	001m	015m	001h			14D	3		1	-1	60	0	False					
WDRVECT	Reno_4_8872	04	73	WDRVECT	DEG	Vector Wind Direction	001m	015m	001h			14D	4		1	-1	360	0	False					
WSP	Reno_4_8872	04	61	WSP	M/SEC	Wind Speed	010s	005m	001h	1D	3D	14D	3		1	-1	60	0	False					
WDR	Reno_4_8872	04	60	WDR	DEG	Wind Direction	001m	005m	001h	1D	3D	14D	4		1	-1	360	0	False					
COT	Reno_4_8872	04	30	COT	PPM	Analog In (Standard)	001m	005m	001h	7D	7D	30D	2		1	0	10	0	False					
ATEMP	Reno_4_8872	04	62	ATEMP	DEGC	Analog In (Standard)	001m	005m	001h	1D	3D	14D	8		5	-5	-251.79	105.99	False					
RELHUM	Reno_4_8872	04	64	RELHUM	PERCENT	Analog In (Standard)	001m	005m	001h	1D	2D	14D	1		1	-1	100	0	False					
TEMPIN	Reno_4_8872	04	69	TEMPIN	DEGC	Analog In (Standard)	001m	005m	001h	7D	7D	30D	7		1	-1	100	0	False					
MAXWSP	Reno_4_8872	04	66	MAXWSP	M/SEC	General	001m						1	61					False				1H	4D
MINTEMP	Reno_4_8872	04	70	MINTEMP	DEGC	General	001m						1	62					False				1H	3D
MAXTEMP	Reno_4_8872	04	71	MAXTEMP	DEGC	General	001m						1	62					False				1H	4D
MAXMPH	Reno_4_8872	04	74	MAXMPH	MPH	General	001m						1	67					False				1H	4D
WSP_MPH	Reno_4_8872	04	67	WSPMPH	MPH	Math Pack	010s	005m	001h	1D	3D	14D	1						False					

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GSI/Modbus Channel Configuration

Reno4_8872

Parameter Name	Source Name	Logger Id	#	Channel Name	Units	Type	Intervals			Storage			Modbus Instrument	Driver Name	GSI Serial Port
							Base	Ext 1	Ext 2	Base	Ext 1	Ext 2			
SO2T	Reno_4_8872	04	10	SO2T	PPB	Modbus	001m	005m	001h	7D	7D	30D	API_SO2_100E/EU/T	SO2	
NOT	Reno_4_8872	04	20	NOT	PPB	Modbus	001m	005m	001h	7D	7D	30D	API_NOY_200E/EU/T	NO	
NO2Y	Reno_4_8872	04	21	NO2Y	PPB	Modbus	001m	005m	001h	7D	7D	30D	API_NOY_200E/EU/T	NO2_	
NOY	Reno_4_8872	04	22	NOY	PPB	Modbus	001m	005m	001h	7D	7D	30D	API_NOY_200E/EU/T	NOY	
O3PPM	Reno_4_8872	04	41	O3_PPM	PPM	Modbus	001m	005m	001h	7D		33D	API_O3_400E/EU/T	OZONE	
NO	Reno_4_8872	04	50	NO	PPB	Modbus	001m	005m	001h	7D	7D	30D	API_NOX_200E/EU/T	NO	
NO2	Reno_4_8872	04	51	NO2	PPB	Modbus	001m	005m	001h	7D	7D	30D	API_NOX_200E/EU/T	NO2	
NOX	Reno_4_8872	04	52	NOX	PPB	Modbus	001m	005m	001h	7D	7D	30D	API_NOX_200E/EU/T	NOX	

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Validation

Reno4_8872

Parameter Name	#	Channel Name	High-High Alarm Limit			High Alarm Limit			Low Alarm Limit			Low-Low Alarm Limit			High ROC Alarm Limit			Low ROC Alarm Limit		
			Base	Ext 1	Ext 2	Base	Ext 1	Ext 2	Base	Ext 1	Ext 2	Base	Ext 1	Ext 2	Base	Ext 1	Ext 2	Base	Ext 1	Ext 2
SO2T	10	SO2T																		
NOT	20	NOT																		
NO2Y	21	NO2Y																		
NOY	22	NOY																		
COT	30	COT																		
O3PPM	41	O3_PPM																		
NO	50	NO																		
NO2	51	NO2																		
NOX	52	NOX																		
WDR	60	WDR																		
WSP	61	WSP																		
ATEMP	62	ATEMP																		
RELHUM	64	RELHUM																		
MAXWSP	66	MAXWSP																		
WSP_MPH	67	WSPMPH																		
TEMPIN	69	TEMPIN						30			20									
MINTEMP	70	MINTEMP																		
MAXTEMP	71	MAXTEMP																		
WSPVECT	72	WSPVECT																		
WDRVECT	73	WDRVECT																		
MAXMPH	74	MAXMPH																		

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Validation, Part 2

Reno4_8872

Parameter Name	#	Channel Name	Floor Limit Base	Floor Limit Ext 1	Floor Limit Ext 2	Floor Value Base	Floor Value Ext 1	Floor Value Ext 2	Percent Valid Base	Percent Valid Ext 1	Percent Valid Ext 2	Ceiling Limit Base	Ceiling Limit Ext 1	Ceiling Limit Ext 2	Ceiling Value Base	Ceiling Value Ext 1	Ceiling Value Ext 2	Overwrite Math Constant Base	Overwrite Math Constant Ext 1	Overwrite Math Constant Ext 2
SO2T	10	SO2T							100	75	75									
NOT	20	NOT							100	75	75									
NO2Y	21	NO2Y							100	75	75									
NOY	22	NOY							100	75	75									
COT	30	COT							100	75	75									
O3PPM	41	O3_PPM							100	75	75									
NO	50	NO																		
NO2	51	NO2																		
NOX	52	NOX																		
WDR	60	WDR																		
WSP	61	WSP																		
ATEMP	62	ATEMP																		
RELHUM	64	RELHUM																		
MAXWSP	66	MAXWSP																		
WSP_MPH	67	WSPMPH																		
TEMPIN	69	TEMPIN																		
MINTEMP	70	MINTEMP																		
MAXTEMP	71	MAXTEMP																		
WSPVECT	72	WSPVECT																		
WDRVECT	73	WDRVECT																		
MAXMPH	74	MAXMPH																		

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VV.4.3 Modbus Instrument Configuration Report

Modbus Instrument Configuration Report

Reno4_8872

Source Name	Modbus Instrument Name	Poll Interval	Modbus Code	Modbus Command Type	Inter Command Delay	Timeout (ms)	TCP Settings Port	TCP Settings IP Address	Serial Port Settings Serial Port	Baud Rate	Stop Bits	Data Bits	RTU Enabled
Reno_4_8872	8872_AM_1	30	100	3		700	502	10.0.0.101					
Reno_4_8872	API CO T300U	30	100	4		700	502	192.168.173.166					
Reno_4_8872	API SO2 T100U	30	100	4		700	502	192.168.173.168					
Reno_4_8872	API NOX T200U	30	100	4		500	502	192.168.173.173					
Reno_4_8872	API NOy T200	30	100	4		700	502	192.168.173.172					
Reno_4_8872	API O3 T400	30	100	4		700	502	192.168.173.169					
Reno_4_8872	API T700 Calibrator	30	70	4		700	502	192.168.173.175					

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VV.4.4 Calibration Configuration Report

Calibration Configuration Report

Reno4_8872

Calibration Name	Start Time	Repeat Interval	Recovery Time	Phase Name	Phase Number	Duration	Response Time	Status Pattern	Affected Channel
CALSEQ#1	12/03/11 02:01	001d	1S	SPAN1	1	15m	1m	2	COT
	12/03/11 02:01	001d	1S	SPAN1	1	15m	1m	2	SO2T
	12/03/11 02:01	001d	1S	ZERO1	2	890s	1m	2	COT
	12/03/11 02:01	001d	1S	ZERO1	2	890s	1m	2	SO2T
CALSEQ#2	12/04/11 04:01	001d	1S	SPAN2	1	1h	1m		NO2Y
	12/04/11 04:01	001d	1S	SPAN2	1	1h	1m		NOY
	12/04/11 04:01	001d	1S	SPAN2	1	1h	1m		NOT
	12/04/11 04:01	001d	1S	ZERO2	2	890s	1m		NO2Y
	12/04/11 04:01	001d	1S	ZERO2	2	890s	1m		NOY
	12/04/11 04:01	001d	1S	ZERO2	2	890s	1m		NOT
COSO2_SZ	01/13/22 00:46	1D	1S	SPAN	1	14m	1m	2	O3_PPM
	01/13/22 00:46	1D	1S	SPAN	1	14m	1m	2	COT
	01/13/22 00:46	1D	1S	SPAN	1	14m	1m	2	SO2T
	01/13/22 00:46	1D	1S	ZERO	2	14m	1m		O3_PPM
	01/13/22 00:46	1D	1S	ZERO	2	14m	1m		COT
	01/13/22 00:46	1D	1S	ZERO	2	14m	1m		SO2T
NOY_SZ	05/01/14 23:00	3D	1S	SPAN	1	44m	1m	4	NO2Y
	05/01/14 23:00	3D	1S	SPAN	1	44m	1m	4	NO2
	05/01/14 23:00	3D	1S	SPAN	1	44m	1m	4	NO
	05/01/14 23:00	3D	1S	SPAN	1	44m	1m	4	NOY
	05/01/14 23:00	3D	1S	SPAN	1	44m	1m	4	NOX
	05/01/14 23:00	3D	1S	SPAN	1	44m	1m	4	NOT
	05/01/14 23:00	3D	1S	ZERO	2	16m	1m		NO2Y
	05/01/14 23:00	3D	1S	ZERO	2	16m	1m		NO
	05/01/14 23:00	3D	1S	ZERO	2	16m	1m		NOY
	05/01/14 23:00	3D	1S	ZERO	2	16m	1m		NOX
	05/01/14 23:00	3D	1S	ZERO	2	16m	1m		NO2
	05/01/14 23:00	3D	1S	ZERO	2	16m	1m		NOT
O3_SZ	05/01/14 02:46	001D	1S	SPAN	1	14m	1m	3	COT
	05/01/14 02:46	001D	1S	SPAN	1	14m	1m	3	SO2T
	05/01/14 02:46	001D	1S	SPAN	1	14m	1m	3	O3_PPM
	05/01/14 02:46	001D	1S	ZERO	2	14m	1m		O3_PPM
	05/01/14 02:46	001D	1S	ZERO	2	14m	1m		COT
O3_SZ	05/01/14 02:46	001D	1S	ZERO	2	14m	1m		SO2T

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Note: CALSEQ#1 and CALSEQ#2 are no longer used.

Appendix X: Quality Assurance (QA) Manager Site Inspection

Standard Operating Procedures

For

Northern Nevada Public Health
Air Quality Management Division

Ambient Air Quality Monitoring Program

The attached Standard Operating Procedure for the Northern Nevada Public Health Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Northern Nevada Public Health Air Quality Management Division to follow the elements described within.

Approved:

Name: Brendan Schnieder

Title of Author: Senior Air Quality Specialist (QA Manager)

Signature: Brendan Schnieder Digitally signed by Brendan Schnieder Date: 2024.12.03 09:13:39 -08'00' Date:

Name: Matthew McCarthy

Title: Senior Air Quality Specialist

Signature: Matthew McCarthy Digitally signed by Matthew McCarthy Date: 2024.12.03 09:25:38 -08'00' Date:

Name: Craig Petersen

Title: Monitoring and Planning Supervisor

Signature: Craig Petersen Digitally signed by Craig Petersen Date: 2024.12.03 09:36:40 -08'00' 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	Northern Nevada Public Health, Air Quality Management Division
AQS	Air Quality System
BAM	Beta Attenuation Monitor
DAS	Data Acquisition System
Met	Meteorological
NCore	National Core Multi-Pollutant Monitoring Station
PM	Particulate Matter
QA	Quality Assurance
QC	Quality Control
SLAMS	State and Local Air Monitoring Station
SOP	Standard Operating Procedure

List of Figures

X.1 Purpose

The purpose of this Standard Operating Procedure (SOP) is to establish uniform procedures for the Quality Assurance (QA) inspections of the monitoring stations operated by the Northern Nevada Public Health, Air Quality Management Division (AQMD) Ambient Air Monitoring Program.

X.2 Summary of Method

The AQMD operates seven ambient air pollution monitoring stations in the Ambient Air Monitoring Program. QA independence is accomplished by the Senior Air Quality Specialist in the Planning Program serving as the QA Manager. The QA Manager will conduct site inspections quarterly, making sure all monitoring stations are inspected a minimum of once per calendar year.

X.3 Procedures

X.3.1 Site Check

Perform a site check 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. For analyzers with the Legacy operating system, press the <TST> button on the front of the analyzer to ensure all diagnostics are within range. If the analyzer uses the NumaView operating system, press Dashboard to view diagnostics. 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 Logbook.

Figure 1 Station Log Report

Air Quality Management Division
Station Log Report

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_Master_Template.xlsx
Last Revision: 11/07/2024

X.3.2 QA Manager Site Inspection

Using the QA Manager Site Inspection Worksheet (Figure 2) as a guide, the QA Manager will complete a series of inspections on each ambient air monitoring station. The QA Manager Site Inspection Worksheet is located on the WCADMIN network on the AQMonitoring drive in the QA Manager folder. Open the QA Manager Site Inspections folder to locate the "Master Copy" of the Excel Site Inspection Worksheet. Complete the Date, Time, Inspector, and Site fields on the worksheet. Save each site inspection worksheet with a date and site name in the respective folder for each monitoring station. Follow the steps below for details on each "Inspection Item" on the worksheet. Place a "X" in the appropriate Yes / No / N/A column. Add any comments or corrective actions required.

1. *Exterior ladder, deck, and railings secure.* Inspect the roof access ladder. The ladder rungs and mounting hardware should be free from corrosion and tightly secured to the exterior wall and rooftop deck of the monitoring shelter. Likewise, the safety railings and mounting hardware should be free from corrosion and tightly secured to the shelter. The rooftop deck should be in good condition with all composite boards secured to the deck support joists.

2. *Exterior paint, trim and siding OK.* The exterior of the monitoring shelter should be completely covered in paint with no chipping, peeling, or graffiti. The trim and siding should contain no warping, cracking, or rot.

3. *Exterior cabling secure.* All monitoring/communication cabling should be securely fastened to the shelter using appropriate staples, clips, or cable ties. The cabling should not present a tripping hazard and should not have considerable movement in the wind.

4. *Gate/fencing OK.* Site security gate should be locked upon arrival to the site and should open and close properly. Fence material and fence posts should be solid and intact.

5. *Data logger clean and operating properly.* Data logger, keyboard, mouse, and monitor surfaces should be clean, dust-free, and in otherwise good working order. Data logger should be collecting data and the display/monitor should be displaying current readings without any warnings or error codes.

6. *Data logger reading correct time.* Time should be +/- 1 minute and date should be correct. On Agilaire 8872 data loggers, time and date can be viewed on lower right corner of the monitor.

7. *Instrument(s) clean and operating properly.* All gas analyzers, beta attenuation monitors (BAMs), particulate matter (PM) samplers, and meteorological (met) instrumentation should be clean, dust-free, and in otherwise good working order. No warnings or error codes should be present.

8. *Instrument(s) reading correct time.* All gas analyzers, BAMs, and PM samplers should be displaying the correct time and date. Time should be +/- 1 min for all instrumentation.

9. *Instrument(s) maintenance/calibration stickers current/intact.* Multipoint stickers on gas analyzers, Zero Test stickers on the BAMs, Scrub Maint stickers on the zero air generators, and MFC Cal stickers on the calibrators should be current within the last 12 months. Photo Cal stickers on the calibrators should be current within the last 6 months.

10. *Manifold sample lines clean.* The Teflon tubing and compression fittings that make up the sample manifold, instrument probes, and calibration lines should be clean and dirt-free.

11. *Manifold fittings secure.* The Teflon/stainless steel/brass fittings that connect the sample manifold, instrument probes, and calibration lines to the analyzers, calibrators, zero air generators, and calibration gas cylinders should be tight and secure.

12. *Sample inlet insect screen clean.* The insect screen attached to the sample manifold inlet under the inlet cone should be intact and clean.

13. *Manifold replaced within last 12 months.* The Teflon sample manifold tubing should be replaced every 12 months. This does not include the calibration line, which is only exposed to clean, particulate-free air and calibration gases.

14. *Gas analyzer(s) exhausted outside of shelter.* All gas analyzers should have the exhaust ports plumbed to the outside of the shelter to limit exposure to staff/guests inside shelter.

15. *Calibrator exhausted outside of shelter.* All calibrators should have the exhaust ports plumbed to the outside of the shelter to limit exposure to staff/guests inside shelter during calibration activity.

16. *Instrument logbook(s) legible with consistent corrections.* All instrument logbook entries should be legible, and all corrections should be made with a single strike-through line and dated/initialed by the operator making the correction.

17. *QA/QC folders complete.* The QA/QC folders should be complete with all QA/QC worksheets and records. It should include all weekly/bi-weekly calibration and/or flow checks, calibrations, multipoint checks, quarterly audits, and miscellaneous data exception forms.

18. *Station logs complete.* The station logs should be complete. It should include all tasks done while at the station.

19. *Logbook(s) labels intact/legible.* All current and historical Station logbooks should have a label indicating Site name, AQS number, and date range. All current and historical QA/QC logbooks should have a label indicating Site name, Parameter, and date range. All current and historical Instrument logbooks should have a label indicating Instrument manufacturer, model, serial number, and date range.

20. *Logbook inventory check.* All gas analyzers, BAMs, PM samplers, and calibrators have one Instrument logbook per instrument. The Instrument logbook is stored with the instrument, even if it moves locations.

21. *All scheduled tasks completed (weekly, bi-weekly, monthly etc.).* All scheduled QA/QC tasks should have been completed within the respective timelines. See Routine Monitoring Responsibilities (Figure 3) for a complete list of all QA/QC tasks.

22. *Calibration gas cylinders(s) secure.* All gas calibration cylinders should be secured to the monitoring shelter wall or bench.

23. *Interior bench and floor clean.* The monitoring site benches should be free from dust and clutter and all onsite supplies should be organized. The shelter floor should be free from dirt and gravel.

24. *Interior lighting OK.* All interior lighting should be in working condition and free from dead bulbs and flickering lights.

25. *Fire extinguisher charged and certified.* Each station should contain a charged fire extinguisher that has been tagged and certified within the last 12 months.

X.3.3 QA Manager Site Inspection Corrective Action

Upon completion of the QA Manager site inspection and site inspection worksheet, if there are any inspection items marked as “No”, a brief comment should be included in the “Comments/Corrective Action Required” column. Additional comments may be included at the bottom of the worksheet. For any corrective actions required, a Corrective Action Request form (Figure 4) should be filled out and submitted to the site operator. Once the corrective action has been adequately resolved, the Corrective Action Request Form will be reviewed and signed by the QA Manager, Supervisor (Monitoring and Planning), and Division Director. Once reviewed and signed by all parties, the Corrective Action Request form will be scanned, and a digital copy of the form will be stored with the QA Manager Site Inspection Worksheets in the respective site folder.

Figure 2 QA Manager Site Inspection Worksheet

Air Quality Management Division

QA Manager Site Inspection Worksheet

Date: ________________ Inspector: ________________ Site: ________________

Time (PST): ________________

Inspection Item	Yes	No	N/A	Comments/Corrective Action Required
Exterior ladder, deck, and railings secure				
Exterior paint, trim, and siding OK				
Exterior cabling secure				
Gate/fencing OK				
Data logger clean and operating properly				
Data logger reading correct time				
Instrument(s) clean and operating properly				
Instrument(s) reading correct time				
Instrument(s) maint/cal stickers current/intact				
Manifold sample lines clean				
Manifold fittings secure				
Sample inlet insect screen clean				
Manifold replaced within last 12 months				
Gas analyzer(s) exhausted outside of shelter				
Calibrator exhausted outside of shelter				
Instrument logbook(s) legible with consistent corrections				
QA/QC logbook(s) complete				
Station logbook complete				
Logbook(s) labels intact/legible				
Logbook inventory check				
All scheduled tasks completed (weekly, bi-weekly, monthly, etc.)				
Calibration gas cylinder(s) secure				
Interior bench and floor clean				
Interior lighting OK				
Fire extinguisher charged and certified				

Additional Comments: ____

File Name: QA Manager Site Inspection Worksheet_Master Copy
Last Revision: 08/23/24

Figure 3 Routine Monitoring Responsibilities

Routine Monitoring Responsibilities

More than Weekly
AirVision Data Review (Every morning)
NCore CO, O3, SO2 auto zero/span (Daily)
SLAMS O3 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)
FRM PM2.5 (1/3 days)
FRM 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 z/p/s
NCore NOx and NOy multipoint w/ GPT
Weigh pre & post FRM filters
Calculate FRM filter concentrations
QA/QC worksheet review/record creation

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

Monthly
Particulate filters (replace all)
Cal Cylinder pressure checks
FRM PM2.5 verifications
FRM PM10 verifications
Speciation SuperSASS 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
FRM PM10 inlet maintenance (lower)
FRM PM2.5 VSCC maintenance
FRM downtube maintenance
QC raw data
Inspect/condition FRM filters
Sweep shelters
Take out shelter trash (as needed)

Bi-Monthly
Replace BAM filter tape

Quarterly
BAM PM10 inlet maintenance (upper and lower)
FRM PM10 inlet maintenance (upper and lower)
Audits (all)
Speciation SuperSASS cyclone maintenance
Speciation URG down tube maintenance
Speciation URG audit filter rotation
Speciation URG pump box cleaning
Lab working mass standard verifications (Qtrly.)
QA Manager Site Inspections

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

Annually
Gas analyzer multipoint check/calibration
Primary O3 standard recertification (CARB)
Audit calibrator photometer/MFC recertification (CARB)
Calibrator MFC recertifications
Zero air generator scrubber replacement
Zero air generator solenoid valve maintenance
WSP/WDR sensor recertifications
Replace sample manifolds
Standard Traceability (flow, temp, RH)
Monitoring Network Annual Plan
Asset Management Framework
Data Certification
SOP Review
Replace NOx/NOy pump exhaust scrubbers
Replace NOx/NOy ozone dryer DFU
Replace NOx/NOy ozone cleaner chemical
Clean NOx/NOy reaction cell/optical glass
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 internal debris filter/12V battery replacement
BAM pump maintenance
Speciation SuperSASS pump maintenance
Speciation URG cyclone o-ring replacement
Speciation URG audit cassette o-ring and filter media replacement

Other
2-year Speciation URG pump rebuild
2-year Speciation URG pump inline filter replacement
2-year Speciation URG motor timing belt replacement
3-year EPA TSA
5-year Monitoring Network Assessment
5-year QAPP review/revision
5-year QMP review/revision
Cal Cylinder recertification/refilling

Last Reviewed: 11/22/24

Figure 4 Corrective Action Request

Air Quality Management Division
Corrective Action Request

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_fillable
Last Revision: 08/23/24

Attachment 1

QA Handbook for Air Pollution Measurement Systems Volume II, Appendix D

Appendix D

Measurement Quality Objectives and Validation Templates

Table of Contents
(click on link to go to individual tables)

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 30.0º 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 20-30.0º 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 20-30º 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 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 < $\pm$ 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 < $\underline{+}$ 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 $\leq$ 2 min Dynamic parameter $\geq$ 2.75 ppm-min All points <$\pm$ 2.1 % or $\leq \pm$ 1.5 ppb difference of best-fit straight line whichever is greater and Slope 1 $\pm$ .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 < $\pm$ 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	***$\leq$ 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	***$\leq$ 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***	***$\geq$ 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) $\geq$75% sampling days in quarter 4) $\geq$ 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 < $\underline{+}$ 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*** ***≤10 days from sample end date if shipped at ambient temp, or*** ***≤ 30 days if shipped below avg ambient (or 4^o C or below for avg sampling temps < 4^o 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 20.0-23.0^o C***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 8.2.1
Temp. Control	***all filters***	***< 2.1^o 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
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	< ± 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 (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	<$\pm$ 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	<$\pm$ 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	< $\pm$3.1 µg from certified value	1, 2 and 3) Method 2.12 Sec. 10.6 Standards used should meet specifications in Method 2.12, Sec. 4.3.7
Routine Filter re-weighing	1 per weighing session	<$\pm$ 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	<$\pm$ 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	< $\pm$ 2.1ºC	1, 2 and 3) Method 2.12 Sec. 10.10
Lab Humidity Check	Every 90 days	< $\pm$ 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	< $\pm$ 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	< $\pm$ 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	< $\pm$ 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***	***$\geq$ 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***	***$\mu g/m^3$ 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/m³*** ($\geq$ 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/m³*** ($\geq$ 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
Detection Limit			
Lower DL	***all filters***	***$\leq$ 2 µg/m³***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 3.1
Upper Conc. Limit	***all filters***	***$\geq$ 200 µg/m³***	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 $\geq$ 3.0 µg/m³	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/m³***	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***	***< $\pm$ 10.1% for values $\geq$ 3.0 µg/m³***	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	***< $\pm$ 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	$\pm$ 0.1º 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
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^{TM}) 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 $\leq$ 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	< + 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 ≥ 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	< + 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	< +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
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	< + 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 < + 5.1%	1,2 and 3) TEOM SOP Sec. 10.1.2
Bypass leak check (TEOM)	every 30 days	+ 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 ± 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. < ± 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***	***≥ 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 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*** (≥ 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
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

1) Criteria (PM2.5 Cont)	2) Frequency	3) Acceptable Range	Information /Action
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
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***	***< $\pm$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 $PM_{10\text{-}2.5}$ 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 $PM_{10\text{-}2.5}$ measurement or for objectives other than comparison to the PM_{10} NAAQS. Although the PM $_{10\text{-}2.5}$ 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 > 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.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***	***$\leq 3\ \mu g/m^3$***	1, 2 and 3) 40 CFR Part 50, App O Sec. 3.1
Upper Conc. Limit	***all filters***	***$\geq 200\ \mu g/m^3$***	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***	***$\geq$ 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 $\mu g/m^3$ ($\geq$ 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 $\geq$ 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 $\geq$ 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 $\geq$ 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	***<$\pm$ 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	$\pm$ 0.1° C resolution, $\pm$ 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	$\pm$ 1 mm Hg resolution, $\pm$ 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^o C***	1, 2 and 3) 40 CFR Part 50, App.J Sec. 7.4.1
Temp.Control	***all filters***	***< 3.1^o 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^{o}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 ≥ 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***	< ± 7.1% of transfer standard and< ± 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	< ± 0.51 mg of true zero and < ± 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	< ± 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%	***< ± 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	< ± 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	< ± 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	< ± 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	$\mu g/m^3$ 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 $\mu g/m^3$ ($\geq$ 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 $\mu g/m^3$	1, 2 and 3) Recommendation
Single analyzer	1/ yr	CV < 10.1% $\geq$ 15 $\mu g/m^3$	1, 2 and 3) Recommendation
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV < 10.1% $\geq$ 15 $\mu g/m^3$	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	$\pm$ 0.1º C resolution, $\pm$ 0.5º 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	$\mu g/m^3$ 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 $\mu g/m^3$ ($\geq$ 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.
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, $\pm$ 0.1° C accuracy	1, 2 and 3) Method 2.10 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 2.10 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***	***≤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***	***≤ 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 ≤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 recommendation
Humidity Range	***all filters***	***24-hr mean 30.0% - 40.0% RH or <5.1% 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 PM_{10} Lo-Vol Filter Based STP			
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 and Table 6-1
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

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	< $\pm$ 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	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 $\geq$ 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	< $\pm$ 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	< $\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
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	< $\pm$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	< $\pm$ 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	< $\pm$ 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	< $\pm$ 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	< $\pm$ 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	< $\pm$ 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	< $\pm$ 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	< $\pm$ 2.1ºC	1, 2 and 3) Method 2.12 Sec. 10.10
Lab Humidity Check	Every 90 days	< $\pm$ 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	< $\pm$ 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	< $\pm$ 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	< $\pm$ 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***	***$\geq$ 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 Sec. 1
Rounding convention for design value calculation	***Each routine concentration***	***nearest 10 $\mu g/m^3$ ($\geq$ 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.
Detection Limit			
Lower DL	***all filters***	***$\leq$ 2 $\mu g/m^3$***	1, 2 and 3) 40 CFR Part 50, App. L Sec. 3.1
Upper Conc. Limit	***all filters***	***$\geq$200 $\mu g/m^3$***	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% $\geq$ 3.0 $\mu g/m^3$	1, 2 and 3) Recommendation
Single analyzer	1/ yr	CV < 10.1% $\geq$ 3.0 $\mu g/m^3$	1, 2 and 3) Recommendation
Primary Quality Assurance Org.	Annual and 3 year estimates	90% CL of CV < 10.1% $\geq$ 3 $\mu g/m^3$	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 m³/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***	***$\mu g/m^3$ 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/m^3***	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% $\geq$0.02 $\mu g/m^3$	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% $\geq$ 0.02 $\mu g/m^3$***	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 $\leq$ 5 sites 8 audits for PQAOs with > 5 sites***	***95% CL Absolute bias < $\pm$15.1% $\geq$ 0.02 $\mu g/m^3$***	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 m^3/min $\pm$ 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	***$\pm$ 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.	$\pm$ 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 $_{10\text{-}2.5}$ 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	<± 2.1°C	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 $\geq$ 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.
Reporting Units	***all filters***	***µg/m^3 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/m^3***	1, 2 and 3) 40 CFR Part 50 App Q Sec. 2.2
Upper Conc. Limit	***all filters***	***$\geq$200 µg/m^3***	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% $\geq$ 0.02 µg/m^3	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% $\geq$ 0.02 µg/m^3***	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 $\leq$ 5 sites 8 audits for PQAOs with > 5 sites***	***95% CL Absolute bias <$\pm$15% $\geq$ 0.02 µg/m^3***	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**	***<$\pm$ 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	$\pm$ 0.1° C resolution, $\pm$ 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	$\pm$ 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

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