PM2.5 PEP Field SOP May 9, 2023 Field operator's edition Temporary Cover Page

This cover page is added here to inform you that this version is available only to the PEP community. It is posted on the AIRQA Website and the PM2.5 PEP TEAMS>>PM2.5 PEP SOP Channel. The track changes edition of this file is posted, also, on the TEAMS Channel in case you are interested in viewing changes from the previous draft we finished reviewing in December 2022. This version has not been officially approved as 508 compliant, but if and when it does, it will replace this document on AIRQA and on the PM2.5 PEP TEAMS>>PM2.5 PEP SOP Channel. If you have any further comments or suggestions, put them on the track changes version, but please send an email to your Regional PEP lead, Dennis Crumpler and Greg Noah noting the contribution. It will be considered in the next review cycle.

Field Standard Operating Procedures (SOP) for the Federal $PM_{2.5}$ Performance Evaluation Program ($PM_{2.5}$-PEP)

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Field Standard Operating Procedures (SOP) for the Federal $PM_{2.5}$ Performance Evaluation Program ($PM_{2.5}$-PEP)

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Assessment Division
Research Triangle Park, NC

Foreword

This document presents standard operating procedures (SOPs) that Field Scientists use when sampling ambient air for fine particulate matter, or $PM_{2.5}$, within the U.S. Environmental Protection Agency (EPA)'s $PM_{2.5}$-Performance Evaluation Program (PEP). Field Scientists supporting the $PM_{2.5}$-PEP must be trained and certified by EPA in the use of these procedures.

EPA makes this document available for download through its online Ambient Monitoring Technology Information Center (AMTIC) web site: https://www.epa.gov/amtic. From this web address (the AMTIC home page), take the following steps to locate and download this document:

1. Under "Quality Assurance," click on the following link: "Understand quality assurance procedures." This will take you to a web page within the AMTIC site titled "Ambient Air Monitoring Quality Assurance[1]."
2. Under "Background," navigate to the section titled "National Performance Evaluation Program."
3. Within the bullets that appear in this section, click on the following link: "$PM_{2.5}$ Performance Evaluation Program." This will take you to a web page within the AMTIC site titled "National $PM_{2.5}$ Performance Evaluation Program[2]."
4. Click on the link given by the title of this document to begin downloading.

EPA has posted this document on the AMTIC site in PDF format which can be read and printed using Adobe Acrobat Reader software. This freeware is available for download on many websites including the EPA website[3].

As EPA considers this to be a living document, EPA will prepare and post revisions to this document as program objectives and technology evolve, and as regulatory requirements change. Comments on the document's technical content and presentation may be sent via e-mail to the EPA/OAQPS $PM_{2.5}$-PEP Lead:

- Through June 30, 2023: Dennis Crumpler, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (Crumpler.Dennis@epa.gov)
- As of July 1, 2023 (interim): Greg Noah, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency (Noah.Greg@epa.gov).

EPA will post a Quality Assurance Bulletin on the AMTIC site (on the same web page from which this document can be downloaded) if any serious errors are identified and require immediate correction. EPA will make evolutionary changes through a revision cycle that usually concludes in the fall of each year

[1] https://www.epa.gov/amtic/ambient-air-monitoring-quality-assurance
[2] https://www.epa.gov/amtic/national-pm25-performance-evaluation-program.
[3] https://www.epa.gov/home/pdf-files

This document achieves all requirements specified in Section 508 of the Rehabilitation Act of 1973, as amended by the Workforce Investment Act of 1998, concerning access of its content to people with disabilities.

Any mention in this document of corporation names, trade names, or commercial products does not constitute EPA's endorsement or recommendation for use.

Acknowledgements

This compendium of field standard operating procedures (SOPs) is the product of the combined efforts of the U.S. Environmental Protection Agency (EPA)'s Office of Air Quality Planning and Standards (OAQPS); EPA's Regional Offices; State, local, and Tribal organizations; and the $PM_{2.5}$-PEP Field Scientists stationed across the country who implement these procedures. Dennis Crumpler, the OAQPS $PM_{2.5}$-PEP Lead, led and directed this current revision.

The EPA's Quality Assurance (QA) Strategy Workgroup reviewed the material included in this document. The following individuals from the Workgroup are acknowledged for their contributions:

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Approval

Title: Field Standard Operating Procedures for the Federal $PM_{2.5}$ Performance Evaluation Program.

For the U.S. Environmental Protection Agency, I hereby approve the Standard Operating Procedures (SOPs) in this document for use in the Federal $PM_{2.5}$ Performance Evaluation Program, and I commit the participants of the program to follow the sections described within.

Signature: Dennis Crumpler **Date:** 05/10/2023

Name: Dennis Crumpler, OAQPS $PM_{2.5}$-PEP Lead

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Acronyms and Abbreviations

AC	alternating current
AFC	Agency File Code
AMTIC	EPA's online Ambient Monitoring Technology Information Center (http://www.epa.gov/amtic)
AQS	EPA's Air Quality System (http://www.epa.gov/aqs)
CFR	Code of Federal Regulations
COC	chain-of-custody
CV	coefficient of variation (equal to standard deviation divided by mean)
DC	direct current
DOT	U.S. Department of Transportation
DQI	data quality indicator
EPA	U.S. Environmental Protection Agency
ETL	Electrical Testing Laboratories
FAA	Federal Aviation Administration
FB	field blank
FDS	field data sheet
FEM	Federal Equivalent Method
FRM	Federal Reference Method
FS	field scientist
GFCI	ground fault circuit interrupter
GPS	global positioning system
LA	laboratory analyst
LPM	liters per minute
MQO	measurement quality objective
NA	not applicable
NAAQS	National Ambient Air Quality Standards
NIST	National Institute of Standards and Technology
OAQPS	Office of Air Quality Planning and Standards
PC	personal computer (In this SOP, "personal computer" is a generic term that includes laptops, tablets, and other touchscreen-based portable devices)
PD	percent difference
PED	Performance Evaluation Database
PEP	Performance Evaluation Program
PM_{10}	particulate matter consisting of particles having an aerodynamic diameter less than or equal to a nominal 10 micrometers
$PM_{2.5}$	fine particulate matter, with the particles having an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
PM_{coarse}	coarse particulate matter, with the particles having an aerodynamic diameter greater than 2.5 micrometers but less than or equal to 10 micrometers (also referred to as $PM_{10-2.5}$)
POC	parameter occurrence code
PQAO	Primary Quality Assurance Organization
PTFE	polytetrafluoroethylene
QA	quality assurance

QAPP	Quality Assurance Project Plan
QC	quality control
R&P	Rupprecht & Patashnick
SLAMS	State or Local Air Monitoring Stations
SLT	State, local, and tribal
SOP	standard operating procedure
TB	trip blank
TDF	Technical Direction Form
TSA	technical systems audit
TSP	total suspended particulate
UL	Underwriters Laboratory
VSCC	very sharp cut cyclone
WINS	well impactor ninety-six

1.0 Overview

Under the auspices of the Clean Air Act, the U.S. Environmental Protection Agency (EPA) oversees the national ambient air monitoring network for fine particulate matter ($PM_{2.5}$), a collection of monitoring stations at which $PM_{2.5}$ is measured in ambient air to assess attainment with $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS). To ensure these measurements are of sufficient quality for this purpose, EPA's Office of Air Quality Planning and Standards (OAQPS) has established a quality system for the network that meets the regulatory requirements specified in the Code of Federal Regulations (CFR), specifically 40 CFR Part 58 Appendix A.

> A significant shift of technology in the $PM_{2.5}$ national monitoring network has resulted in most network sampling sites utilizing (continuous) Federal Equivalent Methods (FEMs) for routine sampling of NAAQS design value data. While this shift has little bearing on the performance of the $PM_{2.5}$-PEP, it is important to recognize that the $PM_{2.5}$-PEP assesses bias across the entire national $PM_{2.5}$ monitoring network, regardless of the sampling method used at a specific site.

The Performance Evaluation Program (PEP) for the national $PM_{2.5}$ monitoring network, known as the "$PM_{2.5}$-PEP," serves as one element of the OAQPS's quality system. OAQPS uses quality control (QC) data collected in the $PM_{2.5}$-PEP to independently evaluate measurement system bias present in the national monitoring network. The $PM_{2.5}$-PEP involves performing a type of field audit (or "sampling event") in which the quantitative data generated from ambient air samples collected within the sampling event are compared with data collected from samples collected routinely within the $PM_{2.5}$ ambient air monitoring network (i.e., from a collocated sampler). As such, the $PM_{2.5}$-PEP serves as a monitoring network on its own merit, and it must collect and analyze ambient air $PM_{2.5}$ samples using sampling and laboratory procedures that adhere to specific $PM_{2.5}$ Federal Reference Method (FRM) requirements stated in the CFR.

This **Field Standard Operating Procedure (SOP) document for the Federal $PM_{2.5}$-PEP** provides the Field Scientist (FS) who conducts field-related activities within the $PM_{2.5}$-PEP with the information necessary to perform these activities correctly and completely. This information includes:

- Planning, preparation, and communication for $PM_{2.5}$-PEP sampling events.
- Inventory, purchasing, and storage of equipment and consumables.
- Completing select sections of the Chain-of-Custody (COC) form for each filter transported on a $PM_{2.5}$-PEP sampling trip and the $PM_{2.5}$-PEP Field Data Sheet (FDS) for those filters associated with a collected sample.
- Filter receipt, storage, and handling.
- Sampler transport and placement.
- Sampler assembly/disassembly.
- Sampler verifications (leak check, barometric pressure, ambient temperature, flow rate).
- Sampling event, filter handling, and post event activities.

- Uploading data files created during sample runs by the $PM_{2.5}$-PEP samplers' data loggers to the $PM_{2.5}$-PEP Microsoft Teams channel established by OAQPS.
- Quality assurance and quality control (QA/QC) procedures.
- Information retention.
- Sampler calibrations (barometric pressure, ambient temperature, flow rate).

This document includes the following four appendices:

- **Appendix A** contains a glossary of terms adopted for use in the $PM_{2.5}$-PEP and therefore used in this SOP document.
- **Appendix B** contains a list of field- and laboratory-related QA flags used to qualify data collected during $PM_{2.5}$-PEP sampling events and generated upon laboratory analysis of exposed sample filters.
- **Appendix C** contains the various data collection forms referenced in this SOP.
- **Appendix D** contains a Field Performance Examination Checklist for Field Scientists, a list of key knowledge, roles, and skills that the FS needs to hold in the $PM_{2.5}$-PEP, including critical quality control activities on which the FS will be evaluated during independent $PM_{2.5}$-PEP audits.

A list of $PM_{2.5}$-PEP acronyms and abbreviations used in this SOP document appears immediately following the table of contents.

To accompany this SOP document, EPA has also prepared a general document that FS can use in real time to find solutions to problems that arise during $PM_{2.5}$-PEP field activities. The **$PM_{2.5}$-PEP field troubleshooting document** is posted on the AirQA.org website (Section 1.2); it is a living document that is occasionally updated to add or modify to the list of problems and some example solutions that have encountered over time within $PM_{2.5}$-PEP field activities.

Also available on the AirQA.org website is the current and recent versions of the **BGI PQ200 Operator's Manual**. Prepared by Mesa Labs, this manual serves as a reference on the sampler, thus providing the FS with detailed specifications for the sampler, if more detail is needed from this SOP document. Previous versions are also posted as they are more relevant when $PM_{2.5}$-PEP participants are using older models and motherboards in $PM_{2.5}$-PEP sampling events.

The acceptance criteria for various QA reviews and checks that occur during $PM_{2.5}$-PEP field activities, as applied to captured data, are taken from the **$PM_{2.5}$-PEP Quality Assurance Project Plan (QAPP)**. The QAPP, also posted on the AirQA.org website, provides more detail on QA procedures and requirements within the $PM_{2.5}$-PEP and cites any regulation used to determine these requirements and the acceptance criteria.

EPA encourages new ideas and suggestions for method and procedural improvements in the $PM_{2.5}$-PEP. They can be submitted to the OAQPS $PM_{2.5}$-PEP Lead either through EPA Regional $PM_{2.5}$-PEP coordinators or directly during workshops facilitated by the OAQPS $PM_{2.5}$-PEP Lead (virtual or in person). They must be reviewed and approved before EPA can implement them within the program.

Notwithstanding the above, emergencies or unique circumstances during a $PM_{2.5}$-PEP sampling event may necessitate a slight departure from the SOP. These circumstances should be

documented and discussed between the FS and Regional $PM_{2.5}$-PEP coordinator. The latter has the ultimate authorization to proceed with the departure and then approve the resultant concentration data for the sampling event in question.

1.1 SOP Document Focus

Because nearly all $PM_{2.5}$-PEP sampling events in recent years have utilized a **BGI PQ200** sampler, the procedure descriptions given in this SOP document were written relevant to use of this specific sampler manufacturer and model.

This document focuses specifically on the equipment and procedures for sampling ambient air to determine a mass concentration measurement of $PM_{2.5}$, defined as fine particulate matter having an aerodynamic diameter less than or equal to a nominal 2.5 micrometers, within the $PM_{2.5}$-PEP. To optimize the consistency of $PM_{2.5}$-PEP measurements nationwide, the $PM_{2.5}$-PEP utilizes the following portable samplers, which EPA approved as FRMs:

- A BGI PQ200 (or equivalent) portable sampler[4] (BGI by Mesa Labs, Butler, NJ) is the preferred sampler and the most routinely utilized within the $PM_{2.5}$-PEP.
  - Version B (Rev B) is the current production model of the BGI PQ200 sampler. This should not be confused with the current model version of the main program controller board, which is "Rev U". The BGI PQ200 Operators Manual for the Rev B sampler, MK101-05 Rev B, is available from Mesa Labs' website or on the AirQA website at http://www.airqa.org>>PEPs>>$PM_{2.5}$-PEP>>Documentation>>BGI-PQ200-Manual.pdf.
  - The program controller board within the BGI PQ200 sampler should be either "Rev T" or "Rev U." While the $PM_{2.5}$-PEP may still utilize a few samplers with Rev T boards, Mesa Labs considers them to be obsolete. Samplers can be converted to the current Rev U boards with the replacement of a couple of sensor boards and the old wiring harness. Consult with Mesa Labs and the BGI PQ200 Operators Manual for instructions. While the first Rev U boards were error prone, the $PM_{2.5}$-PEP fleet is equipped with operable boards at this time. Note that new boards do not have a version printed on them.
  - Older versions of the BGI PQ200 sampler experienced operational limitations on their direct current (DC) motors at higher altitudes (>6,000 feet). These samplers could not consistently generate actual flow rates that met FRM specifications. A newer version of the Maxon DC motor (model number A-max 26) can adequately run the sampler's vacuum pump at altitudes as high as 7,000 feet. If a $PM_{2.5}$-PEP sampling event is to occur at a site exceeding 7,000 feet in altitude, the FS should consult with the Regional $PM_{2.5}$-PEP coordinator to confirm an appropriate sampling strategy.
- The Andersen RAAS 200 portable sampler and the Rupprecht & Patashnick (R&P) 2000 portable sampler have previously been used at elevations higher than 7,000 feet. However, neither are currently manufactured or technically supported.

[4] See https://bgi.mesalabs.com/pq200-particulate-sampler/.

The procedure descriptions linked to $PM_{2.5}$-PEP sample collection in this document address the requirements codified in 40 CFR Part 50 Appendix L. Thus, each FS performing $PM_{2.5}$-PEP sampling events must follow all procedures described in this SOP to ensure that the collected data achieve their quality objectives. Any deviation from these SOPs must be reported in writing and submitted to their $PM_{2.5}$-PEP Regional Lead or the $PM_{2.5}$-PEP coordinator of a self-implementing organization, and to the OAQPS $PM_{2.5}$-PEP Lead.

Each reference or Class I equivalent $PM_{2.5}$ sampler (including the BGI PQ200 sampler) includes a specially designed sample air inlet, a size-fractionating impactor (or a VSCC), and a sample flow rate control system. The particle size discrimination characteristics of both the inlet and the impactor (or VSCC) are critically dependent on specific internal air velocities – a change in velocity will result in a change in the nominal particle size collected. The sampler's actual volumetric flow rate determines the aerodynamic particle size cutpoint, making it critically important to ensure the accurate collection and measurement of $PM_{2.5}$ concentrations.

The design sample air flow rate through the inlet of each $PM_{2.5}$-PEP sampler is **16.67 liters per minute (LPM),** measured as actual volumetric flow rate at the temperature and barometric pressure of the sample air entering the inlet. Temperature and pressure readings as well as verifying no sampler system leaks are critical to ensure the accuracy of the $PM_{2.5}$-PEP sampler's flow rate. Therefore, various checks, verifications, and calibrations of these key parameters are routinely performed in the $PM_{2.5}$-PEP and are described further within this SOP.

1.2 Prerequisites

1.2.1 Training and Certification

All FSs supporting the $PM_{2.5}$-PEP must be trained and certified to perform the activities described in this document. To meet this requirement, OAQPS has developed a two-fold $PM_{2.5}$-PEP training and certification program:

1. An ongoing information-sharing process that provides a baseline level of knowledge about the national $PM_{2.5}$ ambient air monitoring network, the principles and operation of the $PM_{2.5}$-PEP, its QA procedures, and any updates. This information-sharing occurs through attending conferences and training workshops, providing hands-on experience at EPA-operated facilities (e.g., EPA headquarters at Research Triangle Park, North Carolina, and its Regional offices), attending national- and regional-level conference calls and webinars, and providing access to program consultants and documents.
2. Formal training sessions sponsored annually by OAQPS and as required by specific EPA Regions (by a trainer who has successfully completed the OAQPS training and is certified in $PM_{2.5}$-PEP field activities). Each FS who will conduct $PM_{2.5}$-PEP sampling events is required to attend this training and to receive certification on an annual basis. This training typically covers multiple days and includes extensive hands-on field training sessions along with a classroom component. At the end of the training, the FS must pass a written test and a performance test to be recertified.

Before performing a $PM_{2.5}$-PEP sampling event unsupervised, a new FS trainee attends two $PM_{2.5}$-PEP sampling event trips with a certified FS as part of the initial training and certification. On the first trip, the trainee observes how field activities are executed and how they map to this

SOP. On the second trip, the trainee performs these activities under the supervision of the certified FS. Section A8.1 of the $PM_{2.5}$-PEP QAPP includes the FS training requirement and content for the $PM_{2.5}$-PEP.

1.2.2 **Physical Requirements**

A FS supporting the $PM_{2.5}$-PEP must be able to safely perform the following tasks:

- Lift, carry, or otherwise transport four parts of a portable $PM_{2.5}$-PEP sampler (each part weighing no more than 40 pounds) to and from a variety of sampling platforms.
- Navigate stairs and ladders while transporting sampler equipment.
- Assemble, operate, and disassemble a portable $PM_{2.5}$-PEP sampler on platforms several feet above ground level.

The FS can use appropriate tools to facilitate these tasks such as ropes, dollies, hand trucks, small cranes, step ladders, and portable platforms.

1.2.3 **Required Reading**

Prior to implementing field activities, a FS in the $PM_{2.5}$-PEP is expected to be knowledgeable on the contents of the documents listed in Table 1-1 at the levels specified in this table. For those documents assigned a knowledge level score of 1, EPA considers them as required reading; other documents are suggested reading. EPA maintains these documents on its Ambient Monitoring Technology Information Center (AMTIC) website[5]. Select $PM_{2.5}$-PEP documents are also available at the AirQA website,[6] a resource of useful information and for information sharing which OAQPS provides to $PM_{2.5}$-PEP participants through its QA support contractor for the $PM_{2.5}$-PEP.

Table 1-1. Required and suggested reading for Field Scientists and Management participating in the $PM_{2.5}$-PEP

Document and Weblink	Knowledge Level†	
	Field Scientist	Management/ $PM_{2.5}$-PEP Leads
Field Standard Operating Procedures for the Federal $PM_{2.5}$ Performance Evaluation Program (this document) https://www3.epa.gov/ttn/amtic/pmpep.html	1‡	1
Quality Assurance Project Plan for the Federal $PM_{2.5}$ Performance Evaluation Program https://www.epa.gov/sites/default/files/2020-09/documents/pepqapp.pdf https://www3.epa.gov/ttn/amtic/pmpep.html	2	1
Portable Sampler and Verification Device Operating Manuals PQ200 sampler Manual: https://2114285.fs1.hubspotusercontent-na1.net/hubfs/2114285/inmind/public/MK101-05-B-PQ200 sampler-Manual.pdf (For other instrument makes/models, manuals are generally made available on manufacturer's website)	1	3

[5] https://www.epa.gov/amtic
[6] http://www.airqa.org, equivalent to https://airqa.org. The AirQA site is accessible only to registered users.

Table 1-1. (continued)

Document and Weblink	Knowledge Level†	
	Field Scientist	Management/ $PM_{2.5}$-PEP Leads
Laboratory Standard Operating Procedures for the $PM_{2.5}$ Performance Evaluation Program https://www3.epa.gov/ttn/amtic/files/ambient/pm25/qa/peplsop.pdf	5	3
*QA Guidance Document 2.12: Monitoring $PM_{2.5}$ in Ambient Air Using Designated Reference or Class I Equivalent Methods** https://www.epa.gov/sites/default/files/2021-03/documents/p100oi8x.pdf	5	5
Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program (EPA-454/B-17-001) https://www.epa.gov/sites/default/files/2020-10/documents/final_handbook_document_1_17.pdf	4	3
40 CFR Part 50, Appendix L (*Reference Method for the Determination of Fine Particulate Matter as $PM_{2.5}$ in the Atmosphere*) https://www.ecfr.gov/cgi-bin/text-idx?SID=738276cf4dbe6ff77d0166c79e91c4c1&mc=true&node=pt40.2.50&rgn=div5#ap40.2.50_119.l	1	1
40 CFR Part 58, Appendix A (*Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards*) https://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=da9101692428b9ac5f71df62ccd6e470&mc=true&n=pt40.6.58&r=PART&ty=HTML#ap40.6.58.0000_0nbspnbspnbsp.a	3	3
Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4) https://www.epa.gov/quality/agency-wide-quality-system-documents	4	3
Data Quality Objectives (DQOs) for $PM_{2.5}$ https://www.epa.gov/system/files/documents/2021-07/cont_pm2.5-for-aqi_-epa-454-b-02-002-002.pdf	4	3

* Any revisions to monitoring regulations supersede specific requirements of *QA Guidance Document 2.12*.
† This is a graduated score ranging from 1 (required to read, having in-depth knowledge) to 5 (having a basic understanding).
‡ A score of 1 indicates this material is required reading.

1.2.4 AirQA.org Website

As introduced in Section 1.2.3, the AirQA website contains documents, data files, and findings for leaders and contributors to the EPA's PEPs, including the $PM_{2.5}$-PEP. Figure 1-1 displays the login page that appears when typing the AirQA's web address within a web browser (http://www.airqa.org). Users can also register from this page, as access is restricted to only registered users. Once registered, users specify their username and password to access the site.

Once logged in, users are taken to the AirQA's home page (Figure 1-2). For the $PM_{2.5}$-PEP, users click on the "PEPs" option in the navigation bar at the top of the page (circled). From the dropdown menu that appears, the user can select the following options to access $PM_{2.5}$-PEP related material:

- "PM2.5-PEP" (circled) to access PM2.5-PEP documents, datasets, and forms including COC forms for filters to be used in PM2.5-PEP sampling events, raw data files containing PM2.5-PEP field and laboratory data, and PM2.5-PEP data downloaded from AQS.
- "PEP Dashboards" to access reports on PM2.5-PEP QA performance, inventories of samplers and calibrators used in the PEPs, trends in PM2.5-PEP blank sample measurements and lists of monitoring sites by primary quality assurance organization (PQAO).
- "Training" provides access to PM2.5-PEP training materials and records.

Figure 1-1. Login page to the AirQA website

Figure 1-2. AirQA home page

Later sections of this SOP document provide more information on selected materials available on the AirQA website.

1.3 Overview of Field Scientist Activities in the PM2.5-PEP

As summarized in the checklist within Appendix D and as detailed throughout this SOP document, the required duties of the FS in the PM2.5-PEP include the following[7]:

- Maintains an inventory of the capital equipment needed to plan and execute all PM2.5-PEP sampling event activities successfully and to perform required maintenance on this equipment (Section 7.5) to ensure it is in operating condition.
- Receives and inventories all required equipment and consumables and ensures that supplies are adequate in number and quality to perform field activities.
- Requests and receives pre-weighed filters from the PM2.5-PEP weighing laboratory (stored within cassettes) and confirms the receipt of these filter cassettes with the laboratory.

[7] While organizations that self-implement the PM2.5-PEP may have activities/roles prescribed to FSs that differ from the Federal program, they must meet an equivalent adequacy and quality standard. "Independence Criteria and Adequacy" for State, local, and Tribal Implementation of the Performance Evaluation Programs (PEP): Clarification and Guidance regarding 40 CFR part 58 Appendix A, Section 2.4; available at http://www.airqa.org or https://www.epa.gov/amtic/ambient-air-monitoring-quality-assurance#documents

  - Filter cassettes are used in the order in which they are received, with special attention paid to the "use by" dates specified on the COC forms that accompany each filter (Appendix C).
- Assists in developing a plan for the implementation of field activities and gathers and maintains pertinent information for each site on a $PM_{2.5}$-PEP Site Data Sheet (Appendix C).
- Transports the appropriate $PM_{2.5}$-PEP sampling equipment to field sites.
- Assembles the portable sampler, collocates the $PM_{2.5}$-PEP sampler with the site's primary $PM_{2.5}$ sampler (operated by the State, local, and tribal [SLT] agency to gather concentration data for determining $PM_{2.5}$ NAAQS attainment), performs pre-sampling verifications and records results on FDSs according to this SOP, installs a filter cassette, and operates the instrument for 24 hours (i.e., from midnight [00:00] to midnight [00:00] local time).
- Leaves the original location (when scheduling allows) to set up additional 24-hour $PM_{2.5}$-PEP sampling event(s) at other sites and performs additional activities at the site if required (e.g., speciation audits and other field activities).
- Returns to each site after the 24-hour sampling period has concluded, removes and properly stores the filter sample cassette for transport, downloads the stored electronic monitoring data from the sampler, enters additional information as required, disassembles and packs the sampler, and processes and uploads the files of electronic monitoring data from the sampler to the Microsoft Teams channel named "$PM_{2.5}$ PEP Sampling Events download files."
  - Additional guidance for uploading electronic monitoring data can be found within the *Instructions for Uploading BGI .JOB files to the $PM_{2.5}$-PEP TEAMS Channel* available on the AirQA website (PEPs>>PM2.5-PEP>>Documentation).
- Properly packages the filter cassettes (i.e., use of ice substitutes) and COC/FDS forms, following the COC and shipping procedures for transport to the $PM_{2.5}$-PEP weighing laboratory.
- Participates in or assists with scheduled QA activities of the $PM_{2.5}$-PEP including but not limited to:
  - Semi-annual collocation studies (i.e., parking-lot studies),
  - Quarterly sampler maintenance and performance audits (pressure, temperature, flow, leak),
  - Annual Calibration certification of all BGI PQ200 samplers in the Region's fleet,
  - Completing Field Data Verification/Validation/Correction Forms (Form FDV – Appendix C) on a monthly basis when distributed by the $PM_{2.5}$-PEP weighing laboratory.

Responds to challenges to the data when the AQS upload transaction fails to accept the data in a pre-run, or AQS rejects it in a bonified upload transaction. These are identified by the OAQPS QA support contractor for the $PM_{2.5}$-PEP and communicated through the OAQPS $PM_{2.5}$-PEP Lead.

2.0 Planning and Preparing for $PM_{2.5}$-PEP Sampling Events

Forms cited in this section (in order of citation):
$PM_{2.5}$-PEP Field Inventory Form (INV-01)
$PM_{2.5}$-PEP Field Procurement Log (PRO-01)
$PM_{2.5}$-PEP Field Equipment/Consumable Receiving Report Form (REC-01)
$PM_{2.5}$-PEP Site Data Sheet (SD-01)

2.1 Equipment Inventory and Storage

2.1.1 Scope and Applicability

This section details activities, typically conducted at Regional field offices, that support preparing an inventory of existing field equipment, receiving new equipment and consumables, and maintaining the equipment used in performing $PM_{2.5}$-PEP field activities.

2.1.2 Equipment and Supplies

$PM_{2.5}$-PEP field operations utilize equipment and materials that fall within two classes:

1. Long-standing reusable "capital" equipment such as the portable $PM_{2.5}$-PEP samplers, verification devices (calibrators), laptop computers, and electronic notebooks.
2. Temporary or consumable products and supplies such as dust-free wipes, disposable powder-free examination gloves, distilled water and alcohol for cleaning sampler parts, and oil used with a well impactor ninety-six (WINS) particle separator.

The FS or Regional $PM_{2.5}$-PEP Lead should consult with the Regional contract project office to ensure that all capital equipment purchased on a contract funded by EPA reverts back to EPA once the contract expires.

2.1.3 Maintaining an Inventory and Purchasing Schedule for Equipment and Consumables

Table 2-1 lists most of the equipment and consumables needed to execute $PM_{2.5}$-PEP field activities. Vendor/catalog numbers and make/model information are provided when the program requires these specifics. Each Regional field office actively maintains its own inventory of equipment and consumables using a Field Inventory Form (INV-01) or equivalent. Appendix C contains a blank version of the Field Inventory Form.

Table 2-1. Equipment and supplies used in field activities within the $PM_{2.5}$-PEP

Qty.	$PM_{2.5}$-PEP Field Equipment and Supplies	Vendor/Catalog Number*	Make/Model Number*
	Monitoring Equipment and Supplies		
	Portable FRM $PM_{2.5}$ sampler(s) with carrying case	Mesa Labs	BGI PQ200 sampler (preferred)
	Very sharp cut cyclone (VSCC) particle separator	Mesa Labs	VSCCB
	WINS particle separator (if not using a VSCC)	Mesa Labs	Discontinued
	Pre-weighed 46.2-mm diameter filters in the proper cassette	Supplied by weighing lab	

Table 2-1. (continued)

Qty.	$PM_{2.5}$-PEP Field Equipment and Supplies	Vendor/Catalog Number*	Make/Model Number*
	COC form for each filter cassette		
	FDS for each filter cassette designated as "RO–Routine", "CO–Collocated", or (in some cases) "Other"		
	Anti-static sealable bags for shipping COCs and data storage media		
	Impactor oil and dropper (NOTE: Dow 704 has been found to solidify when sustained at 4°C for long periods.)	SPI Supplies	Octoil®-S (SPI Number 00031)
	Impactor filters (37-mm diameter glass fiber)	Mesa Labs (preferred)	
	Teflon-coated tweezers (for handling impactor filters)		
	Sample shipping containers (coolers)		
	Foam brick (ice substitutes), 36/box	Daigger	6 in. x 8 in.
	12-volt electric transport cooler with AC transformer (if used)	Globe Mart/5615-807	Coleman 16 quart
	Filter transport containers with foam inserts		
	Bubble wrap		
	$PM_{2.5}$-PEP FRM Sampler Operations Manual		
	Field notebook(s)		
	Clipboard (8 inch' x 14 inch)		
	Grip binders		
	Data storage media (e.g., diskette, CD, or USB card) for in-house use only.		
	Silicone grease for O-rings (e.g., vacuum grease)	Daigger/AX23061A	EF23061A
	FRM $PM_{2.5}$-PEP Field SOP (this document)		
	Laptop or notebook computer with PQ200 sampler job-control software; preferably not auto-connectable with the EPA network		
	Cables and adapters for connecting the data-download device to the sampler.		
	Magnetic compass or other means of determining site orientation		
	Tape measure (metric)		
	Device for measuring the angle between the lateral plane of the sampler inlet to the tops of trees with driplines inside the 10 m circle from the sampler's inlet.	Numerous models exist from Grainger and Surveyors Supply	
	Smart/cell phone		
	Global positioning system (GPS) device		
	Mechanical pencils and markers (indelible)		
	Mounting Equipment and Tools		
	Ladder and a rope for hoisting equipment		
	Hand truck/cart with wheels and straps for transporting equipment		
	Bubble level for checking the portable FRM sampler		
	Wooden shims or other means for leveling the FRM sampler		
	Toolbox with basic tools, including the following:		
	Allen wrenches (metric and standard)		
	Micro screwdriver set		
	Pliers (multiple sizes and types)		
	Screwdrivers (standard straight and Philips head)		
	Wire cutters		

Table 2-1. (continued)

Qty.	$PM_{2.5}$-PEP Field Equipment and Supplies	Vendor/Catalog Number*	Make/Model Number*
	Small synchs ties		
	Electrical tape		
	Soldering gun/solder		
	Hemostat (for flow rate troubleshooting)		
	Flashlight with spare batteries		
	Heavy-duty, grounded, weatherproof electrical extension cord with multiple outlets and (preferably) built-in ground fault circuit interrupter (GFCI) protection (one 12 ft and one 25 ft length)		
	Tie-down cables, anchors, plywood sheet, and bungee cords to anchor and stabilize the portable FRM sampler and to dampen vibration (optional)		
	Masking tape, Packaging tape, Strapping tape		
	Calibration/Verification Standards and Related Equipment		
	Downtube flow rate adapter		
	Temperature, pressure, and flow verification device with external temperature probe	BGI deltaCal BGI Tri-Cal Alicat	DC-1 TC-12 FP-25
	Temperature verification/calibration standard (NIST-traceable) with probe (optional)	VWR	61220-601
	Styrofoam cup and deionized ice water for temperature calibrations		
	Flow-check filter in transport cassette		
	Impermeable “filter” disk for internal leak checks		
	Accurately set timepiece (cell phone)		
	Spare Parts and Optional Equipment		
	Spare O-rings for the portable FRM sampler		
	Spare batteries (for all battery-powered equipment)		
	Fuses, as required by all equipment used		
	Spare in-line filters (if required by the portable FRM sampler)		
	Voltmeter/ammeter/ohmmeter for troubleshooting		
	Spare impactor(s) or one extra VSCC per trip		
	GFCI safety tester		
	Portable GFCI safety devices (for use when a site’s available power outlets do not have GFCI safety features)		
	Camera (digital) for site pictures		
	Cleaning Supplies and Equipment		
	Lint-free laboratory wipes for cleaning WINS and other sampling equipment (e.g., Kimwipes)		
	Disposable paper towels		
	Large locking plastic bag for cleanup of debris, wipes		
	Soft brush		
	Supply of deionized water for cleaning and rinsing equipment		
	Isopropyl alcohol to aid in removal of grease and dirt		
	Alcohol wipes for preloading hand wipe		
	Penetrating oil (silicone oil or 3-in-1™)		

Table 2-1. (continued)

Qty.	$PM_{2.5}$-PEP Field Equipment and Supplies	Vendor/Catalog Number*	Make/Model Number*
	Lint-free pipe cleaners		
	Safety pin/dental pick		
	Lint-free cotton-tipped swabs		
	Wooden dowel and cloth wads to clean downtube		
	Spray bottle		
	Disposable powder-free examination gloves (e.g., nitrile)		

* When no vendor/catalog number is specified, any vendor is acceptable. Unless specifically stated, other functionally equivalent equipment and supplies from different vendor makes/models are acceptable.

If the Regional field office does not maintain a completed Field Inventory Form, or its current form has not been updated for at least two years, the FS should create a new version (typically a revision of the current form) using the following procedure:

1. Access and complete the Field Inventory Form (INV-01) or an equivalent form with an inventory of all needed equipment and supplies (from Table 2-1 or the Region-specific checklist).
2. Keep an original copy of the completed form and file it under Agency file code (AFC) "$PM_{2.5}$-PEP/301-093-1006.6."
   - EPA Regions and/or self-implementing agencies may use a filing system other than AFC, such as a Technical Direction Form (TDF), as long as it is equivalent in functionality and allows for appropriate responses to interrogatories, technical system audits (TSAs), and/or other reviews.
   - All filing system language and code herein refer specifically to the AFC system.
3. Provide a copy of the completed form to the Regional $PM_{2.5}$-PEP Lead.

Prior to a monitoring site visit, the FS should contact personnel from the SLT agency that manages the site to note those supplies already present at the site that are necessary to perform the $PM_{2.5}$-PEP sampling event (e.g., a portable GFCI device).

2.1.4 National $PM_{2.5}$-PEP Sampler and Calibration Standard Fleet Inventory

OAQPS maintains a National $PM_{2.5}$-PEP Sampler Fleet Inventory (registry) of all samplers and calibrators currently in use within the $PM_{2.5}$-PEP, as well as select equipment owned at the Regional level for use on special audits or sampling events. This inventory provides FSs with an annual picture of instruments that are in service in the program. Available on the AirQA.org website, the National $PM_{2.5}$-PEP Sampler Fleet Inventory contains the following information on each $PM_{2.5}$-PEP sampler:

- Sampler type (typically "BGI")
- 4- to 7-digit serial number
- EPA Region or self-implementing agency (sampler owner)
- Description
- Location (i.e., where sampler is stored)
- Particle separator type (WINS, VSCC)
- Description of any known working problems
- EPA decal number
- Record custodian (first initial, last name)

- Whether the sampler's processing board has been replaced (yes, no, unknown)
- Date of sampler acquisition (mm/dd/yyyy)
- Date of last calibration (mm/dd/yyyy)
- Date of last use (mm/dd/yyyy)
- Indicator of whether sampler is on loan (yes, no, not applicable [NA])
- Plan for further use
- Service status (in service, out of service, unknown)
- Additional comments (as needed)

In the future, the inventory should also track each sampler's quarterly performance checks and annual (or more recent) calibrations.

At least annually (in December), each Regional $PM_{2.5}$-PEP Lead (or designee) should update the National $PM_{2.5}$-PEP Sampler Fleet Inventory with information on its local $PM_{2.5}$-PEP inventory. This includes adding or deleting samplers from the inventory and editing information for a sampler in the inventory which is still in use within the $PM_{2.5}$-PEP. The inventory is accessible as follows:

1. On the AirQA.org home page (Section 1.2.4), select "PEPs" from the navigation bar, and then "PEP Dashboards" from the dropdown menu (Figure 1-2).
2. On the PEP Dashboards page that follows (Figure 2-1), click on the "$PM_{2.5}$-PEP Sampler Inventory icon. The inventory is then displayed in spreadsheet format (Figure 2-2).

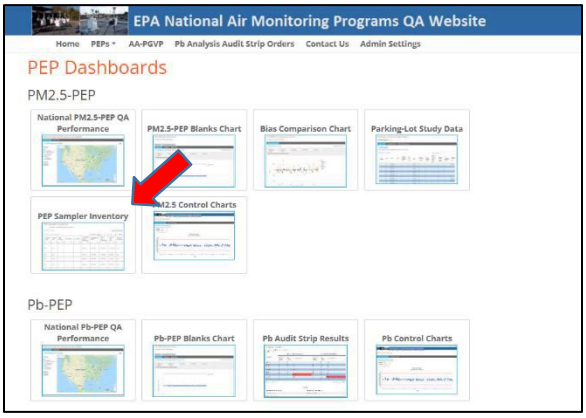


Figure 2-1. PEP dashboards on AirQA

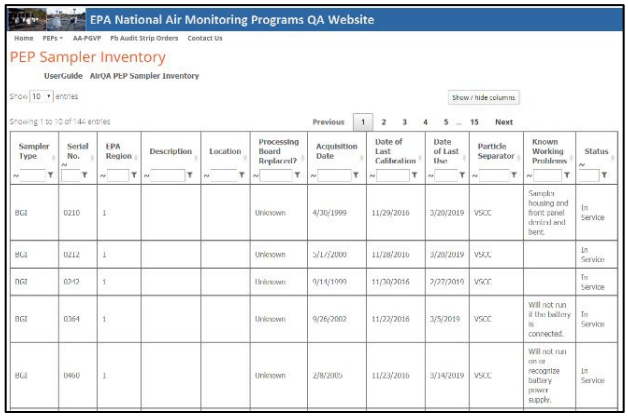


Figure 2-2. The National $PM_{2.5}$-PEP Sampler Fleet Inventory as displayed from AirQA

Each row of the National $PM_{2.5}$-PEP Sampler Fleet Inventory display (Figure 2-2) represents a specific sampler available to the $PM_{2.5}$-PEP. These rows can be sorted by one or more columns and can be filtered by specifying a value in the open field within one or more column headings. The inventory can also be exported to Excel by clicking on the "Export to Excel" button which appears at the bottom left of the webpage.

2.1.5 **Procurement**

In general, OAQPS is responsible for procuring capital equipment for use in the $PM_{2.5}$-PEP, including new portable $PM_{2.5}$-PEP samplers and calibrators. Regional Offices can also arrange to purchase replacement units if their contract ceilings and administrative options under the supporting contracts will accommodate it.

The Regional field office, working with its FSs and/or contractors, is responsible for procuring non-capital equipment and supplies/consumables for use in the $PM_{2.5}$-PEP. Contracts that supply FS personnel to these field offices may also specify that the contractor can purchase consumables, repair equipment, and replacement parts to support the $PM_{2.5}$-PEP. If so, these purchases must be included in the contract's EPA-approved budget, and language must be present in the contract's statement of work for the $PM_{2.5}$-PEP stating this purchasing responsibility.

The FS purchases consumable equipment with the same model numbers as initially procured unless the Regional $PM_{2.5}$-PEP Lead suggests a different item due to improved quality, reduced contamination, improved ease of use, lower cost, or when sales of the original items are discontinued. Any replacement must first ensure that quality requirements will be maintained. The Regional $PM_{2.5}$-PEP Lead will report any equipment changes (e.g., model numbers) that could affect the results of sampling events to the OAQPS $PM_{2.5}$-PEP Lead.

Federal procurements involving a cost exceeding **$10,000** cannot be purchased with an EPA credit card and therefore take a long time to be approved, so planning ahead is critical. Allow six (6) to eight (8) months for delivery of major acquisitions (or longer if supply chain issues are present). It may be more expeditious to check with your Regional contract's project officer on whether equipment can be purchased through the contract.

When performed by a FS or contractor, procurement for the $PM_{2.5}$-PEP involves the following activities:

1. Prepare and issue procurement requests as per EPA requirements.
2. File purchase orders with the Regional field office.
3. Notify the Regional $PM_{2.5}$-PEP Lead of procurement requests. The Field Procurement Log (PRO-01) is available, but not required, for use in maintaining record of orders placed for equipment or consumables.
4. It is recommended to file procurement logs monthly under Agency file code "$PM_{2.5}$-PEP/301-093-1006.6," or whatever is required under the Regional contract and TDF. Agencies may elect to use other filing systems at their discretion.

2.1.6 **Receipt of Consumable Equipment**

Upon receiving an order of purchased equipment and/or consumables from their supplier, representatives from the Regional field office perform the following activities:

1. Pull the appropriate purchase order for the incoming items from Regional field office files.
2. Compare the items and quantity against the purchase order and inspect the condition of each item against acceptance criteria for their use on the $PM_{2.5}$-PEP.
3. Complete an Field Equipment/Consumable Receiving Report Form (REC-01; Appendix C), or an equivalent form, to document receipt of the items.
    a. If the items match the purchase order and their condition is acceptable, signify this on the Field Equipment/Consumable Receiving Report Form (REC-01).

b. If the quantity or condition of any received items is unacceptable, note this on the Field Equipment/Consumable Receiving Report Form (REC-01) with appropriate remarks.

c. Sign and date the packing list for the order and return it to the purchaser. A scanned and e-mailed copy is acceptable for OAQPS purchases.

4. Send a copy of the completed Field Equipment/Consumable Receiving Report Form (REC-01) to the Regional $PM_{2.5}$-PEP Lead and file it under Agency file code "$PM_{2.5}$-PEP/301-093-1006.6," or whatever is required under the Regional contract and TDF. Agencies may elect to use other filing systems at their discretion.
5. Add receipt information to the Field Procurement Log (PRO-01) or an equivalent form.

2.1.7 Equipment Storage

When not in use, $PM_{2.5}$-PEP equipment should be stored in a clean, dry, and secure location. Upon completion of a field trip and return to the field office, the sampler(s) and associated verification gear should be cleaned, maintained as scheduled, and stored for the next scheduled field trip. All equipment should be clearly identified and readily available for the next trip.

Equipment that has failed and has been pulled from service should be repaired promptly or replaced if irreparable. The FSs should consult with their Regional $PM_{2.5}$-PEP Lead or project officer as to how to budget for repairs in the work assignments or task orders.

2.2 Preparation for $PM_{2.5}$-PEP Sampling Events

Preparing for $PM_{2.5}$-PEP sampling events requires attention to many details and interaction among multiple organizations. This section outlines the planning steps necessary to successfully prepare for $PM_{2.5}$-PEP sampling events.

2.2.1 Summary of Method

The sampling event planning process requires communication among multiple organizations, including the FS's organization, the $PM_{2.5}$-PEP weighing laboratory, and the site operator (i.e., the SLT agency managing the site in the network). A schedule needs to be set, operators notified, monitoring site samplers characterized (identify the primary sampler and collocated/backup samplers), travel arrangements made, and all equipment and supplies gathered, packed, inventoried, and readied for shipping.

2.2.2 Cautions

1. The FS must adhere to all laws, ordinances, and policies regarding access to monitoring sites and use of the property of others.
2. As a contractor, the FS shall not represent himself or herself as an employee of EPA or of the federal government unless in the rare instance the EPA Regional $PM_{2.5}$-PEP Lead or other trained staff employed within the EPA Region performs the $PM_{2.5}$-PEP sampling event(s).
3. The FS may not gain access to a monitoring site without the knowledge and permission of the site owner or site operator.

4. The FS must comply with all applicable laws and regulations in transporting equipment and supplies, including those of the Federal Aviation Administration (FAA) and the U.S. Department of Transportation (DOT).
5. The FS must comply with local ordinances, licensing requirements, and "union shop" agreements, where applicable. In general, the FS is expected to perform the tasks necessary to install and operate the $PM_{2.5}$-PEP sampling equipment; however, electrical rewiring or other modifications to monitoring site equipment must be conducted by qualified and properly licensed tradesmen. The FS should report any electrical or mechanical disruptions to his/her Regional $PM_{2.5}$-PEP Lead.
6. The FS must report to the Regional $PM_{2.5}$-PEP Lead any conditions at the site that pose a potential or imminent safety hazard or health threat to the FS during set-up, run-time, and sample recovery. The FS shall not proceed with a $PM_{2.5}$-PEP sampling event in this circumstance.

2.2.3 **Equipment and Supplies**

The following items are key for preparing for $PM_{2.5}$-PEP sampling events:

1. Sampling event schedule.
2. $PM_{2.5}$-PEP Site Data Sheet(s) (Form SD-01 Appendix C).
3. Lists of active and inactive $PM_{2.5}$ network monitoring sites and information on these sites, their points of contact, etc., as maintained by OAQPS and the Regional field offices.

2.2.4 **Preparation and Planning Procedure**

2.2.4.1 $PM_{2.5}$-PEP Sampling Event Schedule

For use in setting a sampling event schedule, each Regional field office must maintain a list of all $PM_{2.5}$ network sites in each PQAO within its jurisdiction that generate $PM_{2.5}$ sample concentration measurements used to determine NAAQS attainment, and thus, are subject to hosting $PM_{2.5}$-PEP sampling events. While not routinely the FS' responsibility, it could be assigned to a contractor if permitted by the operative contract language. If the FS is aware of a site shutdown or suspension of $PM_{2.5}$ sampling at a PQAO's monitoring site, it should be reported to the respective Regional $PM_{2.5}$-PEP Lead and the OAQPS QA support contractor for the $PM_{2.5}$-PEP through the OAQPS $PM_{2.5}$-PEP Lead.

To assist Regional field offices in their maintenance of $PM_{2.5}$ network site lists, OAQPS maintains a $PM_{2.5}$ network site directory from information extracted from AQS. Regional field offices can also use this directory of active and inactive monitoring sites by PQAO when developing annual $PM_{2.5}$-PEP event schedules and cross-checking valid sites and site IDs when the Regional $PM_{2.5}$-PEP Leads or OAQPS and any authorized support contractor finds unmatched data in AQS. This list is available on the PEP Dashboards page on the AirQA website (Figure 2-1) by clicking on the icon named "Monitoring Sites by PQAO" within the "Misc." portion of the page.

By December 1, for the upcoming calendar year, the Regional $PM_{2.5}$-PEP Lead and/or the FS works with the SLT organizations to select an initial list of sites for hosting $PM_{2.5}$-PEP sampling events and to prepare a sampling event schedule. This schedule should be most efficient in its use of resources while considering the following:

1. CFR requirements on the minimum number of $PM_{2.5}$-PEP sampling events to hold within each PQAO.
2. The site's schedule for collecting routine $PM_{2.5}$ network samples (which is dictated by NAAQS requirements).
   - To minimize any additional work that the $PM_{2.5}$-PEP sampling event may cause for personnel employed by the SLT agency, the $PM_{2.5}$-PEP sampling event schedule should align with the site's network sampling schedule.
   - However, if the SLT agency is amenable to hosting a $PM_{2.5}$-PEP sampling event on a day other than a routine network sampling day and is willing to run its primary network sampler and post that day's routine sample results to AQS, then the sampling event can be scheduled for that day. (Thus, accurate reporting of alternate sampling days is essential.)
3. Site proximity (the sites that are closest in proximity to each other can be visited within the same day or week).
   - Should try to minimize travel costs while maximizing the number of sites visited and the amount of collected data that will meet quality criteria for characterizing bias in the national network.
4. Number of samplers at each site.
5. Site access restrictions.

Some suggestions for preparing an efficient $PM_{2.5}$-PEP sampling event schedule include the following:

1. Prioritize those sites having $PM_{2.5}$ concentrations that are expected to be near or above the $PM_{2.5}$ NAAQS. OAQPS recommends maximizing the number of sampling events at these locations over the 6-year period in which all State or Local Air Monitoring Stations (SLAMS) must be subject to a $PM_{2.5}$-PEP sampling event.
2. For sites that operate collocated $PM_{2.5}$ samplers for characterizing network precision, the preference is to schedule $PM_{2.5}$-PEP sampling events on the 1-in-12 day schedule of the collocated/precision routine monitor. This maximizes the scientific utility of the $PM_{2.5}$-PEP data in that the data can be compared against measurements for both the primary and collocated routine network samplers at the site.
3. For sites that have seasonally low $PM_{2.5}$ concentrations, schedule sampling events for those quarters when $PM_{2.5}$ concentrations are expected to exceed 3 $\mu g/m^3$ (i.e., the lower limit on $PM_{2.5}$ concentrations which 40 CFR Part 58 Appendix A regards as valid for use in network bias assessment).
4. Early in the trip, schedule $PM_{2.5}$-PEP sampling events to occur at sites that utilize less frequent sampling cycles than others, as delays and schedule changes tend to accumulate on a trip involving several sites. The more flexible sites can be scheduled for later in the

trip, such as those that collect daily 24-hour samples and thus can host a $PM_{2.5}$-PEP sampling event on any day.

5. Assign sampling events to a single trip for sites that are in close geographic proximity to each other (when possible) so that travel times and distances between sites are minimized.
6. Build "downtime" into the schedule to account for weather, mechanical difficulties, or other unplanned delays.

Once a Region drafts its upcoming $PM_{2.5}$-PEP sampling event schedule, the Regional $PM_{2.5}$-PEP Lead (or designee, potentially delegated through a contract or work order provision) provides it to affected SLT agencies/PQAOs. The FS will make appropriate travel arrangements based on this schedule.

On a quarterly basis through the year (as OAQPS recommends), the Regional $PM_{2.5}$-PEP Lead and/or the FS should review and update the $PM_{2.5}$-PEP sampling event schedule to account for necessary changes.

2.2.4.2 Development of $PM_{2.5}$-PEP Site Data Sheets

For each $PM_{2.5}$ network site eligible to host a $PM_{2.5}$-PEP sampling event within its Region, the Regional field office maintains site information within its files. At a minimum, the following information is recorded on a $PM_{2.5}$-PEP Site Data Sheet (SD-01, given in Appendix C):

1. AQS Site ID
2. Method designation
3. Sampler make and model
4. Site coordinates
5. Network in which the site belongs
6. Reporting organization
7. Reporting organization contact
8. Street address
9. Directions to the site (when departing from the Regional field office)
10. Directions to and from a major thoroughfare
11. Safety concerns
12. Additional equipment needed (e.g., ropes, ladders)
13. Closest hospital (address)
14. Closest express mail facility for the current EPA contracted courier. An alternate courier's location is also recommended.
15. Closest hardware store
16. Recommended hotel (address/phone)
17. Important free-form notes
18. Closest site
19. Second closest site.

As $PM_{2.5}$-PEP sampling events are scheduled at specific sites, the FS pulls the $PM_{2.5}$-PEP Site Data Sheet for each site on the schedule and reviews the information on each. As planning proceeds for each sampling event and the FS coordinates with the site's managing SLT agency (Section 2.2.4.3), the FS makes updates to the Site Data Sheet as needed. The FS includes the Site Data Sheet in a site notebook (or equivalent, e.g., TDF folder) for use during the sampling event. All recorded information on the Site Data Sheet should be verified during the site visit, including the site coordinates which the FS should verify with a GPS device (record the approximate center of the monitoring site). In particular, any incomplete information on a site will need to be recorded if the site is being visited for the first time. At the end of the sampling event, the updated Site Data Sheet should be returned to the files maintained in the Regional field office.

2.2.4.3 Communicating with SLT Agencies Prior to $PM_{2.5}$-PEP Sampling Events and Site Evaluation

For each site listed on the upcoming $PM_{2.5}$-PEP trip schedule, two formal communications need to occur prior to the start of the trip with the SLT agency that manages the site.

First, the Regional $PM_{2.5}$-PEP Lead (or designee, such as the FS) contacts the managing SLT agency's site supervisor/manager/coordinator to finalize preparations for the site visit. If this contact occurs within 30 days of the site visit, contact must be made by telephone followed by an email detailing the correspondence (to create a documented record). If contact occurs prior to 30 days of the site visit, e-mail correspondence is sufficient. Items to be covered in this first contact include:

1. Confirming any site related information that remains unknown or uncertain (e.g., method designation of the site's primary routine sampler used to determine NAAQS attainment).
2. Ensuring that the FS will have proper site access clearance during the $PM_{2.5}$-PEP sampling event.
   - It is recommended that a site representative from the SLT agency be present when the FS first arrives at the site. If this is someone other than the site operator, then the FS must obtain and record the name and phone number of this representative.
   - The FS can access the site alone only if permitted through state requirements and upon receiving written/electronic permission from the managing SLT agency. In this circumstance the FS is strictly forbidden from touching any of the SLT's equipment at the monitoring site, with the only exception being a health or safety emergency.

Second, approximately one week prior to the trip, the FS calls and emails the SLT agency's site operator to confirm that the visit can still be accommodated, that routine sampling will still occur on the scheduled $PM_{2.5}$-PEP sampling event day, and to get final confirmation of meeting arrangements at the site. This contact needs to include a telephone conversation to provide better assurance that the SLT agency has in fact acknowledged the communication. Items which the FS should raise in this call include:

1. Confirming the site schedule for the entire $PM_{2.5}$-PEP sampling event and setting a location and time for the FS to meet the SLT agency site operator.
2. Confirming the site's AQS Site ID, address, and the method designation of the primary routine sampler, to confirm that this information is accurately recorded on the $PM_{2.5}$-PEP Site Data Sheet.
   - The SLT agency's site operator may not know the primary sampler's method designation. This information may need to be confirmed through the site supervisor/manager/coordinator, which can occur during the Regional $PM_{2.5}$-PEP Lead's contact during site visit preparation.
3. Gathering additional information needed for the $PM_{2.5}$-PEP Site Data Sheet.
4. Indicating the need for any assistance in setting up the portable $PM_{2.5}$-PEP sampler and completing other tasks, such as providing freezer space for ice substitutes (if necessary).
5. Briefing the site operator on what will occur during the sampling event.

6. Ensuring that all access clearances to the site have been obtained.
7. Discussing the tasks that the site operator will be requested to do to assist during the $PM_{2.5}$-PEP sampling event.
8. Answering any questions that the site operator may have.
9. Verifying that the site's primary routine $PM_{2.5}$ sampler will run on the scheduled day of the $PM_{2.5}$-PEP sampling event and that the SLT agency will post the results of the collected sample to AQS.
10. Verifying that placement of the $PM_{2.5}$-PEP sampler which will meet all of the siting criteria required by Appendices A and E of 40 CFR Part 58 (Section 5.5.2).
    - Confirm, for example, the total number of samplers which will be present and operating on the platform during the sampling event.
    - If no placement can achieve the siting criteria, have the Regional $PM_{2.5}$-PEP Lead agree to an acceptable alternative placement, or otherwise the sampling event cannot proceed at the site.
11. Verifying whether special mounting equipment may be needed for mounting the portable $PM_{2.5}$-PEP sampler; for example, if awkward positioning may be necessary to achieve siting criteria.
12. Confirm that the site's primary routine $PM_{2.5}$ network sampler is set to run on "local standard time."
    - Local standard time is NOT adjusted for daylight savings time. If the routine network sampler is set to daylight savings time, this should be reported to the Regional $PM_{2.5}$-PEP Lead and noted on the COC.
    - Local standard time requires the FS to recognize the site's time zone.
13. Verifying that sufficient electric power is available for the portable $PM_{2.5}$-PEP sampler and other equipment.
14. Determining if special concerns exist about logistics (e.g., training, equipment, safety, security of equipment).

If certain issues are identified during these two pre-trip communications which need to be addressed or resolved prior to the site visit, then the FS shall work through the necessary arrangements or corrective actions. If this cannot be completed sufficiently in time for the visit, the FS and/or SLT agency site operator should prepare and implement a plan to resolve the issue, and the visit should be postponed until the implementation is complete. The FA should inform the Regional $PM_{2.5}$-PEP Lead of the change in schedule and reasons behind it. Example issues and possible resolutions include the following:

1. The sampler set-up will require climbing or the use of other special safety equipment by the FS.
    a. Buy or rent appropriate equipment prior to the site visit.
    b. Borrow the necessary equipment from the site operator or the operator's organization.

2. Insufficient power is available at the site to operate both the portable $PM_{2.5}$-PEP sampler and the primary $PM_{2.5}$ routine sampler (as well as any other site samplers and equipment that may be in operation during the sampling event).
   a. Obtain permission to run an extension power cord from a nearby outlet.
   b. Complete the sampling event using a battery that was previously tested and verified to be adequate for maintaining power throughout the 24-hour sampling period.
   c. If a site cannot accommodate the power requirements, then cancel the site visit, request the SLT agency representative to install adequate power, contact the Regional $PM_{2.5}$-PEP Lead of this outcome, and document this finding on the $PM_{2.5}$-PEP Site Data Sheet and retain within the Regional field office's records.
3. Special restrictions on site access are in force, such as a requirement for a lengthy background check (e.g., if the site is within a high-security federal installation).
   a. Obtain necessary permissions, keycards, etc., in advance.
   b. Request that the reporting organization or the Regional field office secure the necessary permissions to access the site on behalf of the FS.
   c. Arrange for a "cleared" escort to always accompany the FS (if this is acceptable).
   d. Observe all laws, rules, regulations, and policies at all times on access to restricted sites on public or private land. For example, the FS shall not "borrow" the site operator's key or access card without the knowledge and permission of the site owner.
4. Any new safety hazards discovered since the last sampling event at the site or since the last communication with the SLT agency site operator or contact.

2.2.4.4 Making Travel Arrangements for $PM_{2.5}$-PEP Sampling Events

The FS and/or the contractor administrative staff are responsible for making travel arrangements early enough to ensure that all planned $PM_{2.5}$-PEP site visits and sampling events can occur within the prepared schedule. While this SOP does not present step-by-step procedures for making travel arrangements, the following are some suggestions to consider when making these arrangements:

1. Make travel arrangements well in advance to ensure the availability of hotel rooms and rental vehicles (if applicable) and appropriate access to the monitoring site(s).
2. When possible, arrange for a car or van to transport the sampling equipment due to its size requirements and to minimize the risk of damaging the sensitive equipment due to rough handling (e.g., by airlines or commercial carriers).
3. Leave some flexibility in the trip schedule to account for the possibility of delays due to inclement weather and other unexpected occurrences.
4. Plan adequate time at each site to perform the sampling event and to retrieve the sampler equipment after sampling is completed, remembering that $PM_{2.5}$-PEP sample runs are to occur from midnight to midnight unless the collocated network sampler uses a different 24-hour period.

5. Determine the address and hours of operation for shipping vendors' facilities that are near to the sites.
6. Determine whether any of the travel arrangements currently in place need to be adjusted when speaking with the SLT agency's site operator in the week prior to the $PM_{2.5}$-PEP sampling event (Section 2.2.4.3).

2.2.4.5 Equipment Preparation for $PM_{2.5}$-PEP Sampling Events

The FS's Regional field office shall continuously monitor its supply of pre-weighed filters to ensure it has a sufficient number for use in upcoming $PM_{2.5}$-PEP sampling events. Always select filters for use in a "first-in-first-out" order. The $PM_{2.5}$-PEP weighing laboratory has set up a routine ordering schedule so that each FS can place orders during the designated time period for a sufficient number of filters to last 30 days following receipt. If additional filters are needed at any time, the FS shall submit a request to the $PM_{2.5}$-PEP weighing laboratory at least two (2) weeks prior to when additional filters will be needed.

Prior to departing on a $PM_{2.5}$-PEP sampling event trip, and accounting for the number of sites to be visited, the FS performs the following activities when gathering and preparing the necessary equipment prior to their transport to the field:

1. Inspect all sampling equipment to ensure proper operation. This includes ensuring that sampler inlets and VSCCs are cleaned as scheduled (or WINS impactors, if used, are fully cleaned).
2. If calibration standards have not been used within the last four (4) weeks, confirm that the batteries are not depleted and that the standard is operating as expected.
3. Review the inventory of consumables to ensure availability of adequate supplies throughout the trip.
4. Reserve, inspect, and transport at least one spare portable $PM_{2.5}$-PEP sampler and a spare set of calibration equipment, to serve as backups for the trip.
5. Select and store $PM_{2.5}$-PEP sample filters appropriately (per SOPs) for transport. Verify that filters have not exceeded their 30-day (maximum) holding time and are not damaged or otherwise compromised.
6. Ensure ice substitutes (foam bricks) are completely frozen prior to transport. The reporting organization or hotel may be able to keep cold packs frozen and should be contacted ahead of time to verify and arrange this. The FS cleans and dries the cold packs between uses.
7. Review the COC form for each filter and the $PM_{2.5}$-PEP Site Data Sheets.
8. Review the trip schedule to verify understanding of which tasks must be implemented at specific sites on that trip.

Once trip preparation activities have been completed, the FS connects with the Regional $PM_{2.5}$-PEP Lead either in person or via email message to review the preparation activities and confirm the travel arrangements. If necessary (e.g., per contract stipulation), the FS provides a completed travel authorization form to the Regional $PM_{2.5}$-PEP Lead for approval.

2.2.4.6 Other Advance Planning Activities

Figure 2-3 and Table 2-2 summarize the holding time requirements for $PM_{2.5}$-PEP sample filters to which the FS and the $PM_{2.5}$-PEP weighing laboratory must adhere as stipulated in the CFR. Together, these holding times represent the life cycle of a $PM_{2.5}$-PEP sample filter. Those holding time requirements which are the responsibility of the FS are listed below.

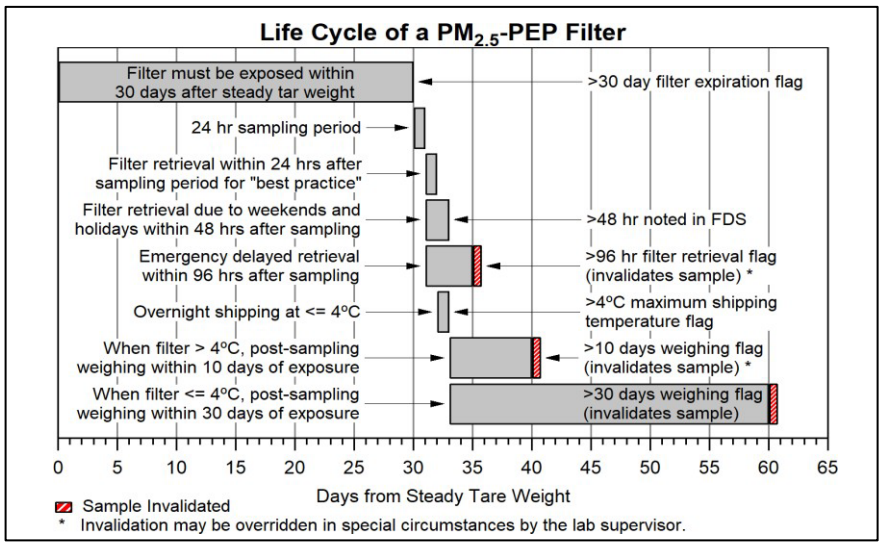


Figure 2-3. Critical $PM_{2.5}$-PEP filter holding times

Table 2-2. Permissible holding times in the $PM_{2.5}$-PEP (in field and laboratory)

Responsible Party	Activity	Permissible Holding Time	From	To
Prior to $PM_{2.5}$-PEP sample collection				
Laboratory	Equilibration/weighing of unexposed filters	Between 24 hours and 30 days	Removal from filter box	Obtaining a stable tare weight
Laboratory	Shipment of unexposed filters to field offices	As soon as possible, but within 7 days (best practice)	Obtaining a stable tare weight	Shipment to Regional offices
FS	Load unexposed filter into $PM_{2.5}$-PEP sampler	Within 30 days[a]	Obtaining a stable tare weight	Sampling start time
Following $PM_{2.5}$-PEP sample collection				
FS	Recover exposed filter from $PM_{2.5}$-PEP sampler	Within 24 hours[b]	Sampling end time	Recovery from the sampler
FS	Ship exposed filter (or blank) to $PM_{2.5}$-PEP weighing laboratory	Ship via next-day delivery on the same day that the filter is retrieved post-sampling[c]	Recovery from the sampler	Shipment to laboratory
Laboratory	Weigh exposed filters	▪ 30 days or less (if received at ≤4°C) ▪ 10 days or less (if received at >4°C and ≤25°C) ▪ Filter result invalidated (if received at >25°C)	End of sampling period	Obtaining a stable post-sampling gravimetric mass

[a] Also refer to the "use by" date on the $PM_{2.5}$-PEP COC form.

[b] Filter retrieval within 48 hours of the end of sampling is permissible to accommodate holidays, weekends, and other situations when the site is inaccessible. Filter retrieval within 96 hours may occur only in emergencies. Samples are invalidated if the retrieval time exceeds 96 hours.

[c] Per best practice. Exposed filters recovered on a Friday should be stored at ≤4°C until the next available shipping day. The laboratory must be notified of the delay so that it can post-weighing before samples expire. The FS will transport exposed filters and blanks in containers with cold packs stored at ≤ -16 to -18ºC for at least 24 hours.

$PM_{2.5}$-PEP sampling event: Initiation of 24-hour sample collection and retrieval of the exposed filter upon sample collection conclusion:

- The 24-hour sample collection period must start within 30 days of the sample filter's pre-sampling weighing, or the filter must be reconditioned and pre-weighed.
- Per best practice, an exposed filter should be retrieved within 24 hours of the end of the sample exposure period.
  - Retrievals occurring from 24 to 48 hours post-sampling are permissible to accommodate holidays, weekends, site inaccessibility (e.g., weather), or other situations that do not impact the sample's validity.
  - Retrievals occurring from 48 to 96 hours post-sampling are permissible in emergencies (e.g., sickness, accident) but the $PM_{2.5}$-PEP weighing laboratory must be notified that the delay occurred, and the FS must add an explanation for the delay in the Notes section of the FDS. Note that such a delay could contribute to an invalidation of the sample depending on results of other QC checks.
  - If a sample is not retrieved for more than 96 hours after the end of the sample exposure period, the sample result is automatically invalidated.

Sample filter shipments and initiation of laboratory post-weighing. Ideally, as detailed in Section 7.3, the FS ships exposed $PM_{2.5}$-PEP filter samples to the $PM_{2.5}$-PEP weighing laboratory via next-day delivery. Shipment should occur on the filter recovery day if this is a Monday through Thursday, otherwise as soon as possible if recovery occurs on a Friday. During the month of December, samples should be shipped on Monday through Wednesday and only in a week that does not include a holiday.

If an issue arises that prevents the FS from shipping a collected filter sample within these guidelines, the filter must be stored at temperatures no higher than 4°C until the next available shipping day. The FS must notify the $PM_{2.5}$-PEP weighing laboratory of the delayed shipment date, as the laboratory is required to weigh the sample within a specified number of days after the end of sample exposure:

- Within ten (10) days if the filter arrives at a temperature higher than 4°C.
- Within 30 days if the filter arrives at a temperature of 4°C or lower.

If the laboratory receives a collected sample filter at a temperature higher than 25°C, it is automatically invalidated. Thus, the FS must include an adequate quantity of frozen foam bricks in the shipping container to ensure that the temperature inside the shipping cartons is controlled to within acceptable ranges for at least 48 hours. The routine plastic corrugated carton with its styrofoam inserts should be sufficient for shipments of three or four (3 or 4) cassettes. More filters or historically troublesome shipping routes require using a larger shipping container with enough additional frozen foam bricks to maintain temperatures for up to 72 hours.

3.0 Chain-of-Custody and Field Data Sheet Forms

Forms cited in this section (in order of citation):
Chain-of-Custody (COC) form
Field Data Sheet (FDS) form
$PM_{2.5}$-PEP Site Data Sheet (SD-01)

3.1 Scope and Applicability

This section describes timing and the responsible party for completing each section of the COC and FDS forms for a sample filter used during a $PM_{2.5}$-PEP sampling event. One criterion for a $PM_{2.5}$-PEP filter sample result to be considered "valid" for input to network bias assessment calculations is that the filter must be physically accompanied by its completed COC and FDS forms when received by the responsible party at each stage of the process.

Appendix C contains blank COC and FDS forms for use in the $PM_{2.5}$-PEP.

3.2 Summary of Method

3.2.1 COC Form

For a given filter cassette:

- **The $PM_{2.5}$-PEP weighing laboratory** initiates the COC form.
- **The $PM_{2.5}$-PEP FS** initiates the FDS form at the monitoring site.

The COC form documents the path of a filter cassette as it is transferred:

1. From the $PM_{2.5}$-PEP weighing laboratory (upon being pre-weighed) to the Regional field office (for eventual assignment to a $PM_{2.5}$-PEP sampling event),
2. From the Regional field office to the $PM_{2.5}$-PEP sampling event site, and
3. From the $PM_{2.5}$-PEP sampling event site (upon conclusion of sampling) to the $PM_{2.5}$-PEP weighing laboratory (for final weighing, review and approval of the reported data and eventual upload of the data to AQS).

As it pre-weighs a new filter and loads it into a clean cassette, the $PM_{2.5}$-PEP weighing laboratory initiates the COC form for that filter. Once the filter cassette arrives at a Regional field office, the FS updates its accompanying COC form at three distinct points in time:

1. Upon initial receipt of the filter cassette (containing the unexposed filter),
2. Upon arrival at the $PM_{2.5}$-PEP sampling event site, and
3. After the filter sample is collected and the cassette is retrieved from the PEP sampler at the site.

The COC form physically accompanies the filter cassette at all times as the cassette moves through the three routes of transfer above and while at each location.

3.2.2 FDS Form

Upon arriving at the monitoring site for a $PM_{2.5}$-PEP sampling event, the FS initiates a FDS (Appendix C) for each PEP sample to be collected over a 24-hour sampling period. The FS does not prepare a FDS for field and trip blanks. The FDS captures information on the sampling event, the verification checks performed on the sampler, and the sampling period.

For each sampling event, the FS ships the fully completed FDS along with the filter cassettes and their COC forms to the $PM_{2.5}$-PEP weighing laboratory for post-sample weighing.

3.3 Cautions

- Resolve and document any mistakes made on the COC and FDS forms by marking a single horizontal line through the error, writing correct information in the available space, and initialing and dating the correction with indelible ink.

3.4 Equipment and Supplies

- $PM_{2.5}$-PEP COC form
- $PM_{2.5}$-PEP FDS form
- Pen with indelible ink

3.5 Procedure

3.5.1 COC Form

The $PM_{2.5}$-PEP COC form (Appendix C) contains five discrete parts listed in Table 3-1. The contents of each section are detailed in the following five subsections. The COC form also includes a general notes section which can hold any free form notes associated with any of its parts. Extra pages may also be attached to the COC form if additional space is necessary for specifying free form notes.

Table 3-1. Stages and responsibilities for completing the COC form for a given filter

COC Form Component	Responsible Party	When Completed
Part I: Weighing Laboratory*	LA	When assigning an unexposed filter (with stable tare weight) to a Regional field office.
Part II: Field Office	FS	Upon receiving a package of unexposed filters from the $PM_{2.5}$-PEP weighing laboratory.
Part III: Field Site	FS	Upon arriving at a $PM_{2.5}$-PEP sampling event but prior to starting the 24-hour sample collection period.
Part IV: Field Filter Shipping to Weighing Lab*	FS	Upon retrieval of the filter from the PEP sampler.
Part V: Weighing Laboratory	LA	Upon receiving a package of exposed filters from a $PM_{2.5}$-PEP sampling event trip.
Transcribing COC information to the $PM_{2.5}$-PED and archiving the form	LA	Upon completion of Part V.

LA = laboratory analyst ($PM_{2.5}$-PEP weighing lab); FS = field scientist (Regional field office).

* Copies of the form are made prior to transferring the filter and form to the next processing stage. Digital photos should be appended to digital files for archiving.

3.5.1.1 COC Part I: PM$_{2.5}$-PEP Weighing Laboratory

PART I – WEIGHING LABORATORY

Filter Weighing and Shipping Information from Weighing Lab or Shipping Log			
Filter ID		Filter Cassette ID	☐ TB - Trip Blank
Weighing Lab		Cassette Type	
Analyst/Custodian		Tare Weight Date	
Shipment Date		Tracking No.	
Sent to (PE Org)		Shipping Company	
Date This Filter Must be Used by:		Return to:	

Normally, the weighing laboratory completes Part I, keeps 1 copy and sends 2 copies to the field office with the unexposed filter cassette.

Completed by an analyst within the PM$_{2.5}$-PEP weighing laboratory for each filter cassette it prepares for shipment to a Regional field office (either by hand or using pre-printed labels), Part I of the COC form contains the following information on the filter and the cassette in which it is inserted:

- ***Filter ID***: The eight (8) character unique ID assigned to the filter to track it through the PM$_{2.5}$-PEP sampling and data reporting process.
- ***Filter cassette ID***: The ID number printed on the filter cassette.
- ***TB – Trip Blank***: Indicator of whether the filter is pre-designated for use as a trip blank for a future PM$_{2.5}$-PEP sampling event trip. This filter cassette is usually marked TB on the static free sealed pouch in which it is placed, and also in Part III of the COC.
- ***Cassette Type***, ***Analyst/Custodian***, ***Tare Weight Date***: Self-explanatory supporting information.
- ***Shipment Date***, ***Tracking No.***, ***Sent to (PE Org)***, ***Shipping Company***: Shipping-related information associated with shipping the cassette (with unexposed filter) from the PM$_{2.5}$-PEP weighing laboratory to the Regional field office.
  - "PE Org" refers to Performance Evaluation organization, corresponding to the organization with which the FS is employed. Self-implementing SLT agencies also get the same labels.
- ***Date This Filter Must Be Used by***: A critical entry indicating the latest date on which the filter can be used within a PM$_{2.5}$-PEP sampling event. If a sampling event is scheduled for more than 30 days after the date when the PM$_{2.5}$-PEP weighing laboratory determined a stable tare weight for the filter, then that filter is not eligible for use in the event.
  - If the filter becomes ineligible for use for this reason, the FS also checks the "Expired Filter (not used)" checkbox in Part III.
- ***Return to***: Shipping address which the FS should specify when shipping the exposed filter cassette back to the PM$_{2.5}$-PEP weighing laboratory once the PM$_{2.5}$-PEP sampling event is completed. All exposed filters must be returned to the laboratory from which they originated.

Upon completing Part I, the PM$_{2.5}$-PEP weighing laboratory retains the original (wet ink) form and a copy of this form for the laboratory's records, while a second copy is shipped with the filter cassette to the Regional field office.

3.5.1.2 COC Part II: Regional Field Office

PART II – FIELD OFFICE

Date Received:	Received by:	Location:
Package Condition: ☐ Good ☐ Reject (Why?)		

If rejected, the filter cassette should be returned to the weighing laboratory with the next outgoing shipment.

Upon receiving a package of

filter cassettes with their accompanying COC forms from the PM$_{2.5}$-PEP weighing laboratory, a FS from the Regional field office follows the procedures detailed in Section 4 and completes Part II of the COC form for each filter cassette included in the package. Part II contains the following fields:

- ***Date received***: The date the package containing the filter cassette was received by the Regional field office.
- ***Received by***: Name of staff member receiving the package containing the filter cassette.
- ***Location***: Name of the Regional field office receiving the package containing the filter cassette
  - This is typically the same as "Sent to (PE org)" in Part I.
- ***Package Condition □ Good □ Reject (Why?)***: Indicator of the integrity of either the entire package containing the filter cassette or one or more individual cassettes within the package, upon receipt by the Regional field office (either good or rejected).
  - The FS may determine that a package was received in good condition but reject the condition of one or more filter cassettes within the package. If this occurs, the FS indicates "Reject" on the COC form associated with the rejected cassette(s), and "Good" for the other cassettes in the package.
  - When "Reject" is indicated, the FS should specify a reason for the rejection within this field. When a package is rejected, this reason could be the same for all cassettes in the package.
  - The FS should return any rejected cassettes to the PM$_{2.5}$-PEP weighing laboratory (with their COC forms) within the next scheduled outgoing shipment of cassettes to the laboratory.

Upon completing Part II, the FS can assign the accepted filter cassettes to PM$_{2.5}$-PEP sampling events and transport them (with their COC forms) to their respective monitoring sites.

3.5.1.3 COC Part III: Field (Monitoring) Site

Upon arriving at a monitoring site hosting the PM$_{2.5}$-PEP sampling event and prior to starting the 24-hour sample collection period, the FS completes Part III of the COC form for each filter cassette assigned to that sampling event. The FS is responsible for entering as much information as possible in Part III prior to and during set-up of the portable PM$_{2.5}$-PEP sampler. (A Void indicator in Part III may be checked prior to, during, or after sample collection if the filter is voided for some reason.)

PART III – FIELD SITE

Sampling Event Information		
Arrival Date at Site		PEP Field Scientist:
Site Name & Description		
Primary SLT PM-2.5 Sampler	Make/Model:	Serial No.:
Primary SLT PM-10 Sampler	Make/Model:	Serial No.:
AQS Site ID		POC:
Other Operators or Observers		

Sampling Event Filter Data		
Sampling Date:	Retrieval Date:	Time:
Event Filter Integrity: ☐ OK ☐ Reject (describe)		
Sample Type		
☐ RO – Routine PEP ☐ FB - Field Blank (Associated RO Cassette ID:_____) ☐ Other (describe) ☐ CO - Collocated PEP ☐ Expired Filter (not used) ☐ TB - Trip Blank (Record last RO Cassette ID used in this audit trip: _____)		
☐ Void (why?)		
PEP Cut Point: ☐ PM-2.5 ☐ PM-10	PEP PM-2.5 Separator Type: ☐ WINS ☐ VSCC	

Some of the site-specific information in Part III (e.g., AQS Site ID, network sampler serial number) can be obtained from the $PM_{2.5}$-PEP Site Data Sheet (Section 2.2.4.2); this information would have been cross-checked with the site coordinator of the SLT agency (Section 2.2.4.3) during pre-visit preparations.

Part III of the COC form has three components and the following fields:

1. ***Sampling Event Information*:**
   - ***Arrival Date at Site***: The date (mm/dd/yyyy) when the FS arrives with the $PM_{2.5}$-PEP filter cassette at the site.
     - For a trip blank filter (Section 7.1.6.3), this field should contain the date of the trip's last sampling event, as the trip blank is returned to the $PM_{2.5}$-PEP weighing laboratory in the same package as the filter cassette for the last sampling event.
     - A field blank filter (Section 7.1.6.2) should have the same date specified for the trip blank.
   - ***PEP Field Scientist***: Name of the FS onsite leading the $PM_{2.5}$-PEP sampling event.
   - ***Site Name & Description***: Site name and any relevant site description for identification purposes.
     - For a trip blank filter (Section 7.1.6.3), this field should specify the last site visited on the trip.
   - ***Primary SLT PM-2.5 Sampler***: Make, model, and serial number of the site's primary routine $PM_{2.5}$ sampler (i.e., the network sampler managed by the SLT agency).
   - ***Primary SLT PM-10 Sampler***: Make, model, and serial number of the site's primary routine PM_{10} sampler (i.e., the network sampler managed by the SLT agency), if one exists and is used at the site.
   - ***AQS Site ID***: Nine-digit AQS Site ID (2-digit State FIPS code – 3-digit County FIPS code – 4-digit unique Site ID: e.g., 01-073-2059). Any leading zeros must be included in each of the three components of the ID.
   - ***POC***: The parameter occurrence code (POC) of the site's primary routine sampler that is collocated with the PEP sampler.
     - Because AQS does not use this field, it can remain blank.
   - ***Other Operators or Observers***: If relevant, the names and affiliations of any assisting operators or other official observers of the $PM_{2.5}$-PEP sampling event, such as EPA or Regional representatives or staff from the local air monitoring authority.
2. ***Sampling Event Filter Data***:
   - ***Sampling Date***: The start date of the 24-hour $PM_{2.5}$-PEP sampling period.
     - For trip blank filters, this is the start date of the trip's last $PM_{2.5}$-PEP sampling event.
   - ***Retrieval Date/Time***: The date and time when the FS retrieved the exposed filter cassette from the PEP sampler following the end of the 24-hour sampling period.
     - For trip blank filters, this date is the same as the Sampling Date.

- ***Event Filter Integrity □ OK □ Reject (describe)***: Indicator of the filter's integrity while in the field and immediately prior to its use, based on the FS's visual inspection (Section 7.1.5).
  - For all but trip blanks, this visual inspection occurs prior to seating the (unexposed) filter cassette within the PEP sampler.
  - If the filter passes visual inspection, then the FS checks the "OK" box.
  - If the filter has any observed defects, the FS checks the "Reject" box and describes all observed imperfections in the space provided (using the "Notes" section at the bottom of the form if additional space is needed).
  - If a filter is rejected, the filter and its COC form are returned to the trip's transport cooler to be shipped back to the $PM_{2.5}$-PEP weighing lab. The FS then selects a backup filter cassette as a replacement and completes Part III of its COC form.

3. ***Sample Type***: The FS checks only one of the six boxes indicating the filter's classification:
   - ***RO – Routine PEP***: A filter to be seated in the $PM_{2.5}$-PEP sampler during the 24-hour $PM_{2.5}$-PEP sampling event and containing the collected sample.
   - ***CO – Collocated PEP***: A filter used in one of the following two capacities:
     - Seated within a PEP sampler as part of a $PM_{2.5}$-PEP collocation study (Section 8.2.4).
     - Seated within a PEP sampler that is collocated with the $PM_{2.5}$-PEP sampling event's primary PEP sampler (whose filter is labeled "RO"). This would happen only when a two-sampler event is prescribed, such as for a PM_{10}-PEP measurement or if the FS is running a back-up sampler due to mistrust of the other.
   - ***FB – Field Blank (Associated RO cassette ID:___)***: A filter classified as a field blank (Section 7.1.6.2) and assigned to the $PM_{2.5}$-PEP sampling event, along with the ID of the cassette used for the sampling event's routine $PM_{2.5}$-PEP sample (allowing its actual $PM_{2.5}$-PEP concentration measurement to be linked to the field blank).
     - Except for "parking lot" events, field blanks are ordinarily generated at the same site and set-up as the trip blank (i.e., a trip's last sampling event).
   - ***TB – Trip Blank (Record last RO cassette ID used in this audit trip:__)*** A filter classified as a trip blank (Section 7.1.6.3), along with the ID of the cassette used for the routine $PM_{2.5}$-PEP sample collected during the last $PM_{2.5}$-PEP sampling event performed on the given trip.
     - If the FS must re-classify a trip blank as an RO filter to salvage a monitoring event, this is noted on the COC form (making an acceptable correction to the form if needed). The FS also puts an "X" through the "TB" mark on the anti-static sealable pouch and notifies the $PM_{2.5}$-PEP weighing laboratory immediately of the substitution.
   - ***Expired Filter (not used)***: Indicator of whether the date of the filter's intended use exceeds the date specified in "Date This Filter Must be Used by" (in Part I).
     - If this is checked, the FS shall not use this filter during the $PM_{2.5}$-PEP sampling event trip, instead returning it unused to the $PM_{2.5}$-PEP weighing laboratory. The FS also writes "expired" on the anti-static sealable pouch.

- ***Other (describe)***: A filter classified for use in some other category, such as a special sample for QA or QC purposes.
  - In the Notes section, the FS should provide additional information about the intended role and use of this filter.

Part III also includes the following three indicator fields:

- ***Void (why?)***: Checked when the FS invalidates the filter for some reason other than being expired (e.g., visible filter contamination, sampler malfunction, filter dropped on the ground during recovery, discrepancy in the COC documentation).
  - The FS should describe the reason in the space provided, using the Notes section if additional space is required.
  - While all other fields in Part III are completed prior to the start of sampling, this indicator could be checked at any time prior to, during, or following sampling.
- ***PEP Cut Point: □ PM-2.5 □ PM-10***: For filters to be exposed during the sampling period, indicator of the particle size to be collected (PM$_{2.5}$ or PM$_{10}$).
  - Not completed for field or trip blanks.
  - The checked box should coincide with the type of sampling event specified at the top of the COC form in the following way:

PEP Chain-of-Custody Form for BGI PQ200A
□ PM 2.5 event □ PM 10 Event

    - ***"PM 2.5 event" specified at top of COC form:*** "PM-2.5" must be specified in Part III, as only PM$_{2.5}$-PEP sampling will occur in the event.
    - ***"PM 10 Event" specified at top of COC form:*** Either "PM-2.5" or "PM-10" can be specified in Part III, as both PM$_{2.5}$ and PM$_{10}$ filter samples are to be collected from two collocated PM$_{2.5}$-PEP samplers.
      - If the given filter is to be used for collecting a PM$_{10}$ sample, the FS should 1) circle the checked "PM 10 Event" at the top of the COC form, 2) specify "PM-10" in Part III of the COC form, and 3) write "PM-10 measurement" in the Notes section at the bottom of the COC form. These three items will bring additional emphasis and less chance of misstating the particle size as the PM$_{2.5}$-PEP weighing laboratory enters sample results into the PM$_{2.5}$-PEP PED.
- ***PEP PM-2.5 Separator Type: □ WINS □ VSCC***: For filters to be exposed during the sampling period and collecting a PM$_{2.5}$ sample, indicator of the particle separator type used in the PM$_{2.5}$-PEP sampler.

3.5.1.4 COC Part IV: Field Filter Shipping to the PM$_{2.5}$-PEP Weighing Laboratory

Completed in full by the FS upon retrieval of the filter (containing the collected sample) at the end of the PM$_{2.5}$-PEP sampling event, Part IV contains fields for specifying filter shipping information:

PART IV – FIELD FILTER SHIPPING TO WEIGHING LAB

Shipment Date		Affiliation:
Shipped by		Shipping Destination:
Tracking No.		Shipping Company:

On completion of Part II-IV, the field scientist keeps one copy and sends the top (original) copy to the laboratory with the filter.

- ***Shipment Date***: The scheduled shipment date for the package of exposed filter cassettes to the $PM_{2.5}$-PEP weighing laboratory. Under best practice, the FS ships the package on the same day as sample recovery (Section 2.2.4.6).
- ***Affiliation***: The employer of the FS (e.g., contractor company name).
- ***Shipped by***: Name of the person shipping the sample to the $PM_{2.5}$-PEP weighing laboratory (typically the FS).
- ***Shipping Destination***: The shipping destination of the package containing the filter sample (i.e., the $PM_{2.5}$-PEP weighing laboratory).
- ***Tracking No.***: The shipment's tracking number as assigned by the shipping company.
- ***Shipping Company***: Name of the company contracted to ship the package to the $PM_{2.5}$-PEP weighing laboratory (e.g., Federal Express or UPS). This company typically holds the current $PM_{2.5}$-PEP shipping contract with EPA.

Upon completing Parts II, III, and IV of the COC form, the FS should retain a copy for the Regional field office records. The FS sends the original (wet ink) form to the $PM_{2.5}$-PEP weighing laboratory in the package with the filter cassette(s).

3.5.1.5 COC Part V: $PM_{2.5}$-PEP Weighing Laboratory

PART V – WEIGHING LABORATORY

Date Received		Received by:		Integrity Flag:
Shipment Integrity OK?	☐ Yes ☐ No	Max Temperature: °C	Cold Pack Condition: ☐ Frozen ☐ Cold ☐ Ambient	

The weighing laboratory will DATE-STAMP and attach the COC form to the receiving log-book, in which same info is recorded.

Upon receipt of a package of exposed $PM_{2.5}$-PEP filters, the $PM_{2.5}$-PEP weighing laboratory analyst processing the package's contents completes Part V of each COC form in the package. Part V indicates the date received at the laboratory, the name of the laboratory analyst receiving and processing the package, yes/no indicator of received in acceptable condition (with integrity flag), a maximum temperature of its contents, and whether the package's cold pack arrived frozen, cold, or at ambient temperature. In general, all information specified in Part V should be the same for all COC forms in the package.

Archiving the COC form. Upon completing Part V, the COC form is considered fully complete for the given filter. Upon entering all information from the COC form into the PM-PED, the laboratory analyst archives the original (wet ink) form within the laboratory's files.

3.5.2 **Field Data Sheet**

Field Data Sheets and some $PM_{2.5}$-PEP documentation cite samplers as "BGI PQ200A," a term that its manufacturer, Mesa Labs, no longer recognizes as a marketed sub-model of the BGI PQ200 portable sampler. The only real difference between the two models is that the original BGI PQ200A has an eyebolt installed on the top. The "A" will be completely phased out on the next printing of the FDS, and it is not used in the procedure descriptions in this SOP.

Although each completed $PM_{2.5}$-PEP FDS, like the COC form, is unique to a filter cassette (and, implicitly, to a $PM_{2.5}$-PEP sampler), a FDS is completed only for cassettes in which the filter is exposed during a 24-hour sampling period and a sample is collected (i.e., the filter is designated as "RO–Routine," "CO–Collocated," or "Other" within Part III of its COC form).

The FDS (Appendix C) contains a summary of key information associated with sample collection; this information is sufficiently detailed and complete to allow for a $PM_{2.5}$ concentration to be calculated from the laboratory measurement should the electronic data downloaded from the sampler be corrupted or unavailable. **The FS should always complete the FDS in full <u>before</u> attempting to download the sampler's electronic data (following sample collection) in the event that the data file was to become corrupted during download**.

The FDS contains three sections:

1. Sampling Event Information
2. PQ200 PEP Sampler Verification Checks
3. PEP Exposure Data

Like the COC form, the FDS also includes a general notes section which can hold any free form notes associated with any part of the form. Extra pages may also be attached to the FDS form if additional space is necessary for listing free form notes.

3.5.2.1 Originating the FDS

For each filter cassette to be used in collecting a sample during the $PM_{2.5}$-PEP sampling event (e.g., routine and collocated PEP samples, PM_{10} and $PM_{2.5}$ samples), the FS originates a new FDS upon arriving at the sampling event site and while beginning PEP sampler verification checks (leak, barometric pressure, temperature, and flow rate verifications against standards).

Initially, the FS specifies the "PEP Event Type" at the top of the FDS by checking the appropriate option:

PEP Event Type: □ FRM PM-2.5 □ PM-10

- ***FRM PM-2.5 event*** – Checked when only a $PM_{2.5}$-PEP sample is to be collected during the sampling event (i.e., no collocated PM_{10} sample).
- ***PM-10*** – Checked when both $PM_{2.5}$ and PM_{10} samples are to be collected (from collocated PEP samplers) during the sampling event.
  - If the given filter is to be used for collecting a PM_{10} sample, the FS should 1) circle the checked "PM 10" at the top of the FDS, and 2) write "PM-10 measurement" in the Notes section at the bottom of the FDS. This will bring additional emphasis and less chance of misstating the particle size as the $PM_{2.5}$-PEP weighing laboratory enters sample results into the $PM_{2.5}$-PEP PED.

3.5.2.2 Sampling Event Information

This section of the FDS consists of two portions.

Sampling Event Information			
AQS Site ID		Setup Date	
Site Name		PEP Field Scientist	
GPS Latitude	__ __ __.__ __ __ __ __	Primary SLT Sampler Serial No.	
GPS Longitude	__ __ __.__ __ __ __ __	PEP PQ200A Serial No.	
Parameter Check Device	**Make/ Model**	**Serial No.**	**Last Calibration Date**
Multi-Standard[1]			
Temperature Standard			
Barometric Pressure Standard			
Flow Rate Standard			
Time Checks OK?	□ Yes □ No (describe)		
Monitoring Site Criteria OK?	□ Yes □ No (describe)		

[1] *Use this line for multi-standard instruments (e.g., BGI TriCal and DeltaCal) when used for all three checks.*

The first portion provides information on the monitoring site, the PEP sampler, and the collocated SLT-operated primary network sampler.

- ***AQS Site ID***: Nine-digit AQS Site ID (2-digit State FIPS code – 3-digit County FIPS code – 4-digit unique Site ID: e.g., 01-073-2059). Any leading zeros must be included in each of the three components of the ID.
- ***Setup Date***: The date (mm/dd/yyyy) on which the FS arrives at the monitoring site and physically positions the PEP sampler in the collocated position with the site's primary network sampler.
  - This date may differ from the date on which the PEP sampler is programmed to initiate the 24-hour PEP sample collection period.
- ***Site Name***: The name or location of the monitoring site.
- ***PEP Field Scientist***: The name of the FS performing the $PM_{2.5}$-PEP sampling event.
- ***GPS Latitude/Longitude***: The latitude and longitude of the approximate center of the monitoring site in decimal degree units (as determined by a GPS device).
  - The FS should report both values to five (5) decimal places, which is precise to approximately 3 to 4 feet.
- ***Primary SLT Sampler Serial No.***: The serial number of the SLT-operated routine (primary) network $PM_{2.5}$ sampler that is collocated with the PEP sampler (and thus will be collecting a sample concurrently with the PEP sampler).
  - If this serial number is not ascertainable, the FS should describe the network sampler in the Notes section of the FDS. The make and model should be noted if possible.
  - AQS pairs the $PM_{2.5}$-PEP sample result with that of the site's designated primary $PM_{2.5}$ sampler to calculate bias and completeness. However, if the $PM_{2.5}$-PEP sampler is collocated with an SLT-operated sampler that is not the site's designated primary network sampler, then AQS may not be able to pair the two measurements – for example, if the date of the $PM_{2.5}$-PEP sampling event is not a day that the site's designated primary network sampler is scheduled to run.
  - The $PM_{2.5}$-PEP weighing laboratory will assume that both the primary SLT-operated network sampler specified here and the PEP sampler collocated with it will collect a sample of the type specified by "PM Cut Point" in the "PEP Exposure Data" section below (i.e., either $PM_{2.5}$ or PM_{10}).
- ***PEP PQ200 Serial No.***: The serial number of the PEP sampler in which the given PEP filter cassette is seated and from which a sample is collected.
  - The type of sample collected by this sampler is specified by "PM Cut Point" in the "PEP Exposure Data" section below (i.e., either $PM_{2.5}$ or PM_{10}).
- ***Time Checks OK?***: Indicates whether the FS confirmed that the PEP sampler's internal clock is working properly (Section 6.1.6.6) and is synchronized with the clock of the routine network sampler with which it is collocated (Section 7.1.7.2).
  - If a "no" response is given, the FS should write a note indicating the reason.
- ***Monitoring Site Criteria OK?***: Indicates whether or not the PEP sampler achieves the siting criteria specified in 40 CFR part 58 Appendix A and Appendix E (Section 5.5.2).

- If a "no" response is given, the extent of, and any reasons for, deviations from the siting criteria should be specified in the space provided or on a separate attachment. In addition, as noted in Step 5 of Section 5.5.2, the FS should document the deviation in the field notebook and the PM2.5-PEP Site Data Sheet and follow-up with official communications to the site contact and the Regional PM2.5-PEP Lead to attempt to rectify the problem(s) and approve an alternate siting.

The second portion of the Sampling Event Information section, labeled *Parameter Check Device*, contains four rows in which the FS records information on the transfer standard device(s) used in the PEP sampler verification checks. Which of these four rows are necessary to complete depends on the devices to be used:

- If using a single multi-parameter transfer standard device (e.g., BGI tri-Cal or delta-Cal), the FS completes only the first row (*Multi-Standard*).
- If using different transfer standard devices to verify the sampler's recorded temperature, barometric pressure, and flow rate, the FS completes only the second, third, and fourth rows (*Temperature Standard*, *Barometric Pressure Standard*, and *Flow Rate Standard*).

In each pertinent row, the FS specifies the following information:

- ***Make/Model***: The make and model of the transfer standard device.
- ***Serial No***: The serial number of the transfer standard device.
- ***Last Calibration Date***: Date (mm/dd/yyyy) of the device's last annual calibration and recertification as verified against a higher order NIST traceable standard (Section 8.3).

3.5.2.3 PQ200 PEP Sampler Verification Checks

The FS completes the second section of the FDS while performing each of the PEP sampler verification checks: leak check (Section 6.2), barometric pressure (Section 6.3), temperature (Section 6.4, for both ambient and filter sensors), and flow rate (Section 6.5).

PQ200A PEP Sampler Verification Checks [2]				Date:
Leak Check	**Criteria**	**Beginning P**	**Ending P**	**Verification OK?**
2-Minute Interval	Change < 5 cmH_2O	cmH_2O	cmH_2O	☐ Yes ☐ No
Bar. Pressure	**Criteria**	**Ref Standard**	**Sampler**	**Verification OK?**
Ambient	± 10 mmHg	mmHg	mmHg	☐ Yes ☐ No
Temperature	**Criteria**	**Ref Standard**	**Sampler**	**Verification OK?**
Ambient Sensor	± 2°C	°C	°C	☐ Yes ☐ No
Filter Sensor	± 2°C	°C	°C	☐ Yes ☐ No
Flow Rate Verification				
Audit Standard FR (Cal.) Check	**Criteria**	**Ref Standard**	**Sampler**	**Verification OK?**
	< 4% difference	Lpm	Lpm	☐ Yes ☐ No
Design Flow Rate "Q" Check	**Criteria (±4%)**	**Ref Standard**	**Design**	**Verification OK?**
	16.00 ≤ Q ≤ 17.34	Lpm	16.67 Lpm	☐ Yes ☐ No

[2] *Indicate only the final result of the check after all troubleshooting has been done. Document troubleshooting in the "Notes" section below and/or in the field notebook. If troubleshooting is unsuccessful, the sampler must be recalibrated or repaired before conducting a sampling event. Fill out a new Field Data Sheet for the replacement sampler.*

In the upper right corner of this section, the FS records the date when these verification checks were performed. This date should precede the start of PM2.5-PEP sampling by one to three days.

The acceptance criteria for each verification check are listed in the column labeled "Criteria." In the next two columns, the FS records the results of each check – typically the readings from the transfer standard and the PEP sampler. (For leak check, the beginning and ending measures are recorded.) Note that some older transfer standard devices may require a relatively complex equation for calculating the flow rate based on the pressure drop across an orifice. The documentation that accompanies each orifice device provides the necessary equations and the constants applicable to the orifice.

For each verification check, the FS records the following:

- If the acceptance criteria are achieved from the two measures specified, indicate "yes" in the column labeled "Verification OK?".
- If the acceptance criteria are not achieved, the FS then performs troubleshooting activities to try and resolve any performance problems and then repeats the verification check.
  - The FS records results only for the final verification, after completing any troubleshooting, and documents any troubleshooting activities in the "Notes" section and/or in the field notebook.
  - If the FS is unsuccessful in resolving an acceptance criteria violation for a specific verification check, the FS should indicate "no" in the column labeled "Verification OK?" and then switch to the backup PEP sampler for the current $PM_{2.5}$-PEP sampling event. The FS should return the problematic sampler to the Regional field office for recalibration or repair before using it in a future $PM_{2.5}$-PEP sampling event. (Switching to the backup PEP sampler would require completing a new FDS and repeating the verification checks.)

3.5.2.4 PEP Exposure Data

The FS completes the third section of the FDS immediately before and after the 24-hour PEP sampling period.

First, the FS specifies the following two indicator variables for the sampler:

PEP Exposure Data			
Filter Cassette ID		Cassette Retrieval Date/Time:	
PM Cut Point	□ PM-2.5 □ PM-10	PEP PM-2.5 Separator Type:	□ WINS □ VSCC
Elapsed Time (ET)		**Filter Integrity OK?**	□ Yes □ No (describe)
Total Volume (m^3)			
Flow Rate (Lpm)	Q: 16.7	Avg:	CV:
Start Date/Time		**Data Download OK?**	□ Yes □ No (describe)
Stop Date/Time			
Temperature (°C)	Max:	Min:	Avg:
Bar. Pressure (mm Hg)	Max:	Min:	Avg:
Field Blank Cassette ID		Sampler Flags[3]:	
Trip Blank Cassette ID		Field Flags:	
Companion Cassette ID[4]			
Collocated Cassette ID(s)[5]			

[3] *Make sure to add (EST) flag in "Sampler Flags" if runtime is outside of 1380- 1500 minute range.*
[4] *For PM-coarse sampling event, if PM-2.5 is routine filter type, then list the companion PM-10 filter cassette ID and vice versa.*
[5] *For parking lot studies, all the IDs can be listed on one form. Be sure to indicate PM cut point.*

- ***PEP Cut Point:* □ *PM-2.5* □ *PM-10***: Indicates whether the exposed filter from this sampler contains $PM_{2.5}$ or PM_{10}.
- ***PEP PM-2.5 Separator Type:* □ *WINS* □ *VSCC***: Indicates the particle separator type used in the sampling.
  - Relevant only if a $PM_{2.5}$-PEP sample was collected. (It is left blank otherwise.)

Once verification checks are completed and the FS approves the sampler for PEP sample collection, the FS selects the filter cassette, loads it into the sampler, and closes the filter chamber. The FS records the cassette ID within the ***Filter cassette ID*** field in this section of the FDS, as well as the cassette IDs for other filter cassettes linked to that sampling event:

- ***Field blank cassette ID:*** for the field blank linked to the sampling event.
- ***Trip blank cassette ID:*** for the trip blank linked to the sampling event (common to all events on the same trip).
- ***Companion cassette ID:*** for a filter (if collected) from a collocated PEP sampler – usually a PM_{10} sample if the given FDS is for a $PM_{2.5}$ sample filter, or vice versa.

  - This field is left blank if only one $PM_{2.5}$-PEP sample will be collected during the sampling event.

- ***Collocated cassette ID(s):*** for any filter(s) from one or more collocated PEP samplers that will collect samples of the same cut point during the sampling event.
  - If the sampling event represents a $PM_{2.5}$-PEP collocation study ("parking lot study"), all collocated filter cassette IDs from $PM_{2.5}$-PEP samplers used to collect a $PM_{2.5}$ sample can be listed on one FDS.

When the 24-hour sampling period for the $PM_{2.5}$-PEP sampling event is ready to begin, the FS records the following:

- ***Start Date/Time***: Date (mm/dd/yyyy) and time (local time in 24-hour military format) of the start of the 24-hour sampling period.

When the 24-hour sampling period ends and the FS returns to review the sampler status and retrieve the collected filter cassette, the FS completes all remaining fields:

- ***Stop Date/Time***: Date (mm/dd/yyyy) and time (local time in 24-hour military format) of the end of the 24-hour sampling period.
- ***Elapsed Time (ET)***: Difference between the start and stop times (in seconds).
- ***Filter Integrity OK?***: Indicator of whether the FS observes the exposed filter to be free of visible imperfections (e.g., pinholes or debris) upon removing it from the PEP sampler.
  - If a "no" response is given, the extent of imperfections in the filter should be noted.
- ***Data Download OK?****:* Indicator of whether the FS successfully downloaded the electronic data file from the PEP sampler (Section 7.3.5.3), and the file is not corrupted.
  - If a "no" response is given, any problems encountered in the download and/or file should be noted.
- ***Sampler Flags:*** A list of any flags displayed by the sampler screen display:
  - **P** = a power failure occurred.
  - **M** = a memory overflow occurred (max run time with 5-minute logger interval).
  - **F** = a 5°C filter overheating lasting more than 30 minutes occurred.
  - **Q** = flow varied more than ±5%.
  - **T** = the sampling period was less than 23 hours 50 minutes.
  - **EST** = the runtime is outside of the 1,380 to 1,500 minute acceptance range.
- ***Field Flags:*** List of any relevant field qualifiers from among those listed in Appendix B.

Values for all other fields in this section of the FDS (e.g., Total Volume, temperature and barometric pressure ranges and averages) are transcribed directly from information displayed on the sampler's screen.

3.5.2.5 Disposition of completed FDS

Once the FDS is fully completed, the FS does the following (Section 7.3.5.1):

- Makes a clear copy of the original (wet ink) form and any accompanying pages of notes.

- Places the original (wet ink) form and any notes along with the filter cassette and its COC form within the package that the FS ships to the $PM_{2.5}$-PEP weighing laboratory.
- Provides the copy to the Regional field office for its records (to be stored for up to two (2) years).

4.0 Filter Cassette Receipt, Storage, and Handling

Forms cited in this section (in order of citation):
Chain-of-Custody (COC) form

4.1 Scope and Applicability

As directed by Section 6 of 40 CFR Part 50, Appendix L, the $PM_{2.5}$-PEP uses 46.2 mm-diameter polytetrafluoroethylene (PTFE) filters to collect $PM_{2.5}$ samples during $PM_{2.5}$-PEP sampling events. This section details the procedures for the receipt, storage, and proper handling of pre-weighed filters throughout the $PM_{2.5}$-PEP sampling event lifecycle.

4.2 Summary of Method

Filters used in the $PM_{2.5}$-PEP originate from the $PM_{2.5}$-PEP weighing laboratory. Therefore, as the Regions and self-implementing agencies have a need for new (pristine) filters to use in future $PM_{2.5}$-PEP sampling events, the Regional field office submits a request to the $PM_{2.5}$-PEP weighing laboratory for a specified number of filters (Section 2.2.4.5). The number of filters to request should be sufficient to meet the field office's need for $PM_{2.5}$-PEP samples over the next 30 days, but not beyond this (as filters cannot be used when more than 30 days have elapsed since their pre-weighing).

Upon receiving a request from a Regional field office, the $PM_{2.5}$-PEP weighing laboratory pre-weighs a sufficient number of new filters to fill the order, loads them individually into clean cassettes, and ships the loaded cassettes to the Regional field office. (A Regional field office can also place special orders for pre-weighed filters, such as for use in $PM_{2.5}$-PEP collocation studies for assessing precision within its $PM_{2.5}$-PEP sampler fleet.) As each filter is pre-weighed, the laboratory designates its purpose as either a routine $PM_{2.5}$-PEP sample, a field blank (Section 7.1.6.2), or a trip blank (Section 7.1.6.3). The number of field and trip blanks to include in a shipment is a specified percentage of the requested number of filters. The laboratory initiates a COC form for each filter (Section 3.5.1) by completing "Part I – Weighing Laboratory" within the form, which includes the filter ID number (assigned by the manufacturer) and cassette ID number (Section 3.5.1.1); these forms accompany the filter cassettes in the shipment. At all times, each COC form must either physically accompany its assigned filter or be under the custody of the FS who is utilizing the filter. At the end of a $PM_{2.5}$-PEP sampling event, the FS will complete and return the COC form with the (exposed) filter to the $PM_{2.5}$-PEP weighing laboratory for post-weighing and archival.

Upon receiving a shipment of loaded filter cassettes, Regional field office personnel follow procedures detailed in Section 4.5. They include completing Part II of each filter cassette's COC form (Section 3.5.1.2) and storing the filter cassettes with their COC forms in a single clean container until assigning them to a $PM_{2.5}$-PEP sampling event and departing for the event.

4.3 Cautions

- To minimize the potential for contamination, each pre-weighed filter cassette must remain capped in its 3-inch x 5-inch anti-static filter cassette bag until the FS is ready to seat it within the PEP sampler prior to the start of sample collection (or as a field blank).

In addition, these filter cassette bags must be transported in 9-inch x 12-inch self-sealing shipping bags and kept until the cassettes are ready for use in the field.

- When handling a filter cassette, care must be taken at all times to minimize potential filter damage or contamination.
- During field activities, a filter must never be removed from its cassette nor touched directly.
- Filter cassette caps must be handled only by their exterior; the interior of the filter caps must never be touched or left exposed to potential contaminants.
- Prior to handling the PEP sampling equipment or filter cassettes, hands must be thoroughly cleaned with an alcohol wipe and allowed to air dry or disposable powder-free examination gloves (e.g., nitrile) must be worn. Reclean hands or replace gloves if they become dirty at any point during the handling of filter cassettes.

4.4 Equipment and Supplies

- Field notebook (either in hard copy or electronic form).
- Pen with indelible ink.
- COC form(s).
- 4-mil thick, 3-inch x 5-inch anti-static plastic bags for holding individual capped cassettes loaded with 46.2-mm-diameter pre-weighed PTFE filters.
- 9-inch x 12-inch self-sealing shipping bags for holding bagged filter cassettes.

4.5 Filter Cassette Receipt and Handling

This section describes the method that Regional field office personnel follow when receiving a shipment of pre-weighed filters from the $PM_{2.5}$-PEP weighing laboratory for use in future $PM_{2.5}$-PEP sampling events.

The $PM_{2.5}$-PEP weighing laboratory will notify the Regional field office of a filter shipment on the same day that it makes the shipment. The laboratory may ship the filter cassettes in shipping containers (like those used to ship post-sampling filters) or in courier-supplied shipping envelopes.

Upon receiving a shipment, the Regional field office representative performs the following steps:

1. Log the receipt of the shipment in the field notebook (e.g., “Filter cassette shipment received from $PM_{2.5}$-PEP weighing laboratory, 1/15/2019”).
2. Inspect the shipping container upon receipt for any damage and record any observed damage in the field notebook.
3. Open the shipping container and inspect its contents.
   - In this and subsequent steps, if any apparent problems are noted among the contents of the shipping container, record these observations in the field notebook and notify the $PM_{2.5}$-PEP weighing laboratory.
4. Remove the COC forms from the shipping container and confirm that “Part I – Weighing Laboratory” is completed within each form (Section 3.5.1.1).

5. Remove the 9-inch x 12-inch bag from the shipping container, open this bag, and remove the 3-inch x 5-inch anti-static self-sealing bags stored within it.
   - Each 3-inch x 5-inch bag contains a pre-loaded, capped filter cassette (Figure 4-1).
   - Do not open the 3-inch x 5-inch bags.
6. Match each COC form with its filter cassette according to the filter cassette number printed on the cassette and specified in Part I of the form.
   - If a one-to-one match exists between all cassettes and COC forms in the shipment, proceed to Step 8.
7. If any filter cassettes do not have a COC form or if any COC forms do not match with a filter cassette, record each discrepancy in the field notebook and notify the $PM_{2.5}$-PEP weighing laboratory of each discrepancy.
   - Any filter cassette that does not have a matching COC form cannot be used in $PM_{2.5}$-PEP activities. Thus, they are excluded from the remaining steps below.

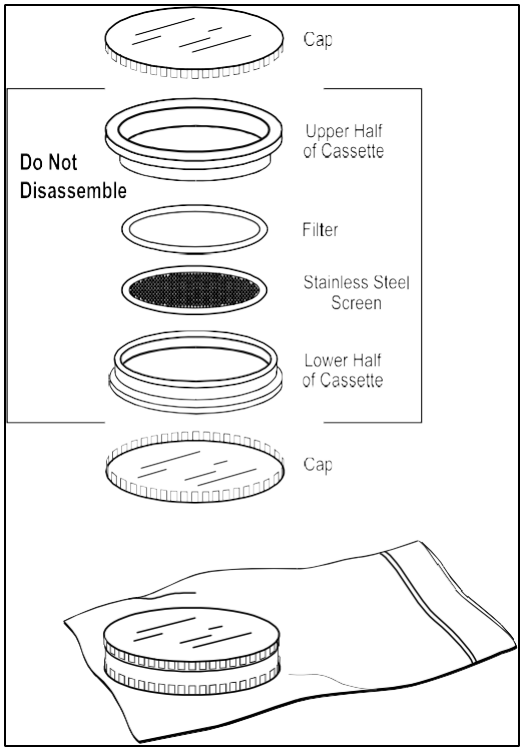


Figure 4-1. Filter cassette equipment and filter cassette in an anti-static sample bag

8. Hold each 3-inch x 5-inch bag up to a bright light and assess the light transmission through the filter cassette. If one filter cassette is noticeably darker than the others, it is likely that two support screens were placed in the "sandwich."
   - This filter should be classified and used as a field blank – if it was assigned any other classification, notify the $PM_{2.5}$-PEP weighing laboratory and record this in the field notebook.
9. Take special note of those filter cassettes labeled as trip blanks. Only one trip blank is used per field sampling trip (which could involve multiple sampling events).
10. Complete Part II of each COC form in the shipment (titled "Part II Field Office") by recording information on "Date Received," "Received by," "Location," and "Package Condition" (Section 3.5.1.2).
11. Return any filter cassettes deemed ineligible for use in the $PM_{2.5}$-PEP (e.g., in Steps 7 and 8) and their COC forms to the 9-inch x 12-inch bag for return shipment to the $PM_{2.5}$-PEP weighing laboratory.
12. Contact the $PM_{2.5}$-PEP weighing laboratory to confirm receipt of the shipment, to report the outcome of the above steps, and if necessary, to report on and attempt to rectify any problems noted with the shipment, and to note that some filters deemed ineligible are being returned.

13. File the COC forms included in the shipment with any COC forms from previous shipments (for filter cassettes that remain unused) and arrange all forms in chronological order according to the date specified for "Date This Filter Must be Used by" in Part I of the form.
14. Store the bagged filter cassettes with the other unused filter cassettes as described in Section 4.6.1 below.

When performing Steps 13 and 14, the FS should also identify any filter cassettes within the storage container (received in earlier shipments) that have not or will not be used in the $PM_{2.5}$-PEP by the date listed within the "Date This Filter Must be Used by" field within Part I of its COC form. If any are found, the FS should do the following:

1. Remove the bagged cassette from the storage container.
2. Check the "Expired Filter (not used)" box in Part III of the cassette's COC form (Section 3.5.1.3).
3. Place the bagged filter cassette and its COC form into the 9-inch x 12-inch bag (as in Step 11 above) so that it can be shipped back to the $PM_{2.5}$-PEP weighing laboratory.

Section 7.1 contains additional instructions on filter handling during setup and sampling.

4.6 Filter Cassette Storage

4.6.1 Storage Prior to Transportation to the Field

While being stored, a filter cassette must remain capped and stored in its sealed 3-inch x 5-inch anti-static plastic bag at all times, and each plastic bag must remain in its 9-inch x 12-inch self-sealing shipping bag.

Until a filter cassette is packed and enroute to a $PM_{2.5}$-PEP sampling event, the filter cassettes must be stored at ambient conditions (not refrigerated) in a single clean container such as those used for post-sample shipping to the $PM_{2.5}$-PEP weighing laboratory. This container must be located in a secure area within the Regional field office to avoid tampering by unauthorized individuals or exposure to other risks of compromising the filters.

4.6.2 Storage of Unused Filter Cassettes during Field Transport

While enroute to a $PM_{2.5}$-PEP sampling event, the FS shall ensure that all cassettes are stored in a single clean container, such as those used for post-sample shipping to the $PM_{2.5}$-PEP weighing laboratory (and used for storage at the Regional field office). The location of the container should be secured to avoid tampering by unauthorized individuals or exposure to other risks of compromising the filters. The container should be shielded from extreme temperatures (hot or cold) at all times.

4.6.3 Storage of Post-sample Filter Cassettes

When storing cassettes containing exposed filters (post-sampling), the FS shall follow the procedures in Section 7.4 when preparing the shipment of cassettes to the $PM_{2.5}$-PEP weighing laboratory and temporarily storing the cassettes when shipping is delayed.

5.0 Transportation of the Sampler and Installation at the Site

Forms cited in this section (in order of citation):
$PM_{2.5}$-PEP Site Data Sheet (SD-01)
COC form

5.1 Scope and Applicability

This section describes the procedures that a FS follows when transporting a portable $PM_{2.5}$-PEP sampler to a monitoring site and siting and installing the sampler for conducting a $PM_{2.5}$-PEP sampling event.

The information presented below is applicable to the BGI PQ200 sampler and may not be applicable to other sampler makes and models. For other approved FRM samplers, refer to the given sampler's instruction manual for supplemental instruction. For the BGI PQ200 sampler, EPA has posted the manufacturer's instruction manuals on the $PM_{2.5}$-PEP Documentation page of the AirQA.org website. These documents can also be accessed on the manufacturer's website (https://mesalabs.com/products/environmental-controls-air-quality).

5.2 Summary of Method

When planning a $PM_{2.5}$-PEP sampling event trip, the FS shall identify and secure the use of at least two (2) $PM_{2.5}$-PEP samplers to transport to the monitoring site(s) for $PM_{2.5}$-PEP sample collection. The FS will assign these samplers as follows:

- One PEP sampler will be selected as the trip's "primary" sampler for collecting a $PM_{2.5}$-PEP sample at each sampling event.
- One PEP sampler will serve as a backup in case the primary sampler cannot pass verification checks or experiences other operational issues prior to the start of sampling and must be replaced.
- If necessary, one or two additional PEP samplers may be needed, such as if a second PEP sampler is to be collocated with the primary PEP sampler in a given sampling event so that a PM_{10}-PEP sample can be collected at the same time as the $PM_{2.5}$-PEP sample. The FS may also wish to have a backup sampler available for the PM_{10}-PEP sampler.

Prior to the sampling trip, the FS inspects each of the PEP samplers at the Regional field office to verify all parts are available and in good working condition. For each sampler, the FS packs all components into the sampler's carrying case or other secure means for transport to the monitoring site.

Upon arriving at the monitoring site hosting a $PM_{2.5}$-PEP sampling event, the FS follows the procedures in Section 6.1 to assemble the primary $PM_{2.5}$-PEP sampler. (Section 6). The FS then places the sampler within four (4) meters of the monitoring site's routine (primary) $PM_{2.5}$ sampler (i.e., the site's sampler used for determining $PM_{2.5}$ NAAQS attainment), adhering to the siting criteria specified in 40 CFR Part 58, Appendix E (Section 5.5.2).

5.3 Cautions

- The $PM_{2.5}$-PEP sampling equipment must be carefully packed and secured within their travel cases or other secure means to ensure no damage occurs to fragile components during transport. If improperly packed, components could loosen and cause damage to circuit boards and other delicate components.
- The travel cases (or other secure means) containing the $PM_{2.5}$-PEP sampling equipment must be sufficiently positioned and secured within the transportation vehicle to avoid movement or vibration of the sampler during transport. For example, placing the sampler on cushioning material and packing dampening material (e.g., foam, cloth) around the sampler will minimize movement and isolate the sampler from vehicle vibrations.

> A sampler that is placed in the transportation vehicle unsecured and outside of its case will roll like a ball and could become a lethal projectile in a vehicular accident!

- The $PM_{2.5}$-PEP sampling equipment must be packed in such a way so that individual carrying/transport cases are not so heavy as to risk damage or injury to the FS. In particular, the main sampler unit is heavy for most individuals and should be handled with care, but also with personal safety in mind.
- Each sampler's alternating current (AC) power supply and battery must be removed from the main unit and packed correctly in the travel case or by other secure means. Removal of the battery, power supply, and weather cover will also help to reduce the total weight of the travel case.
- Some sites may require the $PM_{2.5}$-PEP sampling equipment to be hoisted onto a rooftop or an elevated platform. Any necessary site-specific equipment needed to help the FS place the PEP equipment on the sampling platform should be identified during the planning process (before the sampling event trip) and noted on the $PM_{2.5}$-PEP Site Data Sheet.
- For each sampler, its transport filter cassette (i.e., the cassette placed in the sampler during transport – not a filter cassette) should be confirmed to be securely in place and that the filter compartment is tightly closed prior to transport. A tie wrap may be used to keep the compartment from jarring loose during transport.
- Each sampler's inlet and particle separator should be clean and packed in a way that will prevent it from becoming dirty during transport.
  - If a WINS impactor is used, it should be verified as being free of oil.

5.4 Equipment and Supplies

The FS must ensure the safety and security of the $PM_{2.5}$-PEP sampling equipment when transported to and from the field, and that the potential for rough handling is minimized. The FS can consider various transportation options for the $PM_{2.5}$-PEP sampling event trip, as long as the equipment can be transported securely.

Generally, for the current production model of the BGI PQ200 sampler (Revision B, Control Card Version U – denoted as "Rev U"), BGI ships a new sampler as unassembled and in multiple

boxes. The FS can likewise transport the sampler in multiple boxes and then assemble the pieces upon arriving at the PM$_{2.5}$-PEP sampling site (Section 6.1). With this approach, the sampling equipment must be inventoried upon arrival at its destination to confirm arrival of all necessary parts and then inspected to identify any apparent damages that may have incurred during packaging or shipping.

Older generations of the BGI PQ200 sampler were shipped in four pieces: the main sampler module and three (3) travel cases containing smaller pieces and accessories. The travel cases are no longer manufactured or available for purchase. Therefore, when travel cases are retired, the FS will need to purchase a replacement from a different source (e.g., Pelican Box or another competitive vendor). Historically, each of these three (3) travel cases have had the following use:

1. Travel Case Number 1 (Figure 5-1) transports the sampler's three legs.
   - This travel case may cause security concerns in certain situations as it can resemble a gun case. However, it is fine to use when shipping between the Regions and OAQPS.
   - When traveling by vehicle, long orange tripod bags (e.g., SECO Super-Duty Tripod Bag #8154-11-ORG; available through multiple vendors) is a fine substitute for this travel case.
2. Travel Case Number 2 (Figure 5-2) carries the following:
   - the inlet with attached water trap,
   - a 2 ft. downtube and flow-rate adaptor,
   - two WINS impactor wells with transport cases, and
   - one bottle of oil for the WINS impactor (Octoil-S, SPI Number 00031).
3. Travel Case Number 3 (Figure 5-3) carries the following:
   - the gill screen (ambient temperature sensor housing),
   - the power supply and battery charger,
   - the battery, and
   - the weather shroud (rear cover).

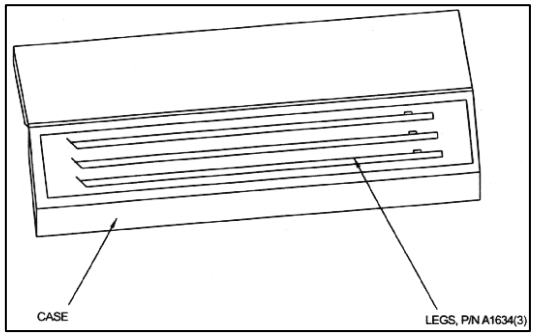


Figure 5-1. Travel case number 1 with legs

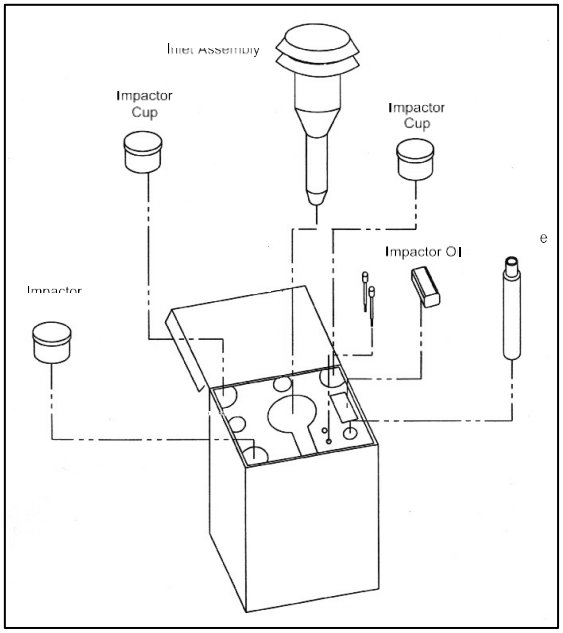


Figure 5-2. Travel case number 2 for inlet and accessories

Additional tools which the FS will need in the field to move equipment from the vehicle to the sampling platform and to set up the sampler include:

- Assorted hand tools (e.g., screwdrivers, pliers, wrenches),
- Spirit level (an ordinary bubble level is sufficiently accurate) for leveling the sampler,
- Measuring tape (metric) for use in measuring heights of objects on or within the vicinity of the sampler to prevent siting violations,
- Range finder with declination measurement,
- Hand truck or cart and hoisting equipment (e.g., ladders, rope) for transporting equipment to the sampling platform,
- Power cords, bungee cords, GFCI adapters,
- Sandbags, concrete blocks, or other means to secure the feet,
- Umbrella,
- Stinging insect killer and repellent, and
- A first aid kit.

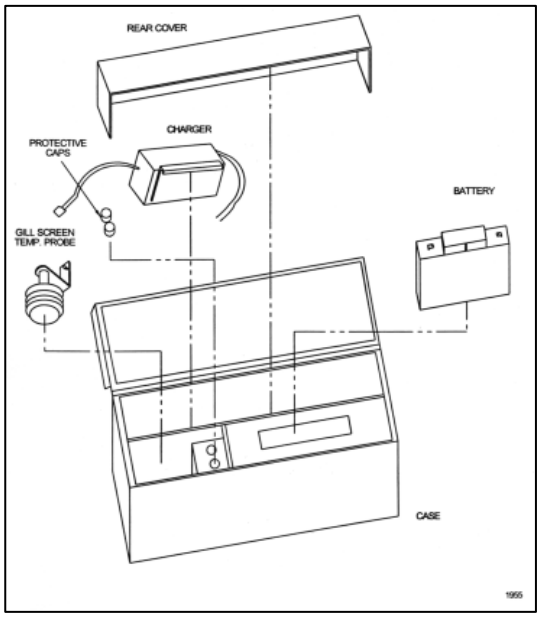


Figure 5-3. Travel case number 3 for gill screen and accessories

The advent of semi-continuous $PM_{2.5}$ samplers in the national network has had an impact on how SLT agencies are siting these samplers. For example, network samplers are more frequently being placed inside shelters. This has posed some challenges to the $PM_{2.5}$-PEP when siting a PEP sampler to meet proximity requirements to the network sampler's inlet. This is one reason why a site review is critical prior to a scheduled $PM_{2.5}$-PEP sampling event. New and innovative solutions may be needed when siting a $PM_{2.5}$-PEP sampler in this situation, such as scaffolding or ladders affixed to the sides of shelters in a manner that can support a $PM_{2.5}$-PEP sampler. If such approaches are taken, the Regional $PM_{2.5}$- PEP Lead should discuss it with the SLT agency's site operator and gain approval.

5.5 Procedures

5.5.1 Preparing for Equipment Transport to the Monitoring Site

Upon acquiring the $PM_{2.5}$-PEP samplers for a $PM_{2.5}$-PEP sampling trip (i.e., the primary and backup samplers) and the necessary verification device(s), tools, supplies, etc., the FS prepares for transporting all equipment (Section 5.4). The $PM_{2.5}$-PEP encourages the use of ground transportation over air transportation for sampling equipment due to the fragile and precise nature of the sampling equipment, the high risk of rough handling during air transportation, and costs.

When preparing to transport $PM_{2.5}$-PEP samplers on a sampling event trip, the FS performs the following activities in addition to those noted in Section 2.2.4.5:

1. Inventory each travel case (or other secure transportation container) across all samplers to verify that all parts are present and in acceptable condition for use.
   - The Regional field office can choose to prepare and use a parts inventory checklist to facilitate this activity.
2. Pack a sufficient number of filters (in cassettes) to cover not only each planned routine $PM_{2.5}$-PEP sample, field blank, and trip blank to be used during the trip, but also enough extra filters (in cassettes) in case one or more of the planned filters are rejected in the field due to damage or contamination. Ensure that the COC form for each filter cassette is also packed with the cassettes.
3. Pack enough field transport containers, pre-frozen ice substitutes, and pre-printed express shipping labels for each planned shipment of exposed $PM_{2.5}$-PEP sample filters to the $PM_{2.5}$-PEP weighing laboratory.
4. Place the equipment into the transport vehicle and secure all equipment to minimize movement and vibration of the main unit and the filter cassettes.

5.5.2 **Transporting Equipment to the Site Platform and Proper Sampler Placement**

Upon arriving at a monitoring site hosting a $PM_{2.5}$-PEP sampling event, the FS performs the following activities:

1. Park the vehicle at a sufficient distance from the site and turn off the engine to minimize the impact of any dust or vehicle emissions. Contact the SLT agency's site operator to announce your arrival and to confirm how to avoid impact to any sensitive monitoring activity that may be occurring at the site.
2. Identify and inspect the area on the sampling platform where the $PM_{2.5}$-PEP sampler will be placed. The SLT agency's site operator should indicate this area, or it should have been marked in advance. Determine and implement the safest and most secure method for transporting the equipment from the vehicle to the platform.
3. Bring the sampling equipment and verification device(s) to the platform within their traveling cases or by other secure means. The main sampler module may be transported to the platform without its traveling case.
   a. Under rainy conditions, install the sampler's battery while in a dry location (e.g., the van or hotel room) before transporting the sampler to the platform, and take extra precautions as a result to account for the sampler's extra weight (e.g., using a hand truck).
   b. Transport the verification device(s) to the platform sufficiently early to allow the equipment to equilibrate to ambient conditions for at least one hour.
4. Upon assembling the $PM_{2.5}$-PEP sampler (Section 6.1), position it on the platform while ensuring that each of the following siting criteria is achieved (as stated in 40 CFR Part 58, Appendix A and E; excerpts from these appendices are provided in the full-page text box below):

- The $PM_{2.5}$-PEP sampler has unobstructed air flow for a minimum of one (1) meter in all directions.
- The $PM_{2.5}$-PEP sampler inlet is placed at a height of two (2) to 15 meters above ground level, or at two (2) to seven (7) meters above ground level if the routine sampler is designated as a micro-scale sampler.
- The vertical distance between the sampler inlet and the site's primary routine $PM_{2.5}$ sampler inlet is no more than one (1) meter.
  - If this is not possible, then consult with the Regional $PM_{2.5}$-PEP lead for guidance. Ideally, this situation should be identified through the pre-visit planning conversations with the SLT agency's site operator (Section 2.2.4.3).
- The horizontal distance between the sampler inlet and the site's primary routine $PM_{2.5}$ sampler inlet is between one (1) and four (4) meters.
  - If the $PM_{2.5}$-PEP sampler is collocated with any other PM sampler, the horizontal spacing between sampler inlets (measured from the edge of the PM_{10} inlet where atmosphere is ingested) must be more than one (1) meter from other $PM_{2.5}$ samplers and more than two (2) meters from other total suspended particulate (TSP) and PM_{10} high-volume samplers. All samplers must be within four (4) meters of each other.
- The sampler inlet is level.

In cases where several samplers are located on the platform, thereby causing one or more of the above collocation criteria from being achieved, the FS must ensure that the $PM_{2.5}$-PEP sampler is appropriately spaced from the site's primary routine $PM_{2.5}$ sampler at a minimum. The number of samplers on the platform and each sampler's placement should be identified and recorded during pre-visit planning, as it may be necessary for the FS to bring specialized equipment for mounting the $PM_{2.5}$-PEP sampler in an awkward position.

5. If the placement of the $PM_{2.5}$-PEP sampler cannot achieve the above siting requirements, note this on the FDS (Section 3.5.2.2), document it the field notebook and the $PM_{2.5}$-PEP Site Data Sheet, and follow-up with official communications to the site contact and the Regional $PM_{2.5}$-PEP Lead to attempt to rectify the problem(s) and approve an alternate siting.
   - If the siting problem is rectified, document this in the field notebook and notify the Regional $PM_{2.5}$-PEP Lead.
   - If the siting problem cannot be rectified, do not proceed with the $PM_{2.5}$-PEP sampling event unless directed by the Regional $PM_{2.5}$-PEP Lead.

Probe and Sampler Siting and Placement Criteria: Excerpts from 40 CFR Part 58 Appendices A and E.

Appendix A

The two collocated $PM_{2.5}$ monitors must be within 4 meters (inlet to inlet) of each other and at least 1 meter apart to preclude airflow interference. A waiver allowing up to 10 meters horizontal distance and up to 3 meters vertical distance (inlet to inlet) between a primary and collocated sampler may be approved by the Regional Administrator for sites at a neighborhood or larger scale of representation during the annual network plan approval process.

Appendix E

2. Horizontal and Vertical Placement

- The probe or at least 80% of the monitoring path must be:
  - 2 and 15 meters above ground level for neighborhood or larger spatial scale sites
  - 2 and 7 meters above ground level for middle and microscale sites.
- The probe or at least 90% of the monitoring path must be at least 1 meter vertically or horizontally away from any supporting structure, walls, parapets, penthouses, etc., and away from dusty or dirty areas. If the probe or a significant portion of the monitoring path is located near the side of a building or wall, then it should be located on the windward side of the building relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.

3. Spacing From Minor Sources

- Local minor sources of a primary pollutant, such as SO_2, lead, or particles, can cause high concentrations of that particular pollutant at a monitoring site. If the objective for that monitoring site is to investigate these local primary pollutant emissions, then the site is likely to be properly located nearby. This type of monitoring site would in all likelihood be a microscale type of monitoring site. If a monitoring site is to be used to determine air quality over a much larger area, such as a neighborhood or city, a monitoring agency should avoid placing a monitor probe, path, or inlet near local, minor sources. The plume from the local minor sources should not be allowed to inappropriately impact the air quality data collected at a site. Particulate matter sites should not be located in an unpaved area unless there is vegetative ground cover year-round, so that the impact of wind-blown dusts will be kept to a minimum.

4. Spacing From Obstructions

- A probe, inlet, or monitoring path must have unrestricted airflow in an arc of at least 180 degrees. This arc must include the predominant wind direction for the season of greatest pollutant concentration potential. For particle sampling, a minimum of 2 meters of separation from walls, parapets, and structures is required for rooftop site placement.

5. Spacing From Trees

- Trees can provide surfaces for SO_2, O_3, or NO_2 adsorption or reactions, and surfaces for particle deposition. Trees can also act as obstructions in cases where they are located between the air pollutant sources or source areas and the monitoring site, and where the trees are of a sufficient height and leaf canopy density to interfere with the normal airflow around the probe, inlet, or monitoring path. To reduce this possible interference/obstruction, the probe, inlet, or at least 90% of the monitoring path must be at least 10 meters from the drip line of trees.

6. Spacing From Roadways

- Since emissions associated with the operation of motor vehicles contribute to urban area particulate matter ambient levels, spacing from roadway criteria are necessary for ensuring national consistency in PM sampler siting.
- For the microscale traffic corridor site, the location must be between 5 and 15 meters from the major roadway. For the microscale street canyon site the location must be between 2 and 10 meters from the roadway. For the middle scale site, a range of acceptable distances from the roadway exists (illustrated in Figure E–1 of Appendix E).

6.0 Sampler Setup and Initial Performance Verifications

Forms cited in this section (in order of citation):
Chain-of-Custody (COC) form
Field Data Sheet (FDS) form

6.1 Pre-Verification Sampler Assembly

6.1.1 Scope and Applicability

This section describes the routine procedures for assembling the portable BGI PQ200 sampler when preparing for a $PM_{2.5}$-PEP sampling event at a monitoring site. Assembly procedures that are specific to other sampler makes and models do not appear here. For other approved FRM samplers, refer to their respective instruction manuals for supplemental instruction.

For the BGI PQ200 sampler, EPA has posted the manufacturer's instruction manuals on the $PM_{2.5}$-PEP Documentation page of the AirQA website (https://www.airqa.org). These documents can also be accessed on the manufacturer's website (https://mesalabs.com/products/environmental-controls-air-quality).

6.1.2 Summary of Method

Assembling the BGI PQ200 sampler involves a series of steps which include attaching the sampler's legs and anchoring the sampler firmly to the platform or ground, attaching the sampler's temperature probe, leveling the sampler, checking the condition of the sampler's transport cassette and particle separator, powering the sampler unit, and synchronizing the sampler clock.

6.1.3 Health and Safety Warnings

- Safety must be top priority. Therefore, if FS determines that sampler assembly is unsafe at a given point in time or under a given set of conditions, the FS can postpone it. If this occurs, the FS records it in the field notebook and notifies the Regional $PM_{2.5}$-PEP Lead.
- Care should be used when assembling the sampler legs and leveling the sampler to avoid personal injury and sampler damage. If necessary, another person should assist.
- Care should be taken to ensure the battery and/or the electronics do not become wet during assembly, resulting in safety and operational hazards.
- Care should be taken when connecting the sampler to AC power. Do not attempt to connect the main power if any power connectors or wires appear cracked, frayed, or wet. All power cords must be at a safe distance from potential hazards.
- Ensure that the site's AC electrical outlet(s) to which the $PM_{2.5}$-PEP equipment will be connected include GFCI safety features and confirm their operation using a GFCI tester. Otherwise, to ensure safety, insert a portable GFCI device into the outlet and plug the sampler into the device. Use extension cords with built-in GFCI protection whenever possible.

- Avoid unnecessarily opening the sampler's control panel or touching the internal electrical components while the AC power or battery is connected. Care should be taken when adjusting internal components (e.g., circuit board adjustments during calibration) while the sampler is connected to a power source.

6.1.4 Cautions

- The manufacturer's assembly instructions must be carefully followed to avoid damage to the $PM_{2.5}$-PEP sampler components and to ensure proper sampler operation.
- Minimize risk of falling by ensuring the unit remains balanced when attaching the legs to the sampler's main body. If necessary, ask another person for assistance in attaching the legs.
- Prior to arriving at the site, review the weather forecast for the site and take note of any adverse weather conditions expected during the sampling period. Take appropriate precautionary steps to ensure safety and protect equipment if adverse weather is forecasted (e.g., extra fortification of the sampler using sandbags or concrete blocks if high winds are possible).
- Physical damage may occur if the sampler's battery and/or studs come into contact with its printed circuit board.
- When using DC power, the sampler's battery should be fully charged prior to initiating the sample run to prevent risk of an incomplete run caused by a temporary power failure.
  - It is highly recommended to replace the battery if it does not charge to its nominal voltage (12 volts) after at least 16 hours of charging, or if the battery is beyond four (4) years of age (typically near end-of-life).
- Proper setup and maintenance is necessary prior to each sampling event to prevent sampler damage and/or contamination. Ensure adequate maintenance to the sampling pump (i.e., soundness of electrical and pneumatic connections) and other components which are repeatedly assembled and disassembled.
- Handle with caution the sampler's water collection jar attached to the side of the inlet to prevent cracking or breakage. Wrap the glass jar with insulating tape or use a plastic jar to minimize the chance of breakage.
- Verify and synchronize the $PM_{2.5}$-PEP sampler's clock to the **local standard time** of the site's primary routine $PM_{2.5}$ sampler. Recognize the site's time zone and do not consider any adjustment to daylight savings time. Then ensure that the $PM_{2.5}$-PEP sampler's scheduled start/stop times coincide with that of the site's primary routine $PM_{2.5}$ network sampler.

6.1.5 Equipment and Supplies

- Portable BGI PQ200 sampler and instruction manual (as described and illustrated in Section 5.4).
- At least one backup $PM_{2.5}$-PEP sampler.
- Extension cord of adequate length, preferably with built-in GFCI protection.

- Wet location rated (certified by either Underwriters Laboratory [UL] or Electrical Testing Laboratories [ETL]) electrical multi-socket (power strip) or an exterior extension cord with multi-socket tap.
- Bubble leveling device.
- Shims for leveling instrument.
- Bricks, sandbags, and/or spikes for driving in the ground, or deck screws (with permission) and zip ties to secure the sampler legs to decks.
- Assorted tools, including screwdrivers and pliers.
- Flashlight for inspection of various sampler assemblies.
- Pen or pencil for marking the sampler for reassembly.
- Properly secured scaffolding or ladders for unique sampler location/siting challenges.
- Two (primary and backup) NIST-traceable multi-calibrators for parametric performance verification checks.
- Soft brush.
- Lint-free wipes (e.g., Kimwipes).
- Powder-free disposable examination gloves.
- Alcohol wipes.
- Spare O-rings and vacuum grease.
- Transport filter cassette (and travel WINS if the impactor is used as the $PM_{2.5}$ separator).
- Diffusion oil and dropper (if the WINS impactor is used as the $PM_{2.5}$ separator).
- An extra pre-cleaned VSCC (optional).
- Portable GFCI device.
- Laptop/tablet computer with the BGI PQ200 sampler downloader software installed.
  - PQ200 sampler downloader software available on the manufacturer's website and on the AirQA.org website (PEPs➔PM2.5-PEP➔Documentation)
- $PM_{2.5}$-PEP COC forms and FDS forms associated with the filters included on the trip.

6.1.6 **Procedure**

This procedure describes the process for assembling the portable $PM_{2.5}$-PEP sampler at the field site or for indoor setup when testing the sampler before field use. This procedure is best understood by working with someone experienced in setting up a sampler.

Prior to assembling the sampler, the FS should turn on the verification equipment in a protected and shaded outdoor location to allow for approximately one hour of equilibration which will ensure that the internal components of the standards reach ambient temperature. As equilibration time may vary, the FS should use discretion on the time required for the sampler to achieve equilibrium.

The procedures below refer to the four sides of the sampler's main unit box:

Side 1: Left side (with handle).

Side 2: Back (where the power supply and its weather shroud and temperature sensor sun shield attach).

Side 3: Right side (with handle).

Side 4: Front (with door).

These sides are viewable in Figure 6-1.

Figure 6-1. Views of Each Side of the BGI PQ200

6.1.6.1 Assembling the Legs and Anchoring the Sampler (One-Man Assembly)

Adhering to the safety protections noted in Section 6.1.3, the process for assembling the sampler legs and anchoring the sampler involves the following steps:

1. Lay the sampler equipment as close to the intended siting location as possible.

2. Lay the sampler's main unit on either Side 1 or 3. If the sampler is to be laid on its back, care should be taken to prevent grass, dirt, and other debris from entering the fan vent hole.
3. Place the three legs beside the main unit for easy access. The legs are identical and interchangeable.
4. Attach two of the three legs to the unit – one at each of the two attachment studs on the bottom of the sampler.
   - If the sampler is laying on Side 1, the attachment stud on Side 1 will be pointing into the ground and will be inaccessible.
   - If the sampler is laying on Side 3, the attachment stud on Side 3 will be inaccessible.
   - Verify that 1) the lock pins snap into place, and 2) the two legs are securely attached.
5. Securely hold the main unit and slowly lift or "walk" the unit up on the two legs into an upright position.
6. Attach the third leg to the last attachment stud.
   - Verify that 1) the lock pins snap into place, and 2) the leg is securely attached.
7. Place the sampler at the intended siting location.
8. Affix the sampler to the ground, platform, or flooring while ensuring that the sampler will be level, stable, and not prone to excessive vibration (whether due to internal sources such as pump motor vibrations, or to external sources such as a nearby train track) during the 24-hour sampling period. In particular, the sampler must not be prone to tipping due to high winds, vibration, or any other event that might occur during the 24-hour sampling period. Methods for securing the sampler include:
   - a 25-lb sandbag or concrete blocks placed on each foot and propped on its respective leg; or long landscape nails driven in the ground through the holes in the feet, or next to them and secured with heavy duty cable ties,
   - With permission from the SLT agency, the feet can be screwed to the deck of a sampling platform using bolts, clamps, etc.
   - If placed on a slick surface, the sampler should be secured with a sandbag hanging from the bottom or by concrete blocks placed on each foot. Placing wooden planks under the sampler legs may prevent damage to rubber or tar roofs.

6.1.6.2 Assembling the Sampler Main Unit

1. If transported separately, remove the sampler's weather shroud (rear cover) from its transportation case and install it on the back of the sampler's main unit (Figure 6-2).
2. Remove the AC power supply from its transportation case and attach it to the AC power supply to the rear of the unit under the weather shroud. *Do not plug in the power supply yet*.
3. Remove the gill screen (Figure 5-3) that contains the ambient temperature sensor from the transportation case and attach the screen to the back of the main unit (Figure 6-2); the attachment points are on the weather shroud (back cover). Position the gill screen

assembly so that it sits above the top of the sampler case. Screw the connectors firmly into the attachment points.

4. Open the front door of the sampler's main unit and feed both female three-pin power connectors through the hole underneath the sampler case.

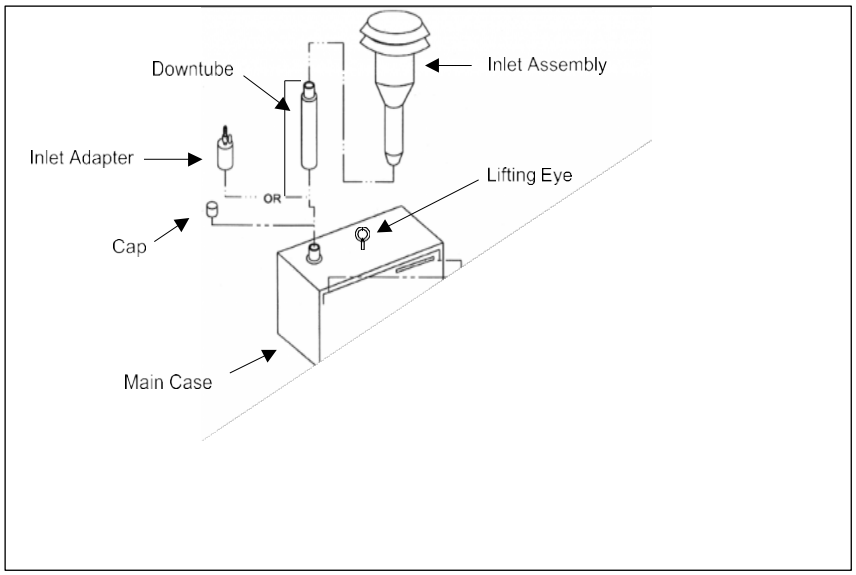


Figure 6-2. Back view of the PM2.5-PEP sampler's main unit

5. While the front door is open, remove the two screws holding the instrument panel. Swing the panel forward on its hinge.
6. Feed the two female three-pin power connectors through the hole that leads to the cavity behind the instrument panel. Connect the female three-pin power connectors to the appropriate male connectors (the male/female connectors are keyed to prevent the installation of a female connector into the wrong male connector).
7. Remove the wing nuts from the battery-securing studs and remove the metal restraining bar. Carefully remove the battery from the transport case and install it in the battery tray located at the rear of the electronics compartment. Take care to avoid dropping the battery or allowing it to come into contact with the printed circuit board. Secure the battery using the metal restraining bar and thread the two wing nuts onto the studs.
8. Verify that the connectors are seated properly on the circuit board.
   - If these connections are loose (e.g., due to transport or opening the front panel), unusual and/or erroneous display readings can result.
9. Connect the color-coded wires to the color-coded terminals on the battery (red on red; black on black).
10. Confirm proper connection of the battery by powering up the unit prior to plugging it into the AC adaptor.
    - Successful unit power-up: The battery is properly connected.
    - Failed unit power-up: Recheck battery connections or replace the battery, if necessary.
11. Close the panel, making sure all wires and cables are out of the way.

6.1.6.3 Leveling the Sampler

1. Inspect the assembled sampler to ensure that the inlet is not misaligned due to an improperly mounted downtube. The downtube should be perpendicular to the top of the sampler's main case. If necessary, adjust the downtube mountings.
2. Place the bubble level on the top of the assembled sampler and adjust the sampler as necessary until the bubble falls within the level indicator (i.e., the unit's top surface is horizontal and parallel with the siting surface).
   - If the sampler's horizontal angle is not even, carefully place shims (wood or other solid material) under the legs until leveling is achieved.
   - Repeat the leveling process if subsequent activities cause the sampler to no longer be level relative to the siting surface.
3. Visually inspect the assembled sampler (front to back, side to side) to verify the following:
   - the size-selective inlet is firmly seated on the downtube, and
   - the downtube is plumb (vertically parallel) with the sampler module.

6.1.6.4 Inspecting the Transport Cassette and Particle Separator

Prior to any transport of a $PM_{2.5}$-PEP sampler, as well as before any verifications are performed, the FS shall confirm that a transport cassette is securely seated within the sampler. (The sampler should never be transported, nor should a flow check verification be performed, while loaded with a filter cassette that is intended for collecting a sample.) Once the sampler is assembled at the monitoring site, the FS shall inspect the transport cassette and particle separator (WINS impactor or VSCC) as follows:

1. Thoroughly clean hands with alcohol wipes and allow to air dry or wear disposable powder-free examination gloves (e.g., nitrile). Reclean hands or replace gloves if they become dirty.
   - It is recommended that gloves be worn when using oil or grease.
2. Open the main unit door and carefully rotate the handle counterclockwise using both hands to open the filter chamber assembly. This action will expose both the transport cassette and the particle separator.
3. Remove the transport cassette and inspect for damage.
4. Verify that the transport cassette is labeled as such (e.g., "Transport") on the side of the cassette.
   - As a best practice, the label on the transport cassette should face outward and be visible when loaded within the sampler.
5. Remove the particle separator and inspect for signs of contamination or damage.
   a. If the sampler uses a VSCC (the default $PM_{2.5}$ separator for the BGI PQ200 sampler):
   - Remove the grit cap and discard any particles.

- Either clean any residue or deposits from the impactor before use or replace it with a clean, backup VSCC.

b. If the sampler uses a WINS impactor:

- Confirm that the impactor is clean inside and out.
- Because it sits directly over the filter cassette when installed, verify that the bottom of the impactor is clean.

5. Inspect the filter housing (lower portion of filter chamber assembly) for obvious contamination, missing pieces, or damage.
   - If the sampler uses a WINS impactor, confirm that any oil loaded within the impactor has not leaked out, requiring cleaning.
   - Ensure that the interior of the housing is clean and free of debris.
6. Verify that O-rings are installed inside the upper and lower filter housings where the O-rings contact the filter cassette, inspect the O-rings for any wear or abrasion, and replace them if necessary.
7. Re-seat the transport cassette into its sampling position.
   - If any damage is noted on either the cassette or the filter it contains, replace the transport cassette and filter with a spare prior to initiating any sampler verifications.
8. After confirming proper seating of the filter cassette and transport particle separator, close the filter chamber assembly by slowly rotating the handle clockwise three quarters of a turn until the cam follower clicks into the indent in the cam. Confirm that the filter chamber assembly closes securely.
   - If necessary, adjust the compression between the filter cassette and the filter chamber assembly by rotating the cam follower adjustment nut.

6.1.6.5 Powering the Unit

When at the monitoring site, the process of powering on the BGI PQ200 sampler involves the following steps:

> The PQ200 sampler display screen depends on the board used. The examples shown in this section are for samplers using the Rev-U board. Consult the BGI PQ200 Operators Manual for specific information.

1. Reconfirm (after the pre-visit confirmation) whether AC power is available at the site and that the site's available electric circuits and outlets meet the requirements for the additional $PM_{2.5}$-PEP sampler (otherwise proceed to Step 2):
   - Verify that the site has available a 110/120-volt grounded outlet that is equipped with a GFCI. If it does not, the FS should place a temporary GFCI device in line with the outlet.
   - If only one outlet is available, use an appropriate expansion device (e.g., power strip rated for wet locations [either UL or ETL certified]). Be sure that the expansion device can handle the same level of current as the circuit. A surge of power at startup can cause problems with the sampler.

- Ensure that the circuit does not appear overloaded; typically, a circuit will be wired to provide 20 amps. For example, if two high volume samplers are plugged into the receptacle and running during the scheduled sampling period, there will likely not be enough power to operate the $PM_{2.5}$-PEP sampler along with all other samplers at the site.

If the FS deems that site's AC power is sufficient for accommodating the $PM_{2.5}$-PEP sampler, then the sampler's AC power supply unit can be plugged into the site's power supply. Proceed to Step 3.

2. If AC power is not available (or is deemed not sufficient) and the Regional $PM_{2.5}$-PEP Lead has approved the use of battery power, the sampler may be operated during the $PM_{2.5}$-PEP sampling event using its battery backup system.
   - Ensure that the battery is fully charged prior to the start of the 24-hour sampling period. When fully charged, battery power is sufficient to operate the BGI PQ200 sampler for 24-hours in all but the most extreme conditions (e.g., high particle loads, cold weather conditions). Notify the Regional $PM_{2.5}$-PEP Lead if there is any concern that a fully charged battery will be insufficient to power the sampler throughout the 24-hour sampling period.
   - When operating from battery power, the sampler's control screen is dimmed. Thus, it may be necessary to press the red **LIGHT** button (if available) to view the screen.

   > The sampler's internal box fan may begin running during installation or retrieval of a filter due to a temperature difference > 5ºC between the internal temperature sensor and ambient temperature probe. If this occurs, close the box lid and allow the fan run for a few minutes until the fan stops running. If the fan does not stop running, there may be wire harness connection problem.

3. Press the **ON/OFF** button on the BGI PQ200 sampler. The screen will illuminate and initially display sampler-specific information (e.g., version number and serial number).
4. After a few seconds, the main screen will appear. The main screen displays the ambient barometric pressure, ambient and filter temperatures, date, time, power source, and any flags that may have occurred. Any status or error messages will also appear on the screen. For example:

5. Confirm that the data file generated by the sampler's internal data logger during its previous run was previously downloaded. If it was not, the screen will display an alert message. If this message appears, download the data file to the notebook or tablet

computer to prevent the information from being lost (see Section 7.3.5.3), document the download in the field notebook, and notify the Regional $PM_{2.5}$-PEP Lead.

- Any data file stored within the sampler from a previous run will automatically be deleted from the sampler computer when the $PM_{2.5}$-PEP sample collection begins.

6. Confirm the accuracy of the date and time displayed on the main screen (#4 above). The time should correspond to within ±1 minute of local standard time at the site. The PQ200 sampler operates exclusively on 24-hour military time format.

> **Best Practice:** Connect the sampler to a power source if the time between sampling events/trips is expected to be more than 72 hours. This will ensure that its super capacitors are fully energized, thereby preventing the need to reset the sampler's date and time after an extended period of non-use.

7. Press the **SELECT** button on the sampler's control panel to enter the Main Menu. If necessary, follow the steps in Section 6.1.6.6 to set the sampler clock to local standard time.

6.1.6.6 Setting the Sampler Clock to Local Standard Time

Prior to a $PM_{2.5}$-PEP sampling event, the FS initially sets the $PM_{2.5}$-PEP sampler clock to local standard time to confirm that the clock is working properly. The following steps are taken to set or adjust the current date and time on a BGI PQ200 sampler:

1. From the Main menu, press **SELECT**. Then press the down arrow button to navigate to the **Set Current Date and Time** option (i.e., the arrow on the left points to this option – see below). The sampler's internal clock setting (date and time, in 24-hour miliary time format) should display – the current setting will be blank if the clock holds no date/time information. The current setting will also be flashing except for the item that can currently be edited.

2. Enter each component of the current date and time (month, day, year, hour, minute) using the arrow keys. Press **SELECT** to store each entry and use the arrow button to move to the next component.
3. Once the current date and local time are completely set and correct (i.e., the time is set to within one (1) minute of the local standard time), press the **EXIT** button to return to the Main menu. Press the **EXIT** button again to return to the home screen.
4. Recheck the final displayed date and time against the time standard (repeating the above steps if anything needs to change) and record the displayed date and time in the FDS (with the time in 24-hour military format).

  - Note that Step 4 is repeated after performing the leak check procedures (Section 6.2).
5. Continue to monitor the displayed date and time through the remainder of sampler set-up (including verification) to confirm that the time value is advancing accurately (i.e., the time being displayed continues to be accurate to within one (1) minute of the local standard time).

6.2 Leak Check Procedures

6.2.1 Scope and Applicability

This section details the procedure for performing the mandatory external and internal leak check on the portable $PM_{2.5}$-PEP sampler prior to conducting the flow rate verification (Section 6.5). This leak check will verify the integrity of all connections in the airflow path including the VSCC (or the WINS impactor) assembly, tubes, fittings, and the sampler's flow rate measurement sensor.

The following information applies only to the BGI PQ200 sampler and may not be applicable as written to other makes or models of equipment.

6.2.2 Summary of Method

The leak check procedure verifies that the air handling system in the sampler is adequately free from leakage that could cause filtration artifacts or the incorrect measurement of flow rate. The sampler must pass a leak check before flow rate verification can be performed.

An internal leak check of the BGI PQ200 sampler involves pulling a vacuum on the internal air volume of the fully assembled sampler, sealing the volume by closing valves, and monitoring the internal pressure change for two (2) minutes. Older samplers and software may require up to 10 minutes for its leak check. If the internal pressure increases too rapidly, this signals that a leak is present, and troubleshooting procedures must be followed to identify and stop the leak.

An internal leak check procedure to assess the presence of leakage within the filter assembly is also described as a troubleshooting procedure (Section 6.2.5.3).

6.2.3 Cautions

- Ensure that the filter cassette is properly seated and that the cam is properly closed to create a seal.
- Do not connect any other device to the flow rate adapter when conducting this procedure.

6.2.4 Equipment and Supplies Specifically Applicable to Leak Checks

- A transport cassette containing a filter which is specifically designated for use in leak checks and/or flow checks. The $PM_{2.5}$-PEP weighing laboratory can provide additional unweighed filters upon request.
  - Filters designated for leak checks, flow rate verifications, and flow rate calibrations are not to be used for collecting a sample.

  - While a filter designated for use in leak checks and/or flow checks can be used repeatedly for this purpose, change the filter every 4-6 sampling event set-ups or more often if the filter has noticeable build-up.
  - The filter should be discarded when soiled or damaged, (The transport cassette should be retained.)
  - If the transport cassette is damaged or inoperable, it should be discarded and reported to the $PM_{2.5}$-PEP weighing laboratory so that a replacement cassette can be shipped and received.
- Flow rate adapter with valve to close flow (Figure 6-3a and Figure 6-3b). These are supplied with every sampler.
- Impermeable disk for internal leak check (stainless steel or plastic film).
- $PM_{2.5}$-PEP FDS.

Figure 6-3a. Photo of flow rate adapter for the $PM_{2.5}$-PEP sampler

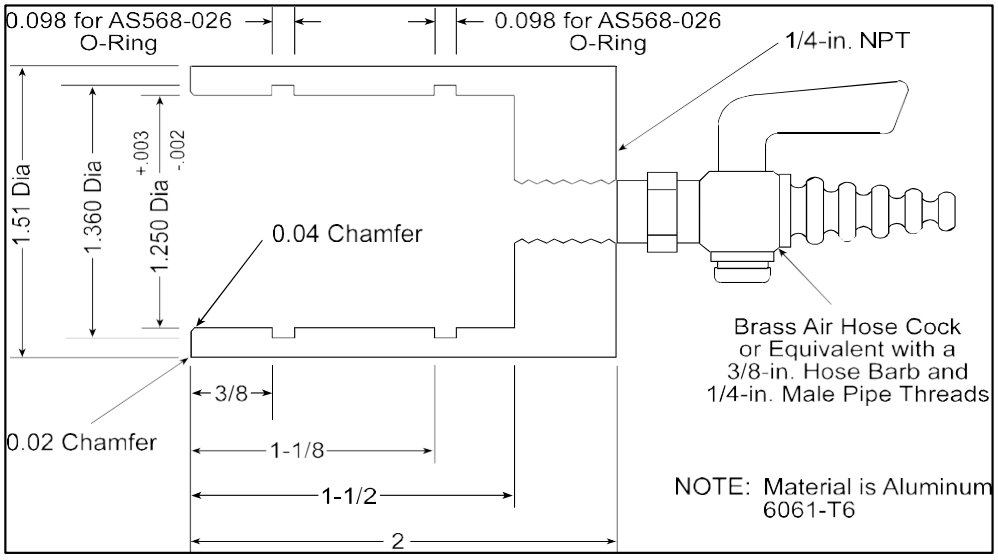


Figure 6-3b. Schematic of the flow rate adapter for the $PM_{2.5}$-PEP sampler

6.2.5 **Procedure**

6.2.5.1 Conducting an External Leak Check

The FS performs an external leak check on the $PM_{2.5}$-PEP PQ200 sampler as follows:

1. Open the main unit door and carefully rotate the handle counterclockwise using both hands to open the filter chamber assembly.
2. Confirm the following while the filter chamber assembly is open:
   - Ensure that the transport cassette designated for use in leak checks is inserted into the filter holder.
   - Ensure that this cassette is properly labeled or marked to prevent its use in collecting a filter sample.
   - Verify a clean transport WINS or clean VSCC is installed within the sampler.
3. Close the filter chamber assembly by rotating the cam clockwise until it locks into place.
4. Remove the downtube from the transport container and install it on top of the sampler. Place the flow rate adapter on the top of the downtube. Close the valve on the adapter to prevent air flow.
5. From the Main menu of the BGI PQ200 sampler, press the arrow keys to navigate to the **Leak Test** option (i.e., the arrow on the left points to this option). Press **SELECT** to enter the leak test menu.
6. Ensure that the flow path is sealed (i.e., the valve on the flow rate adapter is closed and the cam is rotated fully clockwise to seal the VSCC/WINS impactor and filter assembly securely in place). From the leak test menu, press **SELECT** to begin the leak test. The screen will display **PQ200 LEAK TEST: In Progress!** Press **SELECT** again to begin evacuating the system.

7. The pump will pull a vacuum on the system and will turn off when a vacuum in excess of 75 centimeters of water column (cm H_2O) is attained. The system will then begin a two-minute timer. The initial (locked) pressure is displayed on the left side of the screen. This initial pressure reading will exceed 75 cm H_2O.
8. The PQ200 sampler firmware evaluates the performance of the system and reports results of the leak check (i.e., pass or fail) at the end of the two-minute period. Record the initial and final pressure and indicate the result of the leak check on the FDS.

- To pass the test, the differential system pressure (SP) must not drop by more than five (5) cm H_2O water column during the two-minute time interval, or equivalently, 80 mL/min as stated in 40 CFR Part 50 Appendix L and Section 8 of this document.
- If the sampler passes the external leak test, release the vacuum on the system by slowly opening the valve on the flow rate adapter. Remove the flow rate adapter from the downtube, cap the opening and continue to barometric pressure verification (Section 6.3).
- If the sampler failed the leak test, investigate and correct any malfunctions as described in the troubleshooting document. (The outcome of the internal leak check may determine the location of the leak.)

6.2.5.2 Conducting an Internal Leak Check

The FS performs an internal leak check on the $PM_{2.5}$-PEP PQ200 sampler as follows:

1. Release the vacuum on the system by slowly opening the valve on the flow rate adapter. Keep this valve open throughout the leak check.
2. Insert an impermeable disk (i.e., stainless steel or plastic film that is the same size, shape, and rim thickness as the PTFE filter). This disk isolates the air space from beneath the solid disk to the solenoid valve before the pump assembly.
3. Perform the internal leak check by following the same approach as for the external leak check (Section 6.2.5.1), while the flow rate device valve is open to the atmosphere.
   - If the sampler fails the external leak check but passes the internal leak check, the leak must be in an area above the filter. This may indicate that O-rings need replacement. Inspect and replace O-rings if necessary.
   - If an internal leak is detected, confine the search for the leak to the area below the filter disk. Inspect and replace any tubing if cracks or excessive stretching have occurred. If the problem was discovered and rectified, then repeat the external leak check (Section 6.2.5.1).

If the leak checks detect a leak that cannot be located and cannot be rectified by performing all field-based troubleshooting procedures, then the sampler requires further troubleshooting and maintenance and should not be used for the $PM_{2.5}$-PEP sampling event. The leak(s) can be further investigated and rectified upon the sampler's return to the Regional field office. The FS should utilize the backup PEP sampler for the $PM_{2.5}$-PEP sampling event (once it has undergone and passed the verification tests). However, if a backup sampler is unavailable for the $PM_{2.5}$-PEP sampling event, then the sampling event may proceed despite the leak(s) present, but only following completion of all field-based troubleshooting procedures and upon approval of the $PM_{2.5}$-PEP Regional Lead. In addition, the sampler must achieve the following limited conditions to proceed:

1. The leak test failure occurred after 1 minute and 45 seconds.
2. The leak test failed even after placing a new cassette with filter in the sample train.

3. The actual flow rate (with a new travel cassette and filter loaded) was verified to be within one percent (1%) of the sampler's design flow rate. (This does not guarantee that the flow rate through the separator and filter is 16.67 LPM unless the leak is external rather than internal.)

6.3 Barometric Pressure Verification

6.3.1 Scope and Applicability

This section applies to verifying the barometric pressure measurement system of the BGI PQ200 sampler using a barometric pressure verification device. Information herein may not be applicable to other sampler makes or models. Refer to instrument operating manuals for directions on using barometric pressure verification device makes/models.

6.3.2 Summary of Method

The BGI PQ200 sampler has a built-in atmospheric pressure sensor. The sensor's output is processed to allow control of the sampling flow rate to the sampler's design value of 16.67 LPM under actual (local) ambient conditions of temperature and pressure.

Routine verification is performed by comparing the barometric pressure sensor reading at ambient pressure to an external standard of known accuracy. If a pressure difference of more than ±10 mm Hg is observed, then the pressure-sensing and display system must be calibrated (see instrument operating manual) before the sampler may be used within a $PM_{2.5}$-PEP sampling event.

6.3.3 Cautions

- Protect the internal barometer from mechanical shock and sudden pressure changes. A barometer subjected to either of these events must be verified by comparing it to a laboratory mercury column barometer (or other NIST-traceable standard). If required, the barometer will either be adjusted, or an offset correction will be established.
- Minimize the vertical and horizontal temperature gradients across the barometer and avoid exposure to direct sunlight, drafts, and vibrations.
- When equipment containing a internal barometer is transported to the sampling platform, it must equilibrate to ambient temperature and pressure for approximately one hour before use. However, as equilibration times may vary, the FS should use discretion on time required to achieve equilibrium.
- It may be difficult to verify barometric pressure at high altitudes due to the local conditions having significantly lower pressure. The FS should record and document on the COC any available barometric pressure information (e.g., barometric pressure readings from the site's primary sampler, other samplers at the site, and information from the local airport weather station).

6.3.4 Equipment and Supplies

The following equipment and supplies are required for barometric pressure verification checks:

- BGI PQ200 sampler.
- Portable, NIST-traceable barometer for field barometric pressure verifications.
- $PM_{2.5}$-PEP FDS.

6.3.5 **Procedure**

6.3.5.1 Verification of Barometric Pressure System

The FS verifies the $PM_{2.5}$-PEP sampler's internal barometric pressure sensing system by comparing the sampler reading to that of a barometric pressure verification device equilibrated to ambient conditions. The verification process consists of the following steps:

1. Unpack the barometric pressure verification device and place its sensor head on the downtube.
2. Power on the verification device and allow approximately one hour for equilibration to ambient conditions.
    a. If applicable, replace batteries when the verification device indicates battery power is below the operating manual's recommended percentage.
3. Record the pressure readings from both the $PM_{2.5}$-PEP sampler and the verification device and enter them on the FDS.
    a. If the two readings are within ±10 mm Hg of each other, then the verification of the portable $PM_{2.5}$-PEP sampler's pressure sensor is satisfactory, and the FS can proceed with temperature verification (Section 6.4).
    b. If the two readings deviate by more than ±10 mm Hg, then re-check the barometric pressure using a backup verification device.
        i. If the backup verification device and $PM_{2.5}$-PEP sampler readings are within ±10 mm Hg, then the FS must make a judgment call on whether the original problem was with the $PM_{2.5}$-PEP sampler or the original verification device before proceeding. If the FS feels that the problem is with the $PM_{2.5}$-PEP sampler and cannot be rectified while in the field, then the sampler should be replaced with the backup sampler for the $PM_{2.5}$-PEP sampling event and further troubleshooted and/or repaired upon returning to the Regional field office.
        ii. If the same level of deviation exists with the reading from the backup verification device, and if the FS feels that the problem is with the $PM_{2.5}$-PEP sampler and cannot be rectified while in the field, then the sampler should be replaced with the backup sampler for the $PM_{2.5}$-PEP sampling event as the sampler's pressure measurement system may be damaged and should be serviced upon returning to the Regional field office.
        iii. If either case above, if a backup sampler is not available for the $PM_{2.5}$-PEP sampling event, then a barometric pressure calibration (Section 10.1) is necessary.
    c. Record the barometric pressure readings on the FDS along with the results of their comparisons, any decisions made and their justification, and any action taken.

6.4 Temperature Verification

6.4.1 Scope and Applicability

This section describes operations to verify the temperature measurement system within the BGI PQ200 sampler using a temperature verification device. The reported measurements from the sampler's two temperature sensors (ambient temperature and filter temperature) must be verified prior to the sampler's use within the $PM_{2.5}$-PEP sampling event. Information herein may not be applicable to other sampler makes or models. Refer to instrument operating manuals for direction on using specific temperature verification device makes/models.

6.4.2 Summary of Method

Ambient and filter temperature sensors are each verified at a single point using an external temperature standard of known, NIST-traceable accuracy. If the difference in temperature measurements between the $PM_{2.5}$-PEP sampler and the temperature verification device exceeds 2°C in absolute value, the temperature sensor may need to be calibrated (Section 10.2).

6.4.3 Cautions

- Ensure that the temperature reference standard has been calibrated against a NIST-certified standard within the prescribed time period (annually).
- If the reference standard is a BGI deltaCal® or tetraCal® that has been serviced by Mesa Labs or one of their affiliates, be sure to check its standard temperature setting prior to its use in the field.
  - This can be accomplished by checking the flow rate of a sampler with this instrument and comparing the result to the flow check of a trusted reference standard. If there is a difference of about 8-9% the standard temperature may need to be reset to 25ºC. The requisite BGIOpenCal.exe software is available on the AIRQA website $PM_{2.5}$-PEP documentation pages.
- Frequent assembly and disassembly of the $PM_{2.5}$-PEP sampler may cause damage to the ambient temperature probe's connecting pins. Care must be taken when connecting the pins to the main unit.
- Use care when placing the thermometer's probe through the gill screen to avoid any damage to the screen or probe.
- The temperature verification device probe should not be placed in direct sunlight during equilibration and verification.

6.4.4 Equipment and Supplies

- Portable $PM_{2.5}$-PEP sampler (BGI PQ200 sampler).
- NIST-traceable temperature verification device.
- Timepiece.
- $PM_{2.5}$-PEP FDS (Appendix C).

6.4.5 **Procedures**

6.4.5.1 Single-Point Temperature Verification in Ambient Air

The FS must allow the temperature verification devices to equilibrate to ambient (local) conditions for approximately one hour before use. Equilibration times may vary, and therefore, the FS should use discretion on time required to achieve equilibrium. The verification device should be powered on during equilibration. The filter temperature probe must be attached to the verification device and should not touch other objects so as to prevent erroneous readings.

Following equilibration, the FS performs a single-point temperature verification as follows:

1. Note the verification device's ambient temperature probe reading once the reading has stabilized. Compare it to the ambient temperature reading displayed on the $PM_{2.5}$-PEP sampler's main screen.
    a. If the two temperatures agree to within ±2°C, then the ambient temperature sensor response is acceptable.
    b. If the two temperatures deviate by more than ±2°C, proceed to Step 5.
2. Open the door of the $PM_{2.5}$-PEP sampler's main unit. Open the filter holder assembly, remove the cassette, and set aside in a clean location.
3. Place the verification device temperature probe within approximately one (1) centimeter of the sampler's filter temperature sensor located at the bottom of the filter assembly.
4. Allow the temperature reading from the verification device to stabilize. Compare the reading to the filter temperature reading as displayed on the sampler's main screen.
    a. If the two temperatures agree to within ±2°C, then the filter temperature sensor response is acceptable. Proceed to Step 6.
    b. If the two temperatures deviate by more than ±2°C, proceed to Step 5.
5. If either temperature reading (i.e., ambient or filter) is outside of its acceptance criteria, allow 10 to 15 minutes for additional equilibration. Repeat the verification procedure.
    a. If the two temperatures still deviate by more than ±2°C, repeat the process with a backup verification device.
    b. If the backup verification device and $PM_{2.5}$-PEP sampler readings are within ±2°C, then the FS must make a judgement call on whether the original problem was with the $PM_{2.5}$-PEP sampler or the original verification device before proceeding. If the FS feels that the problem is with the $PM_{2.5}$-PEP sampler and cannot be rectified while in the field, then the sampler should be replaced with the backup sampler for the $PM_{2.5}$-PEP sampling event and further troubleshooted and/or repaired upon returning to the Regional field office.
    c. If the two temperatures still deviate by more than ±2°C using a backup verification device, and if the FS feels that the problem is with the $PM_{2.5}$-PEP sampler and cannot be rectified while in the field, then the sampler should be replaced with the backup

sampler for the $PM_{2.5}$-PEP sampling event as the sampler's pressure measurement system may be damaged and should be serviced upon returning to the Regional field office.

d. If either case above, if a backup sampler is not available for the $PM_{2.5}$-PEP sampling event, a temperature calibration will need to be performed (Section 10.2).

6. Remove the verification device from the sampler and return the filter assembly to its normal configuration.
7. Record the two ambient temperature readings and the two filter temperature readings on the FDS along with the results of their comparisons, any decision made and their justification, and any action taken.

6.5 Flow Rate Verification

6.5.1 Scope and Applicability

The following information applies to the BGI PQ200 sampler. Information herein may not be applicable to other sampler makes or models. Refer to instrument operating manuals for directions on using specific flow rate verification device makes/models.

The mass concentration of $PM_{2.5}$ in ambient air is determined as the total mass of collected particles in the $PM_{2.5}$ size range in a total volume of air sampled. The measured volumetric flow rate and the sampling time are used to determine the total volume of air sampled. The sampler's flow rate must be maintained at a constant value within four percent (±4%) of the sampler's design flow rate of 16.67 LPM (i.e., 16.00 to 17.34 LPM) to ensure control of the size-fractionating cut points and accurate measure of total volume.

A single-point flow rate verification must be performed before each $PM_{2.5}$-PEP sampling event. This verification must precede all other verifications (i.e., sampler leak check, temperature, and barometric pressure verification).

6.5.2 Summary of Method

Prior to each $PM_{2.5}$-PEP sampling event, the FS must verify the flow rate of the $PM_{2.5}$-PEP sampler at a single point using an external flow rate verification device (i.e., flow transfer standard) of known NIST-traceable accuracy. If values for the following two metrics exceed their specified acceptance criteria, the sampler may need to be recalibrated (Section 10.3) or sent for repair.

- Percent difference ($PD_{standard}$) in flow rate measures between the $PM_{2.5}$-PEP sampler and the verification device must be within ±4%.
- Percent difference (PD_{design}) between the $PM_{2.5}$-PEP sampler's design flow rate (16.67 LPM) and the flow rate measure from the verification device must be within ±4%.

A one-point flow rate verification must be repeated after completing any sampler calibration procedure to ensure that the $PM_{2.5}$-PEP sampler continues to operate within acceptable deviation from its design flow rate (16.67 LPM ±4%).

6.5.3 Cautions

- Do not perform verifications on the $PM_{2.5}$-PEP sampler without the transport filter cassette installed. For this verification, the transport filter cassette should contain a clean PTFE filter that is free of holes, wrinkles, debris, or other defects.
- Verification of the $PM_{2.5}$-PEP sampler's flow rate measurement system must be in units of the actual ambient volumetric flow rate. Do not use "mass flow rate" or "flow rate at standard conditions."
- Verify that the flow transfer standard is properly seated on the downtube.

6.5.4 Equipment and Supplies

- Portable $PM_{2.5}$-PEP sampler (BGI PQ200 sampler).
- NIST-traceable flow rate verification device
- Calculator
- $PM_{2.5}$-PEP FDS

6.5.5 Procedure

6.5.5.1 Verification of the Sampler's Flow Rate

The FS performs the $PM_{2.5}$-PEP sampler's flow rate verification procedure as follows:

1. Ensure that the sensor head of the flow rate verification device is properly seated on the downtube and is equilibrated to ambient conditions.
2. Install a clean transport filter and cassette in the filter cassette holder.
   - This cassette should not be used for sample collection, as a blank, or as a QC sample.
   - The transport filter cassette may be reused at other sites if it remains clean and is free from any defects such as tears, pinholes, or separation from the support ring.
3. From the sampler's Main menu, use the arrow keys to navigate to the **Calibrate/Verify Flow Rate** option. Press **SELECT** to enter the Test menu.
4. From the Test menu, press the down arrow to navigate to the **Verify** mode.
5. Press **SELECT**. The pump will start. Observe the flow rate measurement on the display screen as it increases and eventually stabilizes. Allow at least two (2) minutes for the measurement to stabilize (more time may be needed in certain conditions such as when elevations are above 4,000 feet or when very cold). The flow rate measurement may continue to fluctuate or oscillate for a time. Once the measurement has stabilized, record the displayed high and low values of the oscillation and the mean flow rate on the FDS.
6. Observe the flow rate value displayed on the flow rate verification device and record that value on the FDS.

7. Recheck the final displayed date and time against the time standard (repeating the steps in Section 6.1.6.6 if the current date or time needs adjustment) and record the displayed date and time in the FDS (with the time in 24-hour military format).

6.5.5.2 Flow Rate Acceptance Criteria

1. Calculate the percent difference ($PD_{standard}$) between the two flow rates as measured by the PM2.5-PEP sampler ($Flow_{sampler}$) and by the flow rate verification device ($Flow_{standard}$):

$$PD_{standard}(\%) = \frac{Flow_{sampler} - Flow_{standard}}{Flow_{standard}} \times 100$$

2. Calculate the percent difference (PD_{design}) between the flow rate as measured by the verification device ($Flow_{standard}$) and the PM2.5-PEP sampler's design flow rate of 16.67 LPM:

$$PD_{design}(\%) = \frac{Flow_{standard} - 16.67}{16.67} \times 100$$

3. If either $PD_{sampler}$ or PD_{design} exceed their acceptance criteria (±4%) as specified in Section 6.5.2, then the FS should verify whether the sampler and/or the flow rate measurement equipment are operating properly by performing the following steps and then repeating the flow rate verification procedure above:
   - If the elevation is above 4000 ft, let the sampler run for at least four (4) minutes at an apparent stable flow.
   - Verify all sampler fittings and air hoses are tight and free of kinks or obstructions.
   - Verify proper seating of the flow rate verification device on the downtube to prevent leakage past the O-rings that seal it to the downtube.
   - Verify that flow has stabilized and ensure that the verification device has been given enough time to equilibrate to ambient conditions.
   - Verify that the VSCC or WINS impactor and filter holder assemblies are closed completely.
   - Visually inspect the sampler and the flow rate measurement equipment. Consider any other factors that might affect the flow rate measurement or the sampler operation.

   If the verification device flow rate and/or sampler flow rate still do not meet acceptance criteria after repeating the flow rate verification procedure, check the temperature and barometric pressure readings because they affect the instrument's flow rate calibration.

4. If the calibrator's reported sampler flow rate continues to fail acceptance criteria, a mechanical problem with the sampler likely exists. The sampler should not be used for future $PM_{2.5}$-PEP sampling until it is recalibrated or repaired. The FS should use the backup $PM_{2.5}$-PEP sampler for the current $PM_{2.5}$-PEP sampling event. If a backup sampler is not available, a flow rate calibration will need to be performed (Section 10.3) in the field.
5. Record the final result of the verification check on the FDS.
6. Disconnect the flow rate standard from the sampler, power it off, and return it to its case. Remove the calibration adapter and carefully reinstall the sampler's inlet.

6.6 Post-Verification Sampler Assembly

6.6.1 Scope and Applicability

This section describes procedures for preparing the BGI PQ200 sampler for sample collection once all routine sampler verifications have been performed and passed. The information presented herein is specific for the BGI PQ200 sampler and may not be applicable to other sampler makes and models.

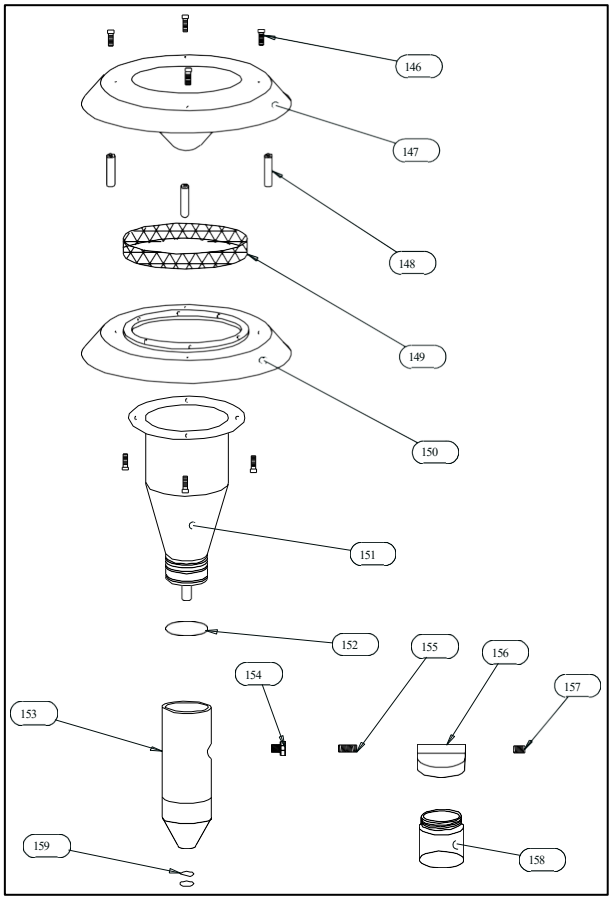
6.6.2 Summary of Method

Once all routine verifications are complete, the FS must attach the inlet assembly and install the WINS assembly (if a VSCC is not being used). If using a VSCC, it should be installed at the Regional field office prior to the trip.

6.6.3 Procedure

6.6.3.1 Attaching the Inlet Assembly

1. Remove the main (first-stage) size-selective inlet assembly from the transport case.
2. Inspect the main (first-stage) size-selective inlet assembly for missing pieces or damage.
3. Inspect downtubes for contamination in the flow path.
4. Examine the two O-rings on the interior of the bottom end of the downtube. Ensure that they are present and in good condition.
5. Ensure that the filter chamber assembly inside the main assembly is in the closed position.
6. Install the main inlet assembly on the downtube.
7. Locate the water collection hardware (part numbers 154–158, Figure 6-4) and attach it to the side of the inlet. Avoid cross-threading the connecting pipe when firmly attaching the collection jar.



Part Number	Description	Part Number	Description
146	#6-32 x 3/8" Philips pan head screw	153	Inlet tube
147	Inlet top	154	1/4" x 3/8" NPT adapter
148	Spacer	155	1/4" NPT nipple
149	Screen	156	Jar top
150	Inlet sub-top	157	1/4" NPT plug
151	Inlet body	158	Glass jar
152	O-ring	159	O-ring

Figure 6-4. Exploded view of the inlet unit of the BGI PQ200 sampler

6.6.3.2 Installing the Very Sharp Cut Cyclone (VSCC) Impactor Assembly

Each $PM_{2.5}$-PEP sampler must be equipped with a second stage particle size selector for collecting $PM_{2.5}$. If the sampler uses a VSCC impactor for fine particle separation, it should be installed at the Regional field office or laboratory prior to the sampling event trip. Refer to the Mesa Labs BGI PQ200 User Manual for detailed instructions.

If the VSCC requires replacement while onsite, the FS can install a backup VSCC assembly within the sampler as follows:

1. Remove the impactor and the impactor housing from the sampler. The housing is composed of a top and bottom piece for holding the impactor.
2. Insert a clean VSCC into the cam assembly and tighten the screw to hold it in place.
3. Loosen the locking screw on the cam adjustment dial.
4. Use a permanent marker to mark a line in middle of the cam adjustment dial.
5. Raise the cam wheel by turning the cam adjustment dial to the left for 1.75 revolutions (i.e., 680 degrees).
6. Use the adjustment dial to ensure that the VSCC is sufficiently tight to ensure the sampler will pass a leak check.

6.6.3.3 Installing the WINS Impactor Assembly

If the $PM_{2.5}$-PEP sampler uses a WINS impactor for fine particle separation, then the FS should load a clean and empty transport WINS impactor within the sampler for transport to the field site.

WINS impactors currently have limited application in the $PM_{2.5}$-PEP. VSCCs are used predominantly.

Once onsite and following all verification checks, the FS should add diffusion oil to the impactor to prevent contamination. An oiled impactor well can be prepared prior to the trip and carefully transported to the site but should never be transported inside the sampler due to the high risk posed by contamination.

The FS installs the WINS impactor assembly through the following steps:

1. Open the main unit door and carefully rotate the handle counterclockwise using both hands to open the filter chamber assembly to expose the transport cassette and transport WINS impactor.
2. The transport WINS impactor should now be visible. If not, gently separate the filter cassette or WINS impactor chamber from the upper housing.
3. Remove the transport filter cassette and set it aside in a well-marked plastic bag.
4. Inspect the impactor assembly (upper portion of filter chamber assembly) for missing pieces or damage.
5. Confirm that the O-ring inside the upper impactor housing where it contacts the impactor well is present and in good condition.
6. Remove the transport WINS impactor and return it to an impactor cup for storage.
7. Confirm that the O-ring inside the lower impactor housing where it contacts the impactor well is present and in good condition. Ensure the interior of the housing is clean and free of any debris. Place the lower impactor housing inside main unit.
8. Select a clean WINS impactor from the transport case and gently pull the upper and lower portions apart. Confirm that the O-ring on the upper part of the impactor well is present and in good condition.

9. Install a 37-mm-diameter glass fiber filter in the lower portion of the well with the rough side of the filter facing upward and the smooth side facing downward.
10. Add 1 mL of Octoil-S diffusion oil to the well using a calibrated dispensing device (i.e., a dropper) to ensure accurate delivery of oil volume. Ensure that the 37-mm-diameter glass fiber filter is saturated with oil and that no air is trapped beneath it.
11. Inspect the bottom of the WINS impactor prior to installation. Carefully clean the outside of the impactor. This is critical to prevent filter contamination since the WINS impactor sits directly above the filter cassette during sampling.
12. Securely re-attach the upper portion of the well and place the loaded WINS impactor into the filter chamber assembly.

6.6.3.4 Completing the Sampler Installation

Upon completing the sampler installation and all verifications, the FS must confirm once again that the sampler remains securely positioned at the siting location and that the inlet is level (see Section 6.1.6.3), making any necessary adjustments prior to preparing for sample collection. The FS should gather all installation tools and shipping materials and store them in a secure location through the remainder of the sampling event.

7.0 Filter Exposure and Concluding the $PM_{2.5}$-PEP Sampling Event

Forms cited in this section (in order of citation):
Chain-of-Custody (COC) form
Field Data Sheet (FDS) form
$PM_{2.5}$-PEP Site Data Sheet (SD-01)

This section of the SOP describes procedures that a FS uses to perform tasks that occur during the $PM_{2.5}$-PEP sampling event, including:

- Preparing the sampler and filter cassette prior to initiating the sample run.
- Recovering the (exposed) filter at the conclusion of the sample run and downloading the data captured by the sampler's data logger.
- Packing and shipping exposed filters to the $PM_{2.5}$-PEP weighing laboratory.
- Disassembling the sampler.

7.1 Preparing for $PM_{2.5}$-PEP sampling

7.1.1 Scope and Applicability

This section describes how to set up the BGI PQ200 sampler to start and end sampling for a 24-hour period (i.e., coinciding with the sampling period of the collocated SLT-operated routine sampler).

The information in this section is applicable to the BGI PQ200 sampler and may not be applicable to other sampler makes and models. See https://mesalabs.com/products/environmental-controls-air-quality to obtain a copy of the user manual. For other approved FRM samplers, refer to the sampler's instruction manual for supplemental instruction. EPA has posted the manufacturer's instruction manuals on the $PM_{2.5}$-PEP Documentation webpage on the AirQA.org website (https://airqa.org).

Before collecting the $PM_{2.5}$-PEP sample within a sampling event, the $PM_{2.5}$-PEP sampler must have successfully passed the date, time, and leak checks and the barometric pressure, temperature, and flow rate verifications described in Section 6.

7.1.2 Summary of Method

Sample exposure involves loading a filter cassette in the sampler and setting the sampler's timer to initiate exposure for a 24-hour period that coincides with the sampling period of the site's routine $PM_{2.5}$ network sampler to which the $PM_{2.5}$-PEP sampler is collocated (typically midnight to midnight local standard time). At the end of the 24-hour sampling period, the FS removes the cassette from the sampler and packages and ships the cassette to the $PM_{2.5}$-PEP weighing laboratory for post-sample weighing.

7.1.3 Cautions

- Prior to conducting performance checks on the $PM_{2.5}$-PEP sampler, verify that the sampler does not have a data logger data file captured during its previous run that was not

previously downloaded. If not, download this file to the PC, as the data logger will delete the prior run's data file when starting the next run.

- Before sampling, the sampler flow rate, temperatures, barometric pressure, and clock must be successfully verified and that no leaks are present (Section 6).
- Ensure that the sample run date falls within 30 days of the official tare mass date for the filter to be used in the sampling event.
- Use care when handling unexposed and exposed filter cassettes (e.g., never open the filter cassette or directly handle a filter).
- Strictly follow all procedures on labeling, documenting, and transporting filters (in their cassettes) to reduce measurement errors.
- Ensure that the personal computer (PC)[8] or other data storage device used for downloading data from the sampler is in good condition and that the battery is sufficiently charged. Best practice is to download data using a non-EPA or EPA-LAN-inaccessible PC and then upload files to the $PM_{2.5}$-PEP Teams channel. Refer to Section 7.3.5.5 or the *Instructions for Uploading BGI Job Files to the $PM_{2.5}$-PEP Teams Channel* document posted on the AirQA.org website for further instruction.
- Ensure that the AQS site identification number is entered within the event information field on the BGI PQ200 sampler – **this is critical to allow pairing of $PM_{2.5}$-PEP sampling data with the SLT-owned sampler data collected at the same time and site.**

7.1.4 Equipment and Supplies

- Portable BGI PQ200 sampler.
- COC form (Appendix C) for each filter cassette.
- Laptop/tablet computer with the BGI PQ200 sampler downloader software installed.
  - PQ200 sampler downloader software available on the manufacturer's website and on the AirQA.org website (PEPs➔PM2.5-PEP➔Documentation).
- $PM_{2.5}$-PEP FDS (Appendix C) for each filter cassette.
- Either:
  - A clean VSCC (already installed in the BGI PQ200 sampler) along with a clean backup VSCC (if available), or
  - A WINS impactor that is loaded with a 37-mm glass fiber filter and the proper volume of diffusion oil. Note, during transport the WINS impactor loaded within the sampler should be free of diffusion oil. Diffusion oil must be added onsite once verification checks are complete.
- Either alcohol wipes or powder-free disposable examination gloves (e.g., nitrile).

[8] In this SOP, "personal computer" is a generic term that includes laptops, tablets, and other touchscreen-based portable devices.

- Pre-weighed PTFE filters (provided by the $PM_{2.5}$-PEP weighing laboratory) loaded into cassettes, with metal filter caps, and transported in 3" x 5" plastic re-sealable anti-static cassette bags.
- 9" x 12" sealable plastic shipping bags
- Marker (indelible ink)
- Binder clips
- Appropriate cooler with ice substitutes frozen to -10°C or colder.

7.1.5 **Filter Cassette Inspection**

Following the handling procedures detailed in Section 4, the FS inspects a filter cassette as follows:

1. Remove one 3" x 5" anti-static bag containing a filter cassette from the 9" x 12" shipping bag.
2. Remove the cassette from the 3" x 5" cassette bag (save bag for post-sample transport).
3. Hold the cassette in a manner that will prevent contact with any part of the filter.
4. Carefully remove the filter caps and place them on top of the anti-static cassette bag with the interior side down.
5. Inspect the filter and cassette for defects as quickly as possible such that exposure time is minimal. Check for any of the following occurrences:
   - Loose or improperly fitting cassette
   - Offset or wrinkled filter
   - Cassette number does not match information on the COC form
   - Recognizable pinhole(s) in the filter
   - Loose material on the filter
   - Filter discoloration that may be evidence of contamination
   - Other imperfections that could affect the filter's weight or cause sampled air to flow unevenly through the filter (e.g., no screen).
6. Check the filter cassette for the cassette ID number.
7. If the filter failed visual inspection, void the filter in Part III of its COC form (Section 3.5.1.3) by specifying "Reject". Replace the cap on the voided cassette, return the cassette to its 3" x 5" bag, place the bag inside the 9" x 12" shipping bag along with the voided COC form, and return it to the transport cooler for shipment back to the $PM_{2.5}$-PEP weighing laboratory. Select a spare filter cassette to replace the voided cassette, and repeat steps 1 through 6 on the spare filter cassette.
   - In the event that the primary filter (RO – routine) must be voided and no other spare filter cassette is available as a replacement, the field blank filter cassette may be used as a replacement.

8. If the filter passed the visual inspection, complete the "Transport of Filter and Field Site Information" on the COC form associated with the cassette.
9. Indicate the filter type (e.g., RO-Routine, FB-Field Blank, CO-Collocated, TB-Trip Blank) on the "Filter Type" area on the COC form and write the filter type on the 3" x 5" anti-static plastic bag in which the cassette was stored.
10. Record the PEP sampler's particle separator type (WINS or VSCC) on the COC form.
11. Install the filter cassette within the $PM_{2.5}$-PEP sampler (if not used as a trip blank) per the instructions in Section 7.1.6.
12. Place filter caps together (exterior side out) and return the caps in the same 3" x 5" anti-static plastic cassette bag from which they came. Field blanks are also re-capped and stored inside the 3" x 5" bag. Seal the bag and store it in the portable sampler until sample collection is complete (standing the bag along the right side of the compartment on the first level of the platform supporting the filter holding assembly).

In case of high winds, it is best practice for the FS to attach the 3" x 5" cassette bag inside the sampler case using binder clips to avoid loss. Given the small size of the cassette bags, it is recommended to store them inside the 9" x 12" shipping bag.

7.1.6 **Filter Cassette Handling and Installation**

Prior to installing the filter cassette within the $PM_{2.5}$-PEP sampler, the FS should confirm with the SLT agency's site operator of the following:

- A filter cassette is installed in the primary routine network sampler, FRM or FEM to which the $PM_{2.5}$-PEP sampler is collocated, and
- The routine network sample will be collected as scheduled, noting the start and stop times of sample collection.

If the SLT agency's site operator loaded a filter cassette and scheduled the sampling run prior to the FS's arrival at the site and will not be on location during the $PM_{2.5}$-PEP sampling event, then prior to the scheduled sampling event, the FS should confirm with the site operator that the routine sampler has a filter cassette installed and the run is scheduled.

The FS transports the portable $PM_{2.5}$-PEP sampler to the site along with a transport cassette and VSCC (or an empty transport WINS impactor assembly installed inside the main unit). The following steps outline the proper procedure for installing the filter cassette within the sampler:

1. Clean hands with alcohol wipes and allow to air dry or wear disposable powder-free nitrile gloves.
2. Make sure the particle separator (VSCC or WINS) has been properly prepared per Section 6.
3. Select and inspect a filter cassette per the steps in Section 7.1.5.
4. Open the main unit door and carefully rotate the handle counterclockwise using both hands to expose the transport cassette (and WINS impactor if present).
5. Remove the transport cassette assembly, place it inside a storage container, and set it inside the main unit. Be sure this cassette is labeled properly to distinguish it from a

sample cassette. If the transport filter cassette (or an exposed, sample filter) is clearly stuck to the upper housing, gently separate the filter cassette (or WINS impactor if present) from the upper housing.

- If collecting a field blank, proceed to Section 7.1.6.2.

7.1.6.1 Installing a Routine $PM_{2.5}$-PEP Filter Cassette

Routine $PM_{2.5}$-PEP sample filters are those whose data are used (along with the data for the sample collected from the collocated routine $PM_{2.5}$ network sampler maintained by the SLT agency) to characterize bias in the national network. The following steps outline the proper procedure for installing a routine $PM_{2.5}$-PEP filter cassette into the sampler:

1. Remove the filter cassette from its 3" x 5" anti-static cassette bag and install it in the filter cassette housing within the $PM_{2.5}$-PEP sampler. In seating the cassette, ensure that the PTFE filter medium is facing up toward the VSCC (or WINS impactor).
2. Close the sampler assembly by slowly rotating the handle clockwise three quarters of a turn. The filter cassette (and WINS impactor, if applicable) should remain properly seated and the assemblies close securely.
3. Ensure that all data have been recorded on Part III of the COC form (SOP Section 3.5.1.3), which must remain in the custody of the FS throughout the sampling event.

7.1.6.2 Field Blanks

Field blanks (FBs) serve to quantify potential contamination of the unexposed filters during the filter loading and unloading processes. The recommended numbers of FBs to collect on a given $PM_{2.5}$-PEP sampling trip (which can involve multiple $PM_{2.5}$-PEP sampling events) can vary:

- At least one FB is to be collected per sampling trip. At a minimum, a FB should be collected on a trip's last $PM_{2.5}$-PEP sampling event to coincide with the trip blank (TB – Section 7.1.6.3).
- If a FS is new to the $PM_{2.5}$-PEP, the FS should collect FBs at her/his first 10 sampling events (sites) to establish a background for comparison of future field blanks. After this initial baseline development period, only one FB should be collected on a sampling trip.

The $PM_{2.5}$-PEP Laboratory Manager or Regional $PM_{2.5}$-PEP Lead can also direct that FBs be collected more frequently than one per trip.

The process of collecting a FB during a $PM_{2.5}$-PEP sampling event involves the following steps:

1. Remove the FB filter cassette from its 3" x 5" anti-static bag and install it within the $PM_{2.5}$-PEP sampler. In seating the cassette, ensure that the PTFE filter medium is positioned facing the VSCC or WINS impactor.
2. Close the sampler assembly by slowly rotating the handle clockwise three quarters of a turn. The filter cassette (and WINS impactor, if applicable) should remain properly seated and the assembly should close securely. The filter cassette should remain installed for up to one minute.
3. Do not run the sampler!

4. Upon fully closing the sampler assembly, re-open it and remove the FB filter cassette.
5. Cap the FB filter cassette with the cassette caps that were included in the package with that cassette. Return the capped cassette to the same 3" x 5" anti-static cassette bag from which it was removed. Seal the bag and place it in the main unit compartment for storage. The FB will be stored in the main unit for the same length of time as a routine filter.
6. Complete Parts III and IV of the COC form for the FB filter.
   - The COC form must remain in the custody of the FS throughout the sampling event. If this paperwork is lost, the sample is invalid.

7.1.6.3 Trip Blank

Designated by the $PM_{2.5}$-PEP weighing laboratory, trip blanks are unexposed filters used to measure possible filter contamination during transportation to and from $PM_{2.5}$-PEP sampling events. They provide a frame of reference in the situation that FBs exhibit a mass gain that exceeds tolerance levels. They are also used to detect potential contamination during the filter loading process or incomplete cleaning of support screens and cassettes between filter assignments. Thus, TBs are used in conjunction with FBs (Section 7.1.6.2). TBs account for ten percent (10%) of all routine $PM_{2.5}$-PEP filters issued.

One TB is collected per trip, even if the trip involves multiple $PM_{2.5}$-PEP sampling events. A trip's TB is transported to every site that is serviced on the trip, remaining at all times within its 3" x 5" anti-static cassette bag and never exposed to field sampling procedures. A TB is NEVER installed within the $PM_{2.5}$-PEP sampler. The TB must also be kept at ambient temperature throughout the sampling trip.

The process that a FS uses to collect a TB during a $PM_{2.5}$-PEP sampling trip involves the following steps:

1. Handle the TB in the same manner as the other $PM_{2.5}$-PEP sample filter cassettes – except at no time is the TB removed from the cassette bag nor installed within the sampler.
2. Transport the TB from the vehicle to the sampling location and then return it to the transport container (again, never leaving the cassette bag).
3. At the completion of the trip, ship the TB along with the samples from the trip's last $PM_{2.5}$-PEP sampling event as described in Section 7.3.5.
4. Complete Parts III and IV of the COC form for the TB filter.
   - The COC form must remain in the custody of the FS throughout the sampling event. If this paperwork is lost, the sample is invalid.

Filters designated as trip blanks must be used for this purpose unless a unique incident eliminates available sample filters during the course of a $PM_{2.5}$-PEP sampling trip (e.g., the last available sampling filter is dropped on the ground during set-up), and a trip blank filter must be used as a routine $PM_{2.5}$-PEP sample to prevent cancellation of a sampling event.

7.1.7 Setting Up the BGI PQ200 Sampler for $PM_{2.5}$-PEP Sample Collection

> Information in this section pertains to the BGI PQ200 portable sampler, Version B with control module Version U. For procedures appropriate when legacy versions of this model are used in the $PM_{2.5}$-PEP, refer to older versions of this SOP (dated 2006 and 2009) posted on the AirQA.org website and in appendices in the respective operating manuals.

The steps to setting up the BGI PQ200 sampler controller for a routine $PM_{2.5}$-PEP sampling event are as follows:

1. Go to the sampler's main screen and confirm that the date and time are set correctly – to local standard time or, if different, the time programmed into the collocated routine network sampler.
   - If the clock needs setting or adjustment, go to Section 6.1.6.6.
2. Press the **SELECT** key to enter the Main menu.
3. Use the arrow keys to navigate to **Site and Filter Information.** Press the **SELECT** key.
4. Use the arrow keys to scroll through characters to add the four- or five-digit filter cassette ID and the nine-digit AQS Site ID. The cassette ID should be entered first in its respective line.
5. Press **EXIT** to return to the Main menu.

   > **Best Practice:** After entering the cassette ID and AQS ID, run the cursor to the end of each ID field so that spaces are inserted to represent any trailing digits (if the ID is shorter than the field). This prevents the sampler from inadvertently adding random, hidden characters to these fields in the downloaded file which can cause problems. Hidden characters most commonly appear in the download file for those samplers deployed in the field for the first time. Refer to the Troubleshooting Guide for further detail.

6. Determine whether the start and stop times of the 24-hour sample run can be set to midnight-to-midnight local standard time (Section 7.1.7.1) or needs to be specified differently to match the start and stop times of the collocated routine network sampler (Section 7.1.7.2) and follow the appropriate procedures to input the start and stop times.

   > **Cautionary Warning**: The data file created by the $PM_{2.5}$-PEP sampler during the previous sample run, even if not complete, should have been downloaded prior to the current $PM_{2.5}$-PEP sampling event. If it was not downloaded, the sampler's screen display will alert the FS that this file still needs to be downloaded. See Section 7.1.7.1 on how to address this concern.

7. Close the sampler door, pack up loose supplies, pick up trash, and secure the site for the 24-hour exposure period.

7.1.7.1 Specifying the Sampler to Run from Midnight to Midnight

1. From the main menu, scroll to **Run Sampler from Midnight to Midnight**, and press **SELECT**.
2. If the data logger data file from the previous sampling run was downloaded earlier, the following message will be displayed, indicating all is ready for sampling to begin:

However, if the data logger data file from the previous sampling run has not yet been downloaded from the sampler, the following message will be displayed instead:

If the second of these screens is displayed (i.e., the data file still needs to be downloaded), press **EXIT** and follow the steps given in Section 7.3.5.3 for downloading the data. Make a note in the field notebook and ensure the file is transferred to the sampler download files repository on the $PM_{2.5}$-PEP Teams Channel (refer to Section 7.3.5.5). If the data file is not needed and can be deleted without downloading, press **RESET**.

The sampler is now successfully programmed to power itself on and begin sampling at midnight local standard time.

7.1.7.2 Specifying the Sampler to Run with User-Defined Start and Stop Times

The start and stop times for the sampling event's 24-hour sampling period must be synchronized between the $PM_{2.5}$-PEP sampler and the site's primary routine network sampler to which it is collocated. The start and stop times should coincide with the site's routine sampler sampling schedule. This synchronization between samplers can be accomplished by either:

- Changing the $PM_{2.5}$-PEP sampler clock time to match the primary routine $PM_{2.5}$ sampler clock, or
- Changing the $PM_{2.5}$-PEP sampler's scheduled sampling start/stop time to coincide with the start/stop times of the primary routine $PM_{2.5}$ sampler.

If the site's primary routine network sampler is either not set to local standard time or deviates from the actual local time by more than one (1) minute, the FS should inform the Regional $PM_{2.5}$-PEP Lead and document this on the COC.

The start and stop times for a $PM_{2.5}$-PEP sampling event may need to be changed from the midnight-to-midnight setting discussed in Section 7.1.7.1 (upon receiving approval by the Regional $PM_{2.5}$-PEP Lead) to coincide with the times for the collocated SLT agency's primary routine $PM_{2.5}$ sampler. The start and stop time for a PQ200 sampler is adjusted as follows:

1. From the home screen, press **SELECT** to enter the Main menu. Use the arrow keys to navigate to **Run with User Defined Start & Stop**. Press **SELECT**.
2. Messages stating **"Set Sample START DATE and TIME**" and **"Set Sample STOP DATE and TIME**" will appear. Press **SELECT**. A flashing cursor will appear on the first value of the start date **(Day of the Month)**, indicating that it can be edited. Enter the correct value (using the arrow keys) and press **SELECT** to store the entry. Use the arrow button to move to the next component.

3. Enter each component of the start and end dates and times (month, day, year, hour, minute) using the arrow keys as in Step 3. Press **SELECT** to store each entry and use the arrow button to move to the next component.
4. Refer to Step 2 in Section 7.1.7.1. If the display shows the warning "Current Data not yet Downloaded!" (i.e., a data logger data file from the previous sampling run that had not previously been downloaded). The data file will be discarded if not downloaded before setting the sample run start and end time.

   The sampler is now successfully programmed to power itself on and begin sampling at the specified start date and time.

7.2 Activities During the 24-Hour Sampling Period

It is not necessary for the FS or site operator to be present at either the start or end of the 24-hour sampling period. However, if convenient, the FS is encouraged to visit the site during the 24-hour sampling period to monitor status and verify that no problems have occurred with either sampler (Section 7.2.1). If the FS determines a problem that will invalidate either sample, the FS can terminate sample collection (Section 7.2.2) and begin the process to schedule a make-up sampling event as soon as possible afterward.

7.2.1 **Monitoring Status During the 24-Hour Sampling Period**

At any time during the $PM_{2.5}$-PEP sample run, the BGI PQ200 sampler display will provide certain status information that may be useful in verifying that sample collection is proceeding properly.

Use the up and down arrows to page through the sampler's screen display to view current values of the following:

Start = Time and date (in military notation) that the current sample started.
Stop = Time and date that the current sample stopped (or is set to stop).
ET = Elapsed time since the current sample run started.
TV = Total volume of air sampled during the current sample run, in m^3.
[DC In] = Current power source from which the sampler is operating.
Q(Vlpm) = Instantaneous flow rate (V for volumetric, M for mass), in LPM.
AVG = Average flow rate, in LPM.
CV = Coefficient of variation of flow rate.
***xxx*mm Hg =** Instantaneous ambient barometric pressure, with *xxx* given in mm Hg.
A*xxx*°C = Instantaneous ambient temperature, with *xxx* given in degrees Celsius.
F*xxx*°C = Instantaneous filter temperature, with *xxx* given in degrees Celsius.
SP*xxx*cm = Pressure drop across the filter, with *xxx* given in cm H_2O **.**
Tmax = Maximum ambient temperature measured during the run, in degrees Celsius.
Tmin = Minimum ambient temperature measured during the run, in degrees Celsius.
Tavg = Average ambient temperature, in degrees Celsius.
BPmax = Maximum barometric pressure measured during the run, in mm Hg.
BPmin = Minimum barometric pressure measured during the run, in mm Hg.
BPavg = Average barometric pressure, in mm Hg.

Pressing **SELECT** during sampling operation provides alternate displays of minimum, maximum, and average values of the ambient temperature readings and of barometric pressures, along with other data.

If certain sampling-related problems have occurred up to the given point in the sampling run, the screen may display one or more of the following character flags in the upper right-hand corner:

P = Power failure has occurred.
Q = Flow rate has exceeded ±4% of the design flow rate (16.67 LPM).
F = A 5° filter overheat lasting longer than 30 minutes has occurred.
M = Memory overflow occurred (maximum run time with a 5-minute logger interval).
T = Actual sample run time was below 23 hours, 50 minutes.

7.2.2 Temporary Suspension of Sampling

During a $PM_{2.5}$-PEP sampling event that is proceeding normally, a FS should not temporarily halt sampling operations for either the $PM_{2.5}$-PEP or the collocated routine network sampler unless absolutely necessary. However, under certain circumstances, it is permissible for the FS to temporarily halt and then resume a sample run. EPA rules indicate that a sample run can be suspended for up to one (1) hour without necessarily jeopardizing the validity of the exposed sample. If the FS initiates a temporary suspension of sampling (for either sampler), the

interruption should be noted on the FDS by specifying the time and duration of the interruption, the affected sampler(s), and reason for the interruption.

To halt a sample run, simply press the sampler's **ON/OFF** button. The Main menu will display the following message:

To resume the halted sample run and continue sampling, proceed with the following steps:

1. From the home screen, press **SELECT** to enter the Main menu.
2. From the Main menu, use the arrow keys to navigate to **Continue with Current Run**. Press **SELECT**.
3. The sampler will then resume the run.

Note that the elapsed sampling duration that will display on the screen will NOT account for the duration of the temporary suspension. In addition, the scheduled stop date will NOT be extended by the duration of the suspension. As noted above, the suspension could be as long as one (1) hour without the suspension invalidating the sample. A sample run is not considered complete until the sample's stop date and time have been attained.

7.3 Sample Recovery and Data Download

7.3.1 Scope and Applicability

This section describes the process for recovering an exposed filter cassette from the $PM_{2.5}$-PEP sampler at the conclusion of the 24-hour sample run and downloading the file of sampler performance data collected during the run by the sampler's data logger.

The following information applies to the BGI PQ200 sampler. Thus, the information presented herein may not be applicable to other makes and models of samplers.

7.3.2 **Summary of Method**

Upon completion of the 24-hour $PM_{2.5}$-PEP sample collection period, the FS returns to the site, documents the sample run information, recovers the exposed filter cassette from the sampler, and downloads the detailed sample run data file, preferably to a PC. As noted within Section 2.2.4.6, it is best practice to retrieve an exposed filter within 24 hours of the end of the sample collection period. Otherwise,

- Retrievals occurring from 24 to 48 hours post-sampling are permissible to accommodate holidays, weekends, site inaccessibility (e.g., weather), or other situations that do not impact the sample's validity.
- Retrievals occurring from 48 to 96 hours post-sampling are permissible in emergencies (e.g., sickness, accident) but the $PM_{2.5}$-PEP weighing laboratory must be notified that the delay occurred, and the FS must add an explanation for the delay in the Notes section of the FDS. Note that such a delay could contribute to an invalidation of the sample depending on results of other QC checks.
- If a sample is not retrieved for more than 96 hours after the end of the sample exposure period, the sample result is automatically invalidated.

In turn, if a filter cassette is not shipped to the $PM_{2.5}$-PEP weighing laboratory within four (4) days of its recovery from the sampler, the sample and its results will be invalidated.

7.3.3 **Cautions**

- Complete the $PM_{2.5}$-PEP FDS (Appendix C) prior to attempting to download data from the sampler.
- Ensure that cold packs have been adequately frozen to keep recovered filters at the necessary temperature until shipping occurs or until they can be transferred to a refrigerator for storage until the next available shipping date occurs.
- Use care when handling the exposed filter cassettes.
- Never open the filter cassette or directly handle a filter.
- Strictly follow all procedures on labeling, documenting, and transporting filters (in their cassettes) to reduce potential contamination, bias, and/or measurement errors.
- Ensure that the PC receiving the downloaded data file is in good condition and that the battery is sufficiently charged.

7.3.4 **Equipment and Supplies**

- BGI PQ200 sampler
- Cooler with cold packs
- COC and FDS forms (Appendix C)
- Transport WINS impactor (clean)
- Transport cassette
- Protective filter cassette containers

- 9" x 12" plastic shipping bags
- Marker (indelible ink)
- PC (laptop or notebook) with the BGI PQ200 sampler downloader software installed (or USB portable storage device if a PC is not available).
  - PQ200 sampler downloader software available on the manufacturer's website and on the AirQA.org website (PEPs➔PM2.5-PEP➔Documentation)
- 9-pin, female-female, RS-232 serial cable with compatible USB adapter that has been tested for handshake with the PC in use.

7.3.5 **Procedure**

7.3.5.1 Ending the Sampling Run and Retrieving the Exposed Filter

If properly programmed, the BGI PQ200 sampler will automatically stop sampling at the end of the 24-hour sampling period. The FS then returns to the site to retrieve the filter cassette from the sampler. The following steps describe the sampler's shutdown procedure:

1. If the sampling period has ended and the sampler pump has stopped running, the sampler's display screen will appear similar to the following:

   From this display screen, push the **EXIT** button to reach the Main menu.
2. Select **Review last run data and conditions** from the Main menu. Scroll through the display screens and record the sampler's summary information over the 24-hour sampling period onto the FDS, including the actual start and stop times, sample elapsed time, flow rate, filter quality, and temperature. These data help determine if the sample is valid, questionable, or invalid.
3. Record any flags that may be displayed onto the FDS. (Section 7.2.1 lists and defines possible flags: P, Q, F, M, T.)
4. Clean hands with an alcohol wipe and allow hands to air dry, or don disposable powder-free examination gloves (e.g., nitrile).
5. Open the 3" x 5" anti-static cassette bag in which the PM2.5-PEP filter cassette was initially transported to the site. Remove the filter caps from the bag and set them on top of the bag, exterior side down.
6. Carefully rotate the handle of the filter chamber assembly counterclockwise using both hands to expose the sample cassette. Be mindful that:

- The cassette may stick to the particle separator or top of the cassette chamber or could fall out if care is not taken. Visually check the location and position of the filter cassette before opening the assembly completely.
- Once the assembly has started to open, the weight of the two plates may force the whole assembly to open.

7. The sample filter cassette (and the WINS impactor, if used) should now be visible. If not, gently separate the filter cassette (and WINS impactor) from its upper housing.
8. Remove the sample filter cassette. Quickly inspect it for integrity and contamination (e.g., tears, bugs) and record any imperfections in the field notebook. Cap the filter cassette with its original filter caps. Place the capped cassette in the same 3" x 5" anti-static bag from which it was removed and seal the bag.
9. Place the bag containing the exposed sample filter in the transport cooler containing pre-frozen cold packs and keep chilled until placed in the shipping cooler. Placing samples in a direct current (DC)-powered cooler is also satisfactory. Certain situations may allow for direct placement into the shipping container and drop-off of the package at the shipping depot.
   - Each Region must maintain an ample supply of cold packs and insulated shipping cartons for shipping collected filter samples, including plentiful backups for use when needed. The $PM_{2.5}$-PEP weighing lab will supply cold pack replacements when needed with the intent that, through attrition, eventually all Regions will use the same supplies. The $PM_{2.5}$-PEP contractor in Region 10 currently keeps an inventory of plastic corrugated shipping cartons with foam insert kits, which were designed specifically for $PM_{2.5}$ shipping. The cartons and insert kits are available upon request. The kits have a service life of approximately five (5) years under routine activity.
10. Refer to the following sections to complete on-site activities:
    a. Section 7.2.5.2 on recording field data to the FDS.
    b. Section 7.2.5.3 on downloading the sample run electronic data file from the sampler.
    c. Section 7.3 for packing and shipping the exposed filters to the $PM_{2.5}$-PEP weighing laboratory.
    d. Section 7.4 to disassemble the $PM_{2.5}$-PEP sampler.

If either the $PM_{2.5}$-PEP or routine network sample is invalidated for any reason (meaning a valid PEP sample cannot be successfully paired with a routine network sample as a result of this sampling event), contact the Regional $PM_{2.5}$-PEP Lead (or the SLT agency, if applicable) to schedule a day to repeat the $PM_{2.5}$-PEP sampling event. The Regional $PM_{2.5}$-PEP Lead should be briefed on any conditions that might affect a scheduled event at the site, e.g., site has been severely damaged by a storm. Otherwise, it may be necessary to delay the sampling event for several months or choose a different site**.**

7.3.5.2 Recording Data to FDS and Electronic Storage of FDS

Prior to downloading data from the BGI PQ200 sampler upon the conclusion of 24-hour $PM_{2.5}$-PEP sampling, the FS must manually complete the $PM_{2.5}$-PEP FDS (Appendix C) by

recording information on the sampling event outcome. In this way, if problems exist or the electronically captured data file becomes corrupted during data downloads, key field sampler information will still be available through the completed FDS. Once they are completed, these hand-written records must be copied, and the originals submitted to the $PM_{2.5}$-PEP weighing laboratory along with the COC forms. Section 3.5.2 provides details on completing each section of the FDS.

After every $PM_{2.5}$-PEP sampling event, FSs must either scan or take a picture of the completed FDS and store the hard copy for two (2) years. The scan can be stored for the duration of files per EPA's policy on historical records (and the Regional Contractor's contractual obligations). This ensures FSs have access to the last two years of field data (COC and FDS forms) to remotely verify the outcome of a $PM_{2.5}$-PEP sampling event whose data do not successfully upload to EPA's AQS.

7.3.5.3 Downloading Data from the BGI PQ200 Sampler Directly to a Personal Computer (laptop or notebook)

The file generated by the BGI PQ200 sampler's data logger during PEP sample collection should be downloaded the same day as the completion of the sample run. The FS can download the sampler data file while at the site or at some point later that same day when the sampler has been removed from the site (e.g., in vehicle or hotel room).

The FS should arrange for data downloads to occur directly to a PC. To do this, the PC must have the BGI PQ200 sampler job controller program application installed. The process for downloading the data file is as follows:

1. Using a serial (nine-pin) cable (female-female), connect the sampler to the PC. A serial-to-USB adapter may be necessary for some PCs. Ensure that it is tested for compatibility with the PC.
2. Open the data downloader application on the PC, then click on the **New File** icon in the upper left corner of the application's main menu. This will open the **New Job** window in which the FS enters information in the following four fields:
    a. **Job Name:** Enter an eight-digit job name which will represent the name of the data file to be downloaded. (The application limits the job name to eight characters maximum.) Here, the file name should be specified as follows:
        i. First four characters = two-digit month and two-digit day of the sample run, using leading zeros if necessary. For example, January 30 would be entered as 0130.
        ii. Last four characters = four digits of the cassette ID number. While some cassette IDs consist of four digits, others may contain five digits. In the latter situation, enter only four of the five digits. However, after saving the file and exiting the application, rename the file to specify the entire cassette ID after the month-day in the first four characters.

    The file with this job name will be automatically assigned the suffix **.job**. (Hence, it is called a "job file.")

b. **Site Name**: Enter a unique site description (e.g., name of town, city location, unique site name). Ensure that this description is unique to the site – for example, if two sites exist in the same town, then avoid ambiguity by not specifying only the town name as the site description for either sampling event.

c. **Station Code:** Enter the nine-digit AQS Site ID code that also appears on the $PM_{2.5}$-PEP Site Data Sheet. Use leading zeroes and move the cursor to the end of the field to ensure no hidden characters are used to pad the field if necessary.

d. **Operator:** Enter the initials of the FS.

No other fields that are displayed in this window need to be entered.

3. Click on **Save**. Select the appropriate subdirectory on the PC at which to store the data file, then press **OK**.
4. Upon return to the main menu page, open the job file just saved and select **Download**. The **Download Summary and Logger Data** window will appear. Under **Options**, choose **Summary and Logger**.
5. Click on **Begin**. After a short delay, the PC will begin to download the data file from the BGI PQ200 sampler.
6. When the download is complete and the file is stored in the specified subdirectory on the PC, click on **Return**. The serial cable can now be removed from the BGI PQ200 sampler and the PC.

> Note that the file **should not be saved again unless** the sampler is operating with a Rev T or Rev D control board. If the file is accidently saved when using a new Mesa BGI Model, refer to the Troubleshooting Guide to properly correct the file.

7. To view information on data collected from the BGI PQ200 sampler, select from tabs **Summary**, **Hourly**, or **Logger**.
8. Further disposition of the downloaded data file is as follows:
   a. The file should be uploaded from the PC to the "$PM_{2.5}$ PEP Sampling Events download files" Teams channel where the $PM_{2.5}$-PEP weighing laboratory can access the file. (See Section 7.3.5.5.)
   b. The file (stored on the PC) should be returned to the Regional field office along with the COC form for the sample filter.

It is possible to copy the job file to a portable storage media device. To do so, select **File Save** from the Main menu on the PC. This will create and save the job file to the storage media device. (Refer to the Troubleshooting Guide.)

When recording data manually, steps 2 through 8 above would be performed prior to manually recording the appropriate data.

7.3.5.4 Use of the BGI DataTrans Device is Suspended

The BGI DataTrans device, used historically in the $PM_{2.5}$-PEP to download data from the data logger of legacy sampler models, is no longer compatible with the current BGI PQ200 models

and is not supported by Mesa Labs. Furthermore, technical support for the DataTrans device no longer is available. Therefore, EPA has suspended use of DataTrans devices in the $PM_{2.5}$-PEP, including with any legacy model BGI samplers that remain in the national $PM_{2.5}$-PEP fleet.

7.3.5.5 Uploading BGI PQ200 Sampler Data Files to the EPA Teams Channel

As of July 2022, EPA requires the registration and encryption of remote memory devices before they can be used on EPA computers operating inside the EPA firewall, including the computers used in the $PM_{2.5}$-PEP weighing laboratory. The USB devices used historically in the $PM_{2.5}$-PEP to download the data files from $PM_{2.5}$-PEP samplers and provide to the $PM_{2.5}$-PEP weighing laboratory (by including the device in a sample shipment) are now too burdensome for the laboratory to use, as each device would require a separate code to access the encrypted files stored on them. As a result, EPA has developed a process to upload data files generated by the $PM_{2.5}$-PEP sampler data logger to an EPA server that is accessible through a Microsoft Teams channel named "**$PM_{2.5}$ PEP Sampling Events download files**."

Prior to the $PM_{2.5}$-PEP sampling event trip, the FS should work with the Regional PEP Lead to initiate a request to obtain a "Guest" account on the $PM_{2.5}$-PEP Microsoft Teams channel (or verify that their existing "Guest" account remains active). If the FS does not have an EPA e-mail account, the FS provides the Regional PEP Lead with a non-EPA e-mail address. The "Guest" account provides access to the Teams channel via the e-mail address. An invitation to the Teams site will be sent to this e-mail address with a link to access the site. (The Regional PEP Lead will contact the Microsoft Teams channel owner or the OAQPS $PM_{2.5}$-PEP Lead to set up a Guest account.)

Once the job file is downloaded from the BGI PQ200 sampler to the PC (Section 7.3.5.3), the FS then uploads the data file to the Microsoft Teams channel. For the data upload process to work, the PC must operate at least Microsoft Windows 10 and have the Microsoft Teams application installed.

Additional detail on connecting to the Teams site and uploading files is available on the AirQA website.

7.4 Filter Packing and Shipment

7.4.1 Scope and Applicability

This section describes how to package exposed filter cassettes into shipping containers and to ship them to the $PM_{2.5}$-PEP weighing laboratory for post-sample weighing.

7.4.2 Summary of Method

Filter cassettes, along with COC and FDS forms, should be shipped to the $PM_{2.5}$-PEP weighing laboratory on the same day as retrieval from the sampler via next-day delivery in a cooler packed with frozen ice substitutes. If $PM_{2.5}$ filter cassettes are not shipped within four (4) days of recovery, samples and their results will be invalidated.

Shipments should occur only on Monday through Thursday to ensure timely (i.e., next-day) receipt of the filters at the $PM_{2.5}$-PEP weighing laboratory. If the FS removes filter cassettes from

the sampler on a Friday, the cassettes must be stored at a temperature of 4°C or below until the next shipping day (typically Monday). The FS must notify the laboratory of any delay in shipment such that the laboratory can determine and plan for the deadline to weigh filters. The FS should avoid shipment on holidays, at the end of the week, or under other circumstances which may cause the package to be held by the courier until delivery the following Monday. In such circumstances, the FS should retain samples at a temperature of 4°C or less over the weekend.

7.4.3 Cautions

- Ensure a sufficient number of cold packs (Section 7.3.4) are adequately frozen for filter shipments to the $PM_{2.5}$-PEP weighing laboratory. Adequate freezing is typically achieved after 24 hours at -10°C to -17°C (14°F to 0°F).
- Use care when handling unexposed and exposed filter cassettes.
- Never open the filter cassette or directly handle a filter.
- Strictly follow all procedures on labeling, documenting, and transporting filter cassettes to reduce potential contamination, bias, and/or measurement errors.

7.4.4 Equipment and Supplies

- Capped cassettes containing pre-weighed/sampled PTFE filters (e.g., routine, field blanks, collocated samples) and stored in 3" x 5" anti-static cassette bags.
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- COC and FDS forms.
- Insulated shipping container (cooler), with white Styrofoam insert kits when required.
- Foam bricks for shipments.
  - While four (4) foam bricks are typically used per container, the quantity will depend on the size of the container and the size of the foam bricks included in the container.
- Roll of bubble wrap.
- Heavy duty rubber bands.
- Masking and packing tape.
- Knife or scissors.
- Two 9" x 12" plastic self-sealing shipping bags (one for cassettes and one for the COC/FDS forms).
- Shipping labels. (The FS should be currently registered as an active user for the PEP's contract shipper in case the pre-prepared shipping label is not usable for any reason).
- Custody seals (optional; applied to a package to indicate tampering during shipment).

7.4.5 Procedure

Filter cassettes should always be capped and remain in their 3" x 5" anti-static, self-sealing cassette bags when not seated in the $PM_{2.5}$-PEP sampler. The following procedure ensures secure

packaging by grouping filter cassettes together between foam bricks, wrapping the grouped filters in bubble wrap, and securing the group of filters in a cooler.

1. Group all 3" x 5" anti-static bags containing sampled filters (or blanks) within their capped cassettes into a single 9" x 12" plastic shipping bag and seal the bag.
2. Ensure a one-to-one match of all filter cassettes with their COC forms.
3. Select a pre-printed express courier label for the shipment.
4. Record the air bill number specified on the shipping label and complete the "Shipping from Field to Weighing Lab" portion of each COC form to be included in the shipment.
5. Find a working surface to prepare the shipment. Lay out a section of bubble wrap and place two foam bricks next to each other on the wrap near its short edge.
6. Place the 9" x 12" plastic shipping bag that contains the sampled cassettes on top of these foam bricks.
7. Place an additional two foam bricks on top of the plastic shipping bag.
8. Roll the bubble wrap around the ice substitute/cassette assembly and secure this assembly using masking tape or heavy-duty rubber bands.
9. Place the foam bricks and cassette assembly in the insulated shipping container.
10. Separate the laboratory and field copies of the COC and FDS forms. Place the laboratory copies of the COC and FDS forms for all samples in a second 9" x 12" plastic shipping bag. Retain the field copies.
    a. Data storage devices containing sampler data are no longer shipped to the $PM_{2.5}$-PEP weighing laboratory. Files containing sampler data are downloaded according to Section 7.3.5.3 and shared with the $PM_{2.5}$-PEP weighing laboratory via the $PM_{2.5}$-PEP Teams Channel (detail in Section 1.3 and Section 7.3.5.5).
    b. ***A filter is invalidated if the COC/FDS forms are not included in the filter shipment! Be sure to include all necessary paperwork in the shipping container.***
11. Immediately place the 9" x 12" plastic shipping bag containing the COC and FDS forms into the shipping container. Place additional bubble wrap in the container to minimize the movement of the ice substitute and cassette assembly during shipping. Close the container.
12. **Seal all edges of the container with packing tape. If using a custody seal, apply across the container lid. If there are two points of entry, apply a custody at each.**
13. Affix a pre-printed express courier shipping label to the shipping container and transport the container to the nearest express courier shipping office. Ship the exposed filters via next-day delivery on the same day as the filter is collected post-sampling on Monday through Thursday, and as soon as possible (i.e., the following Monday) if the samples were recovered on a Friday.
    - If a shipment cannot occur within these guidelines, the chilled package must be shipped within four (4) days of recovery.

14. Notify the laboratory analyst (LA) on the day of shipment to indicate that the package has been shipped. Provide your name, the date, the air bill number, and the number of containers in the shipment.

If the exposed filter cassettes cannot be shipped on the day of filter recovery, use the following procedures for storing post-sampled filter cassettes at the field office:

1. Transport filter samples inside sealed bags to the location of refrigerator storage in a chilled cooler or insulated box with cold ice substitutes.
2. Ensure the foam bricks to be used for shipping are in the freezer and remain there until cassettes are ready to be shipped.
3. Secure the COC and FDS forms in a safe place.
4. Keep the cassettes capped in the 3" x 5" anti-static filter cassette bags and place the bags inside the 9" x 12" plastic shipping bag. Place the shipping bag in a refrigerator to store overnight and keep the sample between 0°C and 4°C.
5. When an appropriate shipping day occurs, complete Steps 1 through 14 above.

7.5 Sampler Disassembly

7.5.1 Scope and Applicability

This section describes disassembly of the portable $PM_{2.5}$-PEP sampler following routine completion of filter sample exposure, filter recovery, and data collection. The information presented herein is specific to the BGI PQ200 sampler and may not be applicable to other sampler makes and models.

7.5.2 Summary of Method

The disassembly procedure is essentially the reverse of the assembly procedure (Section 6.1 and Section 6.6). As with assembly, it is important to follow proper procedures to avoid personal injury and to avoid damage to and minimize wear and tear on the sampler.

7.5.3 Cautions

- When dismantling the sampler, remove any debris (e.g., dirt and pollen) that may be adhered to the sampler base and/or legs before storing for transport. Dirt, pollen, and other debris are a source of contamination if introduced to the sample collection filter enclosure.
- Handle the water collection jar attached to the side of the inlet with caution to prevent cracking or breakage. Wrap the glass jar with insulating tape or use a plastic jar to minimize the chance of breakage.

7.5.4 Procedure

Ensure that all transport containers are in the vehicle if they were removed during the run day.

Disassemble the portable $PM_{2.5}$-PEP sampler and prepare it for transport from the site as follows:

1. Power the unit down and disconnect the power supply.
2. If a VSCC is installed in the sampler, it does not need to be removed. However, the VSCC should be inspected for contamination and cleaned. If the sampler will used more than once during a trip, cleaning can be delayed until set-up at the next $PM_{2.5}$-PEP site.
3. If a WINS impactor is installed in the sampler, remove it and clean the impactor well. Return the impactor to its transport case or reinstall it in the sampler for transport. The impactor should not contain oil if being reinstalled for transport.
4. Place the transport cassette into the sampler's filter compartment. The sampler should always be shipped or stored with a transport filter cassette in place.
5. Close the sampler's filter chamber assembly by slowly rotating the handle clockwise three quarters of a turn until the cam follower clicks into the indent on the cam. Ensure the filter cassette and VSCC (or WINS impactor) are seated properly and the filter chamber assembly closes securely.
6. Disassemble the sampler in the reverse order of its assembly (Section 6.1).
7. Check the sampling site to ensure no equipment and/or supplies are left at the site.

7.6 Sampler Maintenance and Cleaning

7.6.1 Scope and Applicability

This section describes the routine procedures for maintaining and cleaning the sampler and the particle-size separator. The information presented herein is specific to the BGI PQ200 sampler and may not be applicable to other sampler makes and models.

7.6.2 Summary of Method

The $PM_{2.5}$-PEP sampler must be regularly inspected and cleaned to ensure reliable operation and to avoid contamination that can affect the quality of collected data. While the $PM_{2.5}$-PEP defaults to a quarterly maintenance and performance check, visual inspection should be performed in every assembly and disassembly in the field (e.g., cleaning the VSCC or the WINS impactor well and wiping the legs of the sampling device if needed.).

7.6.3 Cautions

- The FS must properly set up and maintain the sampler to prevent damage and contamination. Be particularly attentive to maintenance of the pump, ensuring the soundness of electrical and pneumatic connections that will be repeatedly assembled and disassembled.
- Periodically check the sampler's O-rings. As necessary, clean and lubricate O-ring surfaces to aid in assembly and to ensure leak-free seals. Replace O-rings that are split, brittle, or cracked. Only use O-rings that are specified for the equipment.

7.6.4 Equipment and Supplies

- Lint-free wipes (Kimwipes).

- Isopropyl alcohol.
- Wooden dowel (downtube cleaning).
- Lint-free pipe cleaner.
- Marking pencil.
- Soft brush (interior cleaning).
- Distilled water.
- Sampler maintenance forms.
  - Quarterly maintenance checklist and the calibration form.
- Selections of O-rings.
- Silicone vacuum grease (if using WINS).
- Safety pins or dental pick.
- Oil-free compressed air.

7.6.5 **Procedure**

Sampler components used in the $PM_{2.5}$-PEP must be maintained and cleaned periodically. Table 7-1 gives a schedule for performing preventive maintenance of field equipment in the $PM_{2.5}$-PEP. The FS may also use the Quarterly Maintenance and Repair checklist found in Appendix C.

Table 7-1. Schedule for preventative maintenance of $PM_{2.5}$-PEP field equipment

Frequency	Maintenance item
Every $PM_{2.5}$-PEP sampling event	1. Inspect and, if necessary, empty the water collector jar 2. Clean and/or change-out WINS impactor well if used in the sampling event. 3. Inspect the grit pot on the VSCC, clean if necessary 4. Inspect visible O-rings in the flow path
Every 10 $PM_{2.5}$-PEP sampling events or as needed	Disassemble the VSCC and clean with distilled water and lint-free wipes (this requirement may be fulfilled by a quarterly cleaning) [1] Some Regions and most participating SLTs will not perform 10 events in a year. In these cases, the quarterly inspection and commensurate cleaning will suffice.
Quarterly (every 3 months)	1. Clean the sampler's inlet surfaces 2. Clean the main (first stage) size-selective inlet (PM_{10} head) 3. Clean the impactor housing (if applicable) and impactor jet surfaces 4. Clean the interior of sampler unit 5. If necessary, clean VSCC with distilled water and lint-free wipes; air dry 6. Check the condition of sample transport containers 7. Clean the sampler downtube 8. Inspect cooling air intake fan(s) and filter; replace if necessary 9. Inspect all O-rings, visible and hidden, and reapply vacuum grease as needed 10. Inspect vacuum tubing, tube fittings, and other connections to the pump and electrical components. Service if necessary. 11. Tighten all nuts and screws, replace those that become lost.

[1] Although Mesa Laboratories indicates 30 days of continuous 24-hour sampling can be tolerated by the VSCC, the $PM_{2.5}$-PEP requires cleaning on a 10-day sampling event cycle to minimize any likelihood of excess contamination. Further, the FS should inspect and clean the VSCC whenever unusual circumstance may warrant such action (e.g., local fire in the vicinity).

7.6.5.1 WINS Impactor Well Cleaning

If the sampler is using a WINS impactor, the following approach is used to clean the WINS impactor well:

1. Separate the upper and lower portions of the well.
2. Remove the used filter from the well while avoiding transfer of diffusion oil to outside surfaces of the impactor well.
3. Using lint-free wipes, wipe clean the two halves of the well and any other surface that may have been exposed to oil.
4. Re-assemble the well and place it in the impactor cup.
5. Clean hands to remove any oil residue.
6. Do not replace the filter and oil unless preparing to sample.

7.6.5.2 VSCC Cleaning

If the sampler is using a VSCC particle separator, its cleaning regimen is as follows:

1. Remove the VSCC from its installed position in the instrument.
2. Remove the side transfer tube. If it is too tight to remove by hand, use a rigid plastic lever. Care should be taken to not damage the two "O" ring seals.
3. Remove (unscrew) the top cap and grit pot.
4. Wet a lint-free wipe with water and remove all visible deposits (most likely found at the bottom of the cone and inside the grit pot).
5. Inspect all "O" rings for shape and integrity and replace if needed.
6. Lubricate all "O" rings and the transfer tube (to avoid difficult disassembly) with light grease.
7. Assemble the VSCC in reverse order and reinstall. Refer to Figure 7-1.
8. Perform a leak check according to manufacturer's operating manual specifications.

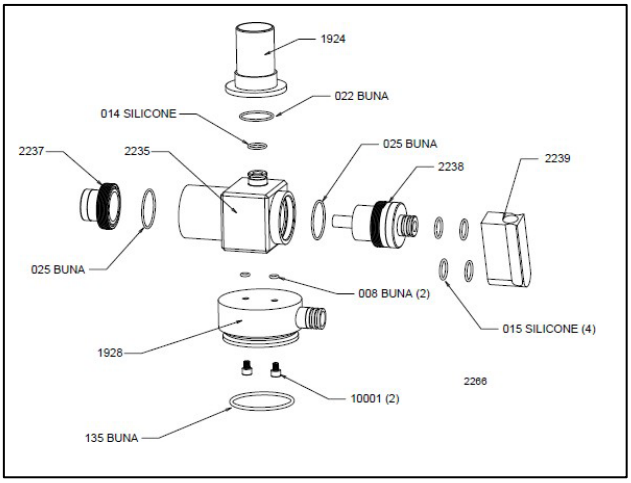

Figure 7-1. Exploded view of VSCC

7.6.5.3 Main (First-Stage) Size-Selective Sampler Inlet, Downtube, and Sampler Interior

The FS dismantles and cleans the sampler inlet and other components as described below. This is typically completed at the Regional field office.

1. Mark each assembly point of the sampler inlet with a pen or pencil as guides during reassembly.

2. Disassemble the sampler's size-selective inlet unit according to the manufacturer's instructions, taking care to retain all parts (Figure 6-4).
    a. If needed, apply penetrating oil or commercial lubricant to make removal of assembly screws easier. Once free of the sampler, wipe away any excess oil and rinse with alcohol.
3. Gently wipe all interior surfaces of the inlet and bug screen using a soft brush, lint-free wipes, and distilled water.
    a. Take care in performing this step as some edges may be sharp. Use lint-free wipes and/or a small, soft brush to clean small openings and crevices. If needed, use a clean wooden dowel followed by an alcohol rinse to clean the downtube.
    b. Using wipes moistened with distilled water, remove any remaining deposits.
    c. Completely dry all components.
4. Re-assemble the unit by aligning the parts according to guides marked in Step 1.
    a. Ensure that all O-ring seals are properly lubricated, seated, and sealed, and that all screws are uniformly tightened.
5. Clean the downtube interior by forcing or pulling a plug of water-moistened, lint-free wipes through the tube with a dowel. Do not scrape or abrade the interior surfaces. Allow to dry. Inspect the O-rings.
6. With the filter chamber assembly open, inspect the interior of the impactor housing (e.g., above and below the impactor well). The housing should be clean, dry, and free from oil. If necessary, clean the areas with a lint-free wipe. Clean the interior of the impactor jet using a lint-free pipe cleaner or similar tool. The upper impactor housing may be removed to do this. Do not score or abrade the jet orifice surfaces.
7. Without removing the O-rings, check for distortion, cracks, fraying, deficient lubricant, or other problems. Use a flashlight to better observe their condition. Replace or recondition the O-rings as necessary.
8. Close the filter chamber assembly to prevent dust intrusion.
9. Wipe or dust the interior of the sampler's main unit to remove bugs, dirt, and/or water deposits that may have collected inside the unit. Inspect the box cooling air intake filter and clean or replace it if necessary.

7.6.5.4 Service and Replacement of O-rings and Tubing

The BGI PQ200 sampler includes ten (10) O-rings within its flow path. Additional O-rings are part of the flow rate adapter and the performance check calibrator. Plastic tubes connect the sampler's components to the pump. A small plastic tube connects the atmospheric pressure sensor to the exterior of the sampler's main case. Flexible rubber or plastic tubing is also part of the flow rate and pressure sensors used in verification and calibration.

Some O-rings and tubing will likely need to be serviced and replaced as use and exposure to the elements cause them to degrade. To detect problems and make repairs in a timely fashion, the FS should follow these guidelines:

- Frequently inspect O-rings that hold the sampler inlet and the downtube in place.
  - O-rings are subject to wear each time the sampler is assembled and disassembled.
- Apply a *light* coat of silicone grease to O-rings such that the inlet, downtube, and upper impactor housing can be easily connected. Wipe any excess with a lint-free cloth.
  - Excessive grease may dissolve in the O-ring and cause premature degradation.
- Inspect the O-rings in the assemblies that hold the VSCC (or WINS impactor) and the filter cassette. A flashlight and/or magnifying lens may be needed to detect brittleness, cracks, or indentations.

  Do not use grease on any O-rings that come into contact with the filter cassette!

  - O-rings must be free of dust or debris to prevent scoring or indentions that may create leaks.
  - O-rings in the assemblies holding the VSCC (or WINS impactor) and filter cassette are not subject to sliding friction and generally *do not* require silicone grease.
- When O-rings are the suspected cause of leak check failures, verify whether the sealing pressure is adequate and look for loose tubing or connecting fittings.
- When removing O-rings, do not use tools that could score or nick the metal surfaces and channels where the O-rings are seated. Using a plastic or wooden dowel to dislodge a faulty O-ring is preferable. A small metal pin or a dental pick may be used to pull an O-ring away from its channel so that the ring can be grasped and removed.
- Remove all grease and dust from the metal channel before inserting a new O-ring. Be sure the new O-ring is properly aligned and fully seated before use.
- Inspect all types of tubing for cracks and brittleness and replace as needed.
  - Cracks often occur at the point where the tube is connected to a port or fitting.
- Periodically inspect all compression fittings, electrical connections, and mounting screws, bolts, or other hardware for signs of loosening. Tighten or replace as needed.
  - Unusual noise or excessive vibration may indicate that something is loose.

8.0 Quality Assurance/Quality Control

Forms cited in this section (in order of citation):

Chain-of-Custody (COC) form
Field Data Sheet (FDS) form
$PM_{2.5}$-PEP Field Data Verification/Validation/Correction Form (Form FDV)

8.1 Data Completeness

Completeness is defined as the percent of valid data generated by a measurement system, expressed relative to the expected (or required) amount. For the $PM_{2.5}$-PEP, completeness is a data quality indicator (DQI) that is monitored at the PQAO level based upon the number of $PM_{2.5}$-PEP sampling events among sites within a PQAO's jurisdiction which met each of the following criteria:

- The sampling event was successfully completed.
- All of its filter samples met criteria for validity, were shipped to the $PM_{2.5}$-PEP weighing laboratory within the required time frame and were received by the laboratory within the $PM_{2.5}$-PEP's required temperature range and in proper physical condition.
- All of its field data achieved acceptance criteria and have been recorded in the PED. (This criterion can be extended to require posting of the data in AQS.)

The corresponding measurement quality objective (MQO) for completeness states that each PQAO must achieve 100% of its required number of $PM_{2.5}$-PEP sampling events each year.

Each EPA Region (and self-implementing agency in the $PM_{2.5}$-PEP) has information about the expected number of $PM_{2.5}$-PEP sampling events to perform and are expected to obtain valid data for 100% of these sampling events each year. According to Section 3.2.4 of 40 CFR Part 58 Appendix A, any PQAO having at least one monitoring site used for determining $PM_{2.5}$ NAAQS attainment must ensure the following number of $PM_{2.5}$-PEP sampling events are performed each year among its sites (ideally distributed evenly throughout the year) and provide "valid data":

- PQAOs with five or fewer monitoring sites: five (5) valid $PM_{2.5}$-PEP sampling events.
- PQAOs with more than five monitoring sites: eight (8) valid $PM_{2.5}$-PEP sampling events.

Here, a "valid" $PM_{2.5}$-PEP sampling event means that $PM_{2.5}$ concentrations are measured during the sampling event and reported by both the site's primary $PM_{2.5}$ sampler (operated by the site's SLT agency) and the $PM_{2.5}$-PEP sampler, these concentrations have not been invalidated, and their values are at least 3 $\mu g/m^3$.

Achieving a $PM_{2.5}$ concentration measurement of at least 3 $\mu g/m^3$ may not be possible at sites with consistently and naturally low $PM_{2.5}$ concentrations. Therefore, for purposes of completeness in the $PM_{2.5}$-PEP, sampling events are not invalidated when the reported $PM_{2.5}$ concentration is less than 3 $\mu g/m^3$. However, AQS excludes these data from the bias assessment that it performs. Therefore, EPA recommends that an extra $PM_{2.5}$-PEP sampling event be scheduled (if possible) when a sampling event results in a reported $PM_{2.5}$ concentration below 3 $\mu g/m^3$ (for either the $PM_{2.5}$-PEP and/or SLT sampler). OAQPS is currently investigating the

lower concentration threshold and the validity of using concentration data below this threshold in bias assessments.

Temporally, PQAOs are to schedule $PM_{2.5}$-PEP sampling events for each quarter of the year, unless there is high expectation that in a given quarter, ambient $PM_{2.5}$ concentrations are consistently no higher than 3 $\mu g/m^3$. Geographically, PQAOs are required to distribute $PM_{2.5}$-PEP sampling events among different monitoring sites to ensure the following:

- Each FRM or FEM method designation represented among a PQAO's network samplers is evaluated by at least one $PM_{2.5}$-PEP sampling event each year, and
- Each of the PQAO's primary FRM or FEM network samplers (i.e., each network site) is the host of a $PM_{2.5}$-PEP sampling event at least once every six (6) years.
  - To achieve this requirement, a PQAO needs to host a $PM_{2.5}$-PEP sampling event at approximately 15% of its network sites in a given year.

8.2 Quality Assurance/Quality Control Procedures Led by Field Scientists

8.2.1 Scope and Applicability

This section describes the QA/QC procedures that a FS implements at prescribed frequencies at monitoring sites during $PM_{2.5}$-PEP sampling events.

8.2.2 Summary of Method

Table 8-1 lists the field QC checks which a FS performs within the $PM_{2.5}$-PEP, along with how frequently each is performed and the acceptance criteria for each check. The last column of this table cites the section in this SOP document which describes each check.

8.2.3 Quarterly $PM_{2.5}$-PEP Sampler Performance Checks and Audits

Once every three (3) months, a FS performs the following QA performance tests on all samplers used for $PM_{2.5}$-PEP sampling events:

- External leak check
- Internal leak check (only if external leak check fails)
- Temperature audit
- Pressure audit
- Flow rate audit.

These quarterly performance checks and audits utilize the same procedures as for verification checks (Section 6). However, they use an independent transfer standard verification device that is different from the primary standard used for calibration or the verification device used for routine $PM_{2.5}$-PEP verification operations in the field. Table 8-1 lists the acceptance criteria for these performance checks and audits; the audit criteria are as specified in CFR Part 50 Appendix L.

Table 8-1. $PM_{2.5}$-PEP quality control checks performed by Field Scientists while in the field

Requirement	Frequency	Acceptance Criteria	SOP Ref.
Holding Time and Inspection of $PM_{2.5}$-PEP Filters			
Time from pre-weigh to sample exposure	All filters	Less than 30 days [a]	Section 2
Filter retrieval following end of sampling period	All filters	Within 24 hrs [b]	Section 2
Filter shipment	All filters	Ship via next-day delivery on the same day as filter is collected post-sampling (best practice) [c]	Section 2
Visual filter defect check	All filters (prior to use)	No pinholes, particles, ring separation, or other imperfections	Section 7
$PM_{2.5}$-PEP Blanks			
Field blank (FB) [d]	General: 1 per FS per trip [k] New FSs: 1 per $PM_{2.5}$-PEP sampling event for first 10 sampling events [k]	±30 μg change between weighings	Section 7.1.6.2
Trip blank (TB) [e]	10% of all filters	±15 μg change between weighings	Section 7.1.6.3
Data Completeness			
Number of $PM_{2.5}$-PEP sampling events performed per PQAO	PQAOs with ≤ 5 $PM_{2.5}$ sites: 5 PQAOs with > 5 $PM_{2.5}$ sites: 8	100% completeness	Section 8
Calibration/Verification of $PM_{2.5}$-PEP Samplers (Using Normal PE Verification Devices)			
Clock/timer verification	Each $PM_{2.5}$-PEP sampling event	±1 min from local standard time against a time standard [f]	Section 6.1.5
External leak check	Each $PM_{2.5}$-PEP sampling event	<80 mL/min (5 cm H_2O of vacuum pressure loss over 2 minutes) [g]	Section 6.2
Internal leak check	Upon failure of external leak check	<80 mL/min (5 cm H_2O of vacuum pressure loss over 2 minutes) [g]	Section 6.2
Single-point barometric pressure verification	Each sampling event and following each calibration	±10 mm Hg of working standard	Section 6.3
Barometric pressure calibration	Upon failure of the single-point verification [h]	Adjust to within ±5 mm Hg of calibration standard	Section 10.1
Single-point temper-ature verification (ambient and filter)	Each sampling event and following each calibration	±2°C of working standard	Section 6.4
Temperature calibration (ambient and filter)	Upon failure of the single-point verification [h]	Adjust to within ±1°C of calibration standard	Section 10
Single-point flow rate verification	Each sampling event	±4% of working standard ±4% of design flow rate (16.67 LPM)	Section 6.5
Flow rate calibration (follow Operating Manual for 2020 and newer models)	Upon failure of the single-point verification	Adjust to within ±2% of calibration standard at design flow (16.67 LPM)	Section 10

Table 8-1. (cont.)

Requirement	Frequency	Acceptance Criteria	SOP Ref.
$PM_{2.5}$-PEP Sampler Performance Checks and Audits (Using Independent Verification Devices) [i]			
External leak check	1 per quarter	<80 mL/min (5 cm H_2O of vacuum pressure loss over 2 minutes) [g]	Section 8
Internal leak check	Upon failure of external leak check	<80 mL/min (5 cm H_2O of vacuum pressure loss over 2 minutes) [g]	Section 8
Barometric pressure audit	1 per quarter	±10 mm Hg of calibration standard	Section 8
Temperature audit	1 per quarter	±2°C of calibration standard	Section 8
Flow rate audit	1 per quarter (manual)	±4% of calibration standard ±4% of design flow rate (16.67 LPM)	Section 8
$PM_{2.5}$-PEP Precision (Using Collocated Samples) [j]			
Regional $PM_{2.5}$-PEP Collocation Events	2 per year (semi-annual)	CV within 10% (else sampler is flagged and filters reweighed. If CV >20%, all sampler data are flagged from the last precision check and corrective action initiated.)	Section 8
Regional $PM_{2.5}$-PEP Collocation Events	2 per year (semi-annual)	Any sampler with at least 2 and more than 50% of all relative notable differences over the entire collocation event are flagged and require further evaluation.	Section 8

[a] Refer to the "use by" date on the $PM_{2.5}$-PEP COC form.

[b] $PM_{2.5}$-PEP filters should be routinely recovered within 24 hours after conclusion of exposure. Forty-eight (48) hour collection is permissible to accommodate holidays, weekends, and other situations when the site is inaccessible. Up to 96-hour collection is permissible in the case of an emergency (e.g., sickness, accident). For filters collected between 48- and 96-hours, the FS must leave a comment in the notes section of the FDS explaining why the filter wasn't collected earlier, which may contribute to an invalidation depending upon the result of other QC checks. If the collection time is >96 hours, the sample will receive an invalidation flag.

[c] The FS will always transport exposed filters and blanks with frozen foam bricks (sealed wet ice is allowed for short term transportation only and not overnight shipment). The $PM_{2.5}$-PEP recommends packaging and shipping via next-day delivery on the same day as the filter is collected post-sampling. However, if the sample is recovered on a Friday, then it should be stored at a temperature ≤4°C until the next available shipping day. The laboratory must be notified of the delay to plan for post-weighing before samples expire.

[d] A trip may include sampling events for more than one FRM/FEM sampler type. It is up to the FS to determine the site where the field blank will be taken unless otherwise directed by his/her Regional $PM_{2.5}$-PEP Lead (such as when a problem is identified at a particular site).

[e] If the laboratory sends out 1 to 10 filters, then 1 trip blank should be included in the shipment. If the laboratory ships out 11 to 20 filters, then 2 trip blanks should be included. The FS will determine with which trip to use the trip blank filter(s), in a manner similar to the field blanks. However, if the FS receives more than one trip blank in a shipment, then he or she must make sure that only one trip blank is carried per trip.

[f] Cell/smart phones are used as time standards during $PM_{2.5}$-PEP field activities; the time standard frequency and range requirement are satisfied as long as the phone is configured to automatically update and synchronize when connected to its cellular network. Alternatively, FSs can use a smart phone to navigate to the following website, which can also be used as a time standard: https://www.time.gov/.

[g] FSs follow the leak test procedure described in *BGI PQ 200 Air Sampler User Manual*, which specifies the leak test criteria as internal vacuum pressure (cm of H_2O) loss per unit time. The PQ200 sampler leak check criterion is to check for 5 cm H_2O of vacuum pressure loss over 2 minutes. The listed leak check criterion was approved by EPA as equivalent to CFR requirements.

[h] The BGI PQ200 sampler is not capable of performing multipoint verifications. If the BGI PQ200 sampler fails a single-point verification, then a calibration should be performed next. The single-point calibration should not be performed in the field (it is more difficult to perform in the field and it is better to complete in a laboratory in which temperature and humidity are better controlled) unless it is the last resort to accomplishing a $PM_{2.5}$-PEP sampling event.

Table 8-1. (cont.)

[i] Quarterly audits are performed similarly to the verification checks conducted prior to every $PM_{2.5}$-PEP sampling event. However, an audit for a given sampler should (preferably) be conducted by a trained experienced technician (meeting all training requirements as described in Section A8 of the $PM_{2.5}$-PEP QAPP) other than the FS(s) that typically uses the given sampler during $PM_{2.5}$-PEP sampling events. Also, the working standard used during the audit must be a different standard than that used during verifications or calibrations. The fourth and final audit of the year can satisfy the annual calibration requirement if the specific parameter performance verification falls within the limit that would otherwise satisfy the post-calibration verification.

[j] Twice per year, all $PM_{2.5}$-PEP samplers used by a Region (and self-implementing organizations) must be collocated and 24-hour concentrations analyzed as described further in Section 8. These are often referred to as "parking lot collocation studies."

[k] A sampling "event" is defined as a single 24-hour sampling run at a given site and date. A sampling "trip" can encompass a single or multiple sampling events. A single sampling trip includes all events that occur before the FS returns to the Regional office.

8.2.4 **Regional Semi-Annual $PM_{2.5}$-PEP Collocation Studies**

Twice per year, all $PM_{2.5}$-PEP samplers within a Region's active fleet participate in a $PM_{2.5}$-PEP "collocation study." In this study, all samplers in the active fleet are collocated and sample runs occur concurrently among all samplers over the same 24-hour period. These studies are also known as "parking lot studies" because they usually take place in the parking lot of the Regional field office. The data collected in $PM_{2.5}$-PEP collocation studies allow for precision or repeatability to be estimated for a Region's fleet of $PM_{2.5}$-PEP samplers and their analytical procedures. They also provide information to assess bias or errant behavior that may be present in individual $PM_{2.5}$-PEP samplers relative to the rest of the fleet. The $PM_{2.5}$-PEP QAPP contains the equations for calculating precision and individual sampler bias from $PM_{2.5}$-PEP collocation study data.

8.2.4.1 Procedure

A $PM_{2.5}$-PEP collocation study has the following requirements and procedures:

- Each study must involve a minimum of three (3) $PM_{2.5}$-PEP samplers.
  - If a Region has fewer than three samplers, the $PM_{2.5}$-PEP Coordinator should contact the OAQPS $PM_{2.5}$-PEP Lead to either arrange to acquire an additional $PM_{2.5}$-PEP sampler or receive a permanent transfer of a sampler from another Region.
- To assess within-sampler repeatability of sample measurements, each study must involve a minimum of three (3) 24-hour sampling runs (or "events").
  - For a given sampler, each event requires a different filter.
  - The start time of each event can be adjusted (e.g., 10 am -10 am, 11 am – 11 am, noon to noon) to allow time for pre-run verifications and to allow all three events to be completed in a shorter time frame.
  - While each event should occur on consecutive days, a one or two-day (e.g., weekend) gap between events is allowable. However, if a gap of more than two days occurs between any two events within a study, the reason should be documented in the notes provided to the $PM_{2.5}$-PEP weighing laboratory.
- For each FS participating in a collocation study, one FB should be collected within each event (i.e., on each testing day), rotating among the samplers in the study.
  - For example, if two FSs are participating in the collocation study, then two FBs are required within each event.
- A minimum of one TB must be collected for every three events performed in a given study.
  - For example, if a study consists of three events, one TB is required. If a study consists of four to six events, two TBs are required.
  - The TB should accompany the last filter to be loaded into a sampler during the selected event.

- All filters collected in the collocation study (routine filters, FBs, and TBs) are shipped to the $PM_{2.5}$-PEP weighing laboratory using normal shipping procedures as described in Section 7.4 of this SOP.
- Prior to the start of each event, the FS must conduct performance verifications for each sampler, as is done for routine $PM_{2.5}$-PEP sampling events.
  - In addition, at the conclusion of the study, the FS must perform a final verification on each sampler before disassembling it.
- The inlets of the collocated samplers must be within one (1) to four (4) meters horizontal of each other and within one (1) meter in vertical height.
  - The four-meter maximum distance between inlets may be unachievable if a large number of samplers are participating and the available space cannot accommodate the necessary area. In this situation, the FS must ensure that all sampler inlets are within three (3) meters of the center of the sampler's configuration. Figure 8-1 provides an example configuration with 16 samplers. Here, the center of each one-meter circle represents the location of each sampler's inlet. To allow enough space for the FS to move between the second and third horizontal rows of samplers, the maximum distance between inlets exceeds four meters, yet all sampler inlets are within three meters of the center of the layout.

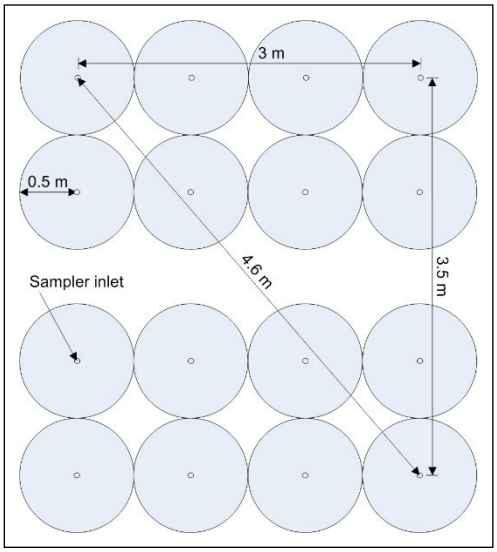

Figure 8-1. Example configuration for a collocation study involving 16 samplers

- The FS must document the layout of the samplers and any nearby obstructions.
- If the site location and/or sampler layout is different from a previously approved study design, the Regional $PM_{2.5}$-PEP Lead must review and approve the layout before the collocation study can proceed.
- At the end of each event (testing day), the FS must record the position of each sampler (by serial number) on a diagram of the sampler layout along with the daily wind direction, cut point, and $PM_{2.5}$ separator type (if applicable). This diagram documents any changes to the sampler position during the study, and the information can provide insight on why unusual or extreme $PM_{2.5}$ measurements were observed among the samplers.

8.2.4.2 Collocation Coding

Assigning the proper code to each filter sample collected in a $PM_{2.5}$-PEP collocation study is important to ensure that the corresponding sample data are correctly imported into the PED and AirQA. When conducting a collocation study, the FS uses the convention displayed in Table 8-2 to indicate the AQS Site ID for a sample data record. Note that because collocation studies are

not normally performed at monitoring sites, their specified IDs follow a unique format: "*xx*region*y*," where *xx* denotes the two-digit FIPS code of the Regional office, and *y* denotes the EPA Region number (with 10 denoted by 0).

On each filter's COC form, the FS specifies "Collocated" as the filter type and "NA" (not applicable) within the make and model and serial number fields of the SLT agency operated sampler (which doesn't exist in collocation studies).

Table 8-2. Determining a value for the AQS Site ID for samples collected in a $PM_{2.5}$-PEP collocation study

EPA Region	State Where Regional Office Is Located	FIPS State Code	Surrogate AQS Site ID
01	Massachusetts (MA)	25	25region1
02	New Jersey (NJ)	34	34region2
03	Maryland (MD)	24	24region3
04	Georgia (GA)	13	13region4
05	Illinois (IL)	17	17region5
06	Texas (TX)	48	48region6
07	Kansas (KS)	20	20region7
08	Colorado (CO)	08	08region8
09	California (CA)	06	06region9
10	Washington (WA)	53	53region0

8.3 Standards Recertifications

EPA certifies all primary and transfer standards used in the $PM_{2.5}$-PEP as NIST-traceable for one-year periods. Thus, on an annual basis, these standards must be returned to EPA for re-certification. EPA uses its own metrology laboratory for its re-certification testing and informs the Regional offices of where and when to send their standards for this recertification.

Table 8-3 provides the acceptance criteria used in all annual recertifications. Any standard that fails its acceptance criteria must have a corrective action identified and the problem rectified before it can be used again within the $PM_{2.5}$-PEP. In some cases, this corrective action may be to return the standard to the manufacturer for repair.

Table 8-3. Acceptance criteria for annual recertification of primary and transfer standards used in the $PM_{2.5}$-PEP

Standard	Acceptance Criteria
Field barometer	±5 mm Hg of NIST-traceable standard
Field thermometer	±1°C of NIST-traceable standard
Flow rate transfer standard	±2% of NIST-traceable standard

FSs must routinely update (minimally annually or more frequently if known changes occur) the "Calibrator Inventory" page on the AirQA website (PEPs>>PEP Dashboards>>Calibrator Inventory) for all calibrators in the Region's possession. If instruments move out of the inventory or new ones move in, the Regional $PM_{2.5}$-PEP Lead or the FS can delete old instruments or add new ones at any time.

8.4 Field Data Verification and Validation

8.4.1 Scope and Applicability

This section describes the QA procedures used in the $PM_{2.5}$-PEP to verify and validate field data. These terms are defined as follows:

- *Verification* refers to the process of examining the result of a given activity to determine the result's conformance with stated requirements.
- *Validation* refers to examining a result to determine its conformance to user needs.

8.4.2 Summary of Method

In the $PM_{2.5}$-PEP, the FS (and the weighing laboratory) perform a 100% accuracy check of all data hand-entered on the COC and FDS forms. Any data entries found to be unacceptable must be corrected before shipping the samples and COC/FDS forms. All $PM_{2.5}$-PEP Regional Leads have the ability to review data under their purview (via AQS and/or the AirQA website) as the data are made available within the system. Backup versions of field and laboratory data are housed on the AirQA website.

Figure 8-2 summarizes the field data verification and validation procedure. Monthly (typically between the second and third week of the month), the $PM_{2.5}$-PEP weighing laboratory sends an electronic report to the Regional $PM_{2.5}$-PEP Lead and their FS(s). This report includes data from the PED and the information captured electronically from the FDS. The laboratory also provides a $PM_{2.5}$-PEP Field Data Verification/Validation/ Correction Form (Form FDV – Appendix C). The FS reviews the field information and affirms its validity by initialing the hard-copy or electronic Form FDV. The FS also indicates any necessary edits on this form, placing initials beside any edits. The laboratory personnel making the edit then initials once the edit has been completed. The FS

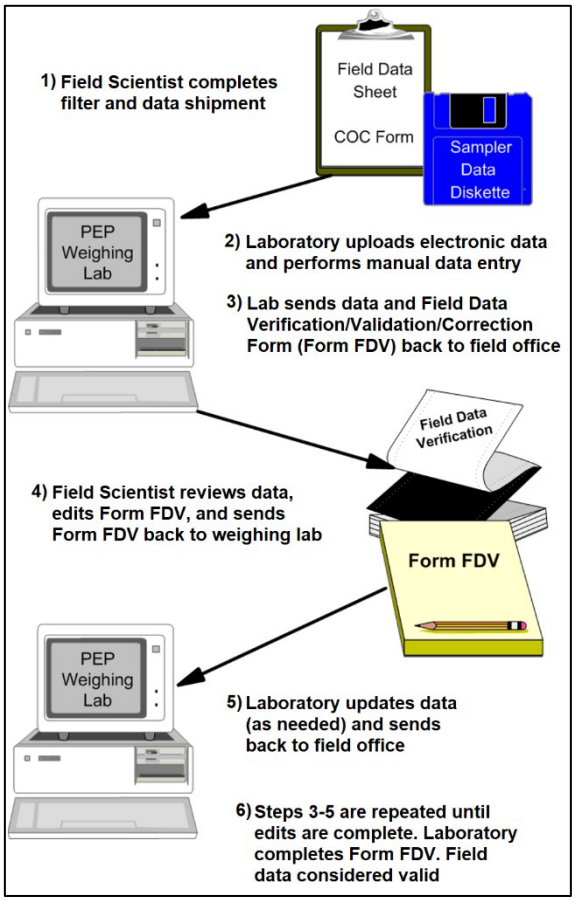

Figure 8-2. Field data verification and validation data flow in the $PM_{2.5}$-PEP

summarizes the validated data in monthly reports to the Regional $PM_{2.5}$-PEP Lead. Section 9.2.5 of this SOP provides further information on monthly reporting requirements.

8.4.3 **Procedure**

The $PM_{2.5}$-PEP weighing laboratory generates a Form FDV for each EPA Regional Office. This form may be in hard-copy or electronic (spreadsheet) format and includes the Filter ID, cassette ID, Filter Type, and Sample Date for samples from that Region. After this form has been generated, new data are added monthly to provide a complete record for the year.

Between the second and third Monday (approximately the 10^{th} calendar day) of each month, the $PM_{2.5}$-PEP weighing laboratory e-mails data for review by the Regional $PM_{2.5}$-PEP Lead(s) and FS(s). This includes an electronic data report, information for all available data from the previous data shipment (prior month), and the Form FDV. The laboratory keeps a record of each monthly data shipment to the Regions based on Filter ID.

The FS makes copies of the COC and FDS forms (Appendix C) as well as an electronic or hard-copy version of the portable sampler data. The FS is not asked to check data that are automatically transferred from the sampler; only values that are entered manually (e.g., cassette ID, AQS Site ID, flags, run date) require inspection.

Table 8-4 identifies the parameters that should be reviewed for both sets of data sent to the field offices. While the "key" fields for both data sets are the cassette IDs and the Filter IDs, other parameters on the COC and FDS forms also must be reviewed as they may not have been completed or entered correctly. The FS is responsible for communicating these edits to the laboratory analyst (LA) on Form FDV.

1. The FS receives the data report and Form FDV from the $PM_{2.5}$-PEP weighing laboratory.
2. The FS reviews all field-generated data except the data transferred electronically from the sampling instrument. The FS verifies that these data are complete and validates that the data values are correct.
3. If the data are correct, then the FS notes this along with the date reviewed into the FS Date field (see Form FDV with example data in Appendix C). If any data need correction, the FS follows Steps 4 through 12.
4. If any data are not correct, the FS indicates that the data need to be corrected (see Form FDV with example data in Appendix C). Note that each correction should be entered on a separate line of the form, even if multiple parameters related to the same Filter ID require editing.
5. Using Form FDV, identify the parameter that needs to be corrected and enter the parameter name in the "Parameter" field. Table 8-4 (first column) lists the parameter names, which are the same as those used on Form FDV. The corresponding parameter names used in the COC or FDS forms are listed in the second column.
6. Enter the current (incorrect) value into the "Current Value" field on Form FDV.
7. Place the correct value in the "Correct Value" field.
8. Initial the "FS Initial" field and enter the date when the data were reviewed in the "FS Date" field.

9. Add comments to explain why the value was changed.
10. Form FDV requires that multiple edits to the same Filter ID be listed on separate rows of Form FDV. The FS may add rows to electronic FDV forms as needed. Quotes may be used in the "Filter ID" field to signify additional edits to the same Filter ID (see Form FDV with example data in Appendix C).
11. The FS completes the data review before the end of the month and submits an updated Form FDV to the $PM_{2.5}$-PEP weighing laboratory and the Regional $PM_{2.5}$-PEP Lead. The FS includes a hardcopy of Form FDV with his/her monthly progress report.
12. The $PM_{2.5}$-PEP weighing laboratory updates the data report and Form FDV, returns to the FS, and the above steps are repeated if a second set of corrections are necessary.
13. The $PM_{2.5}$-PEP weighing laboratory reports progress on verification and validation during annual training or equivalent events/meetings.

Table 8-4. Parameters to be checked in $PM_{2.5}$-PEP field data verification and validation

Field Name on Report	Field Name on Form	Form(s)
PED Data Report		
PE Filter ID	Filter ID	COC
PE cassette ID	Filter cassette ID	COC and FDS
Site AQS ID	AQS Site ID	COC and FDS
Start Date	Start Date/Time	FDS
PE Serial No.	Primary Site Sampler Serial No.	COC
Field Data Summary Report		
FS	$PM_{2.5}$-PEP Field Scientist	FDS
FRM Sampler Serial Number	FRM Sampler Serial No	FDS
Date	Sampling Date	FDS
AQS Site ID	AQS Site ID	FDS
Temp. Readout Serial Number	Temp. Trans. Std.	FDS
Temp. Probe Serial Number	Temp. Trans. Std.	FDS
BP Serial Number	BP Trans. Std.	FDS
FR Pressure Serial Number	Flow Rate Std	FDS
Leak Check Beg. Pressure	Beginning P	FDS
Leak Check End Pressure	Ending P	FDS
BP STD Pressure	Std. Pressure	FDS
BP Samp. Pressure	Sampler Pressure	FDS
Amb. Temp. Standard	Std. Temp. (ambient sensor)	FDS
Filter Temp. Standard	Std. Temp. (filter sensor)	FDS
Amb. Temp. Sampler	Sampler Temp. (ambient sensor)	FDS
Filter Temp. Sampler	Sampler Temp. (filter sensor)	FDS
Actual FR Sampler	Sampler FR (design flow rate check)	FDS
Filter Cassette No	Filter cassette ID	FDS
Free Form Notes	Notes	FDS

9.0 Information Retention

9.1 Scope and Applicability

The Federal Records Act (44 U.S.C. 31) and other statutes require federal agencies, including the EPA, to create records that document their activities. Since 2019, all government agencies have been instituting electronic/digital filing and archiving capabilities. By December 31, 2021, EPA was supposed to be fully digital. The filing schedules have not changed significantly since 2014. EPA Regional $PM_{2.5}$-PEP Coordinators and Leads will file the records they generate and receive and dispose of these records according to Agency schedules. This section highlights the document and records procedures for $PM_{2.5}$-PEP field activities. Refer to Section 3.0 for detailed information on the document and records procedures which EPA applies to the COC and FDS forms used in the $PM_{2.5}$-PEP.

Currently, EPA records schedule #1006, "Administrative Management," is the relevant schedule for records generated in $PM_{2.5}$-PEP activities. Implemented on August 31, 2021, records schedule #1006 supersedes schedule #006. It covers records related to the day-to-day management and maintenance of the internal infrastructure. For more information on EPA records schedules, see https://www.epa.gov/records/epa-records-schedules-detailed-information.

At the date of this SOP, the following hard copy documents exist within the $PM_{2.5}$-PEP as semi-permanent records:

- COCs that accompany $PM_{2.5}$-PEP filters from pre-weighing to completed exposure and analysis,
- FDSs that are initiated in the field and follow $PM_{2.5}$-PEP filters through the completed analysis, and
- Hardbound field notebooks that are maintained as a historical record of field activities.

The COC and FDS will eventually be digitized and completed electronically. In addition, once a field notebook is full, it should be scanned into a digital form and stored as an electronic document per the appropriate record category and schedule.

As noted in Section 2.1.3, the $PM_{2.5}$-PEP utilizes the AFC system described in Table A9-2 of the $PM_{2.5}$-PEP QAPP to organize and archive records. EPA Regional contractors are guided by their contract provisions, which are implemented through their Technical Direction Form (TDF) policies. These policies are presumed to be equivalent to EPA's AFC schedules, so long as it allows for appropriate responses to interrogatories, TSAs, and/or other reviews. Self-implementing agencies within the $PM_{2.5}$-PEP are expected to use a similar filing system for the same reasons.

The term "reporting package" refers to all information generated when performing $PM_{2.5}$-PEP activities and reported to EPA. Table A9-1 of the $PM_{2.5}$-PEP QAPP identifies these relevant documents and records, while Table A9-2 lists the AFC function and schedule numbers for each document/record type. An overarching major code called "$PM_{2.5}$-PEP" is maintained to delineate these files from other programs.

9.2 Information Included in the $PM_{2.5}$-PEP Reporting Package

9.2.1 Data Reporting Package Format and Document Control

The $PM_{2.5}$-PEP records management system uses AFCs to facilitate the easy retrieval of information during TSAs and reviews. It also includes EPA records schedules to ensure that the $PM_{2.5}$-PEP follows EPA policy on how long to keep records (retention) and what to do with them afterwards (disposition).

Elements of the $PM_{2.5}$-PEP reporting package are filed under the major code "$PM_{2.5}$-PEP," followed by the AFC function and schedule numbers listed in Table A9-2 of the $PM_{2.5}$-PEP QAPP. For example, COC forms are filed under "$PM_{2.5}$-PEP/301-093-1006.3."

9.2.2 Field Notebooks

Although the $PM_{2.5}$-PEP uses data entry forms and electronic data records to capture all routine environmental field operations, it uses field notebooks to record additional information about these operations. Each $PM_{2.5}$-PEP field notebook is uniquely numbered and assigned to a specific FS.

9.2.3 Communications

Each FS is responsible for recording communications related to their $PM_{2.5}$-PEP field activities. Among the communication records stored are the following:

- E-mail messages (printed or stored electronically) on $PM_{2.5}$-PEP activities which are deemed noteworthy or important to document.
- $PM_{2.5}$-PEP Phone Communication Forms (COM-1; Appendix C) for phone messages and conversations deemed noteworthy or important to document.
- $PM_{2.5}$-PEP Monthly Field Progress Report Forms (COM-2; Appendix C) which the FS completes and provides to the Regional $PM_{2.5}$-PEP Lead on a monthly basis. The deadline for delivery of completed forms is the 15th calendar day of the following month, unless otherwise specified by the Regional $PM_{2.5}$-PEP Lead. The information in this form includes:
  - Reporting period: Start and end date which the report covers.
  - Reporter: Name of person writing the reports.
  - Progress: Descriptions of progress made on field activities within the reporting period, including $PM_{2.5}$-PEP sampling events scheduled, and events conducted.
  - Issues: Old issues reported in earlier reports that still must be fully resolved, and new issues that arise within the reporting period. Includes a summary of critical findings and data corrections (if applicable) as recorded on Form FDV (Section 8.4) during the monthly verification and validation of field data.
  - Actions: Action(s) needed to resolve issues, the person(s) responsible for taking that action, and the anticipated dates when the action will be completed.

9.2.4 **Electronic Data Collection**

Besides maintaining paper-based documents (e.g., notebooks, forms, binders), the $PM_{2.5}$-PEP captures and stores much of its data electronically. The $PM_{2.5}$-PEP generates printouts from its electronic systems, including from the PED and from spreadsheets used by the FS and others. When the $PM_{2.5}$-PEP designates certain printouts as permanent record (e.g., data which leads to significant findings or conclusions), the FS works with the Regional $PM_{2.5}$-PEP Lead to file them as a data reporting package and to archive the package properly.

9.2.5 **Hand-Entered Data**

All information recorded by hand (e.g., COC and FDS forms; Appendix C) must be done in indelible ink. Any necessary corrections to such entries are made by inserting one line through the incorrect entry, initialing and dating this correction, and placing the correct entry alongside the incorrect entry (if this can be accomplished legibly) or by providing the information on a new line.

9.2.6 **Data Retention/Archive**

Each Regional field office retains the information captured and maintained within a $PM_{2.5}$-PEP reporting package for a period of four (4) calendar years (e.g., all data from calendar year 2020 are archived through 12/31/2024). Upon reaching the four-year archival date, the Regional $PM_{2.5}$-PEP Lead informs the OAQPS $PM_{2.5}$-PEP Lead that the material has met the archive limit and asks for a decision on whether to continue archiving the material or to dispose of it. Some individual contracts may require a retention time longer than four (4) years, in which case the data/materials must be archived for this extended period before disposal.

10.0 Calibrations

Forms cited in this section (in order of citation):
$PM_{2.5}$-PEP Calibration Worksheet

This section describes the verification/calibration process for the BGI PQ200 sampler with the "Rev T" or "Rev U" main controller board. Specifically,

- Section 10.1 addresses barometric pressure calibration.
- Section 10.2 addresses temperature calibration.
- Section 10.3 addresses flow rate calibration.

These calibration procedures are significantly different than those used for older BGI models. for For details on the calibration procedures for older BGI models, refer to prior versions of this SOP and to their respective BGI Operator Manuals. For other approved FRM samplers, refer to the specific sampler's instruction manual for further guidance. Where possible, manufacturer's instruction manuals are posted on the $PM_{2.5}$-PEP page of EPA's AMTIC website (https://www.epa.gov/amtic) and on the $PM_{2.5}$-PEP Documentation page of the AirQA.org website.

Although the verifications and calibrations addressed here are not part of typical $PM_{2.5}$-PEP field operations, their procedures are included for two reasons:

1. To give experienced operators the information needed to complete their required annual sampler calibrations or to otherwise correct problems.
   - Note that if a sampler fails a particular single-point verification and continues to fail following a calibration, then the FS must troubleshoot the problem further prior to using the sampler in a $PM_{2.5}$-PEP sampling event.
2. The Regional $PM_{2.5}$-PEP Lead may direct a FS to calibrate the $PM_{2.5}$-PEP sampler in the field if that sampler repeatedly fails certain verification tests despite attempts at troubleshooting, if no other backup sampler is available (and to ward off needing to cancel the $PM_{2.5}$-PEP sampling event).

As of spring 2023, the $PM_{2.5}$-PEP has fewer than 10 operational BGI PQ200 samplers with an older main controller board designated as "Rev D" or "Rev T." EPA strongly recommends continuing to use these samplers for the $PM_{2.5}$-PEP until the board no longer functions. Note that the flow controller board is common to all control boards and can be replaced upon causing malfunction. For details, see the *PQ200 Troubleshooting Guide* document, available at the $PM_{2.5}$-PEP Documentation page on the AirQA.org website. $PM_{2.5}$-PEP samplers with "Rev D" boards have several additional control boards, and given their age, are probably not worth the effort to upgrade to a Rev U sampler configuration. However, $PM_{2.5}$-PEP samplers using the "Rev T" board that are in good condition may be able to convert to a "Rev U" control board and hardware configuration.

10.1 Barometric Pressure Calibration

10.1.1 Scope and Applicability

Each portable $PM_{2.5}$-PEP sampler is subject to a barometric pressure calibration annually, as well as upon failure of a single-point barometric pressure verification.

10.1.2 Summary of Method

In a barometric pressure calibration, the FS calibrates the sampler to within ±5 mm Hg of a NIST-traceable barometric pressure standard. Each $PM_{2.5}$-PEP Regional Office or self-implementing SLT agency must have an independent, NIST-traceable reference barometer for performing this comparative measurement.

The barometric pressure calibration is a single-point calibration. BGI determined that the pressure sensor's response to change in pressure is linear within the range of barometric pressures likely to be encountered. Because the operator is essentially adjusting the offset of this linear curve programmed into the sampler, a multipoint calibration is not necessary.

Once the barometric pressure calibration is complete, the operator must verify the sampler's barometric pressure reading using a separate NIST-traceable device (NOT the device used in the calibration). Using different (independent) devices to calibrate and verify ensures there are no erroneous measurements by either device. The verification involves confirming that the reading is within an acceptable ±10 mm Hg verification tolerance (Section 6.3).

10.1.3 Cautions

- The cautions given in Section 6.3.3 are also relevant here.
- Barometric pressure calibration and verification activities must be completed before conducting a flow calibration on the sampler.
  - Because barometric pressure enters into the flow rate calculation, DO NOT perform a flow calibration if the barometric pressure and/or temperature is outside of acceptable verification limits.
- Protect all types of barometers from mechanical shock and sudden changes in pressure.
  - A barometer subjected to either of these events must be recalibrated by comparing it to a laboratory mercury column barometer or other NIST-traceable pressure standard and adjusting it to specifications or making an established offset correction.
- Minimize the vertical and horizontal temperature gradients across any barometer, and avoid direct sunlight, drafts, and vibrations.
- Ensure that lines to the barometric pressure board are not crimped or clogged with debris prior to verification or calibration.
- Ensure that the barometric pressure reference standard used to verify the instrument's sensors has been calibrated within the past year against a NIST-certified standard.
- Confirm that the standard device used in the calibration is different (independent) from the standard device used for verification.

- The independent calibration device is used exclusively for calibrations, while the working transfer standard is used to verify the calibration.

10.1.4 **Equipment and Supplies**

The following equipment and supplies are required for the barometric pressure verification and calibration procedure:

- 2 NIST-traceable barometric pressure devices having a ±1 mm Hg resolution and at least a ±5 mm Hg accuracy.
- Small flat-head screwdriver (for adjusting the barometric pressure potentiometer if the sampler uses a "Rev T" board).
- Spare batteries (for the transfer standards).
- $PM_{2.5}$-PEP Calibration Worksheet (Appendix C).

10.1.5 **Procedure**

When performing the required annual barometric pressure calibration on a sampler, a single-point verification (Section 6.3), using an independent NIST-traceable reference standard, is done both before and after the calibration. If in the initial verification, the measurements from the sampler and the standard differ by less than 5 mm Hg (i.e., the acceptance criterion for a calibration), it is not necessary to move forward with a calibration. The measurements and their difference are recorded on the "Barometric Pressure" line within the "Initial Verification" section of the $PM_{2.5}$-PEP Calibration Worksheet.

The calibration proceeds if the difference in measurements exceeds ±5 mm Hg within the initial verification, or if the sampler is repeatedly failing verification tests in the field. The procedure for performing a calibration (and subsequent reverification) is as follows. (This process should be performed indoors if possible.)

1. Examine the sampler for any obvious physical damage that could be responsible for the verification failures, including crimped or plugged tubing leading to the pressure sensor, evidence of shipping damage (e.g., bent or loose components), a damaged pressure transducer, or electrical problems.
2. Power on the sampler and allow the electronics to warmup for 30 to 60 minutes. Note where the barometric pressure reading is displayed on the sampler's home screen.
3. Power on the transfer standards and let equilibrate for one hour.
    a. If applicable, replace batteries if a transfer standard indicates battery power is below the operating manual's recommended percentage.
4. If the calibration is performed due to failure of a single-point barometric pressure verification, confirm that the two pressure readings observed from that verification (i.e., the sampler's reading and that taken from the verification device) and their difference have been recorded on the "Barometric Pressure" line within the "Initial Verification" section of the $PM_{2.5}$-PEP Calibration Worksheet before proceeding.
    - The difference should not exceed ±10 mm Hg in absolute value (Section 6.3).

5. Observe the reported pressure readings from the NIST-traceable calibration barometric pressure standard and the sampler's barometric pressure sensor.
   - Record these two measurements and their difference on the "Barometric Pressure" line within the "Initial Calibration Comparison" section of the $PM_{2.5}$-PEP Calibration Worksheet.
   - Note that the barometric pressure standard's proximity to the sampler's barometric pressure sensor is not relevant in measuring barometric pressure.
6. If necessary, align the sampler's ambient reading to agree with the reading from the transfer standard to within 5 mm Hg by performing the following depending on the sampler's motherboard version:
   a. "Rev T" board: Adjust the small brass screw on the barometric pressure potentiometer until the ambient readings agree to within 5 mm Hg. The potentiometer is located on the motherboard behind the lithium battery denoted by "BARO." A clockwise adjustment increases the reading, whereas a counterclockwise adjustment reduces the reading. Consult the sampler instruction manual for diagrams of the printed circuit boards, if necessary.
   b. "Rev U" board: From the main menu, select **Calibrate Temperature & Pressure** and press **Select** to choose barometric pressure. Use the **UP** and **Down** buttons to change the value displayed by the sampler until the ambient readings agree within 5 mm Hg of the transfer standard.
7. Record both adjusted readings and their difference on the "Barometric Pressure" line within the "Adjusted Calibration Comparison" section of the $PM_{2.5}$-PEP Calibration Worksheet.
8. Perform a post-calibration verification by applying the single-point verification described in Section 6.3 and recording the measurements and their difference on the "Barometric Pressure" line within the "Post Verification" section of the $PM_{2.5}$-PEP Calibration Worksheet.

10.2 Temperature Calibration

10.2.1 Scope and Applicability

Each portable $PM_{2.5}$-PEP sampler is subject to a filter temperature or ambient temperature calibration annually, as well as upon failure of a single-point filter temperature or ambient temperature verification.

If calibration does not resolve the problem, then the FS must troubleshoot the problem further prior to using the sampler in a $PM_{2.5}$-PEP sampling event.

10.2.2 Summary of Method

The BGI PQ200 sampler measures temperatures at two locations:

- outside the sampler (ambient temperature), and
- inside the filter cassette housing (filter temperature).

A calibration of the two temperature probes is performed annually or upon failure of a one-point temperature verification of either probe. The sampler must be calibrated to within 1°C of the reading given by an independent NIST-traceable reference thermometer. In this method, the internal circuitry of the sampler is adjusted to make the sampler's readout match the reference thermometer.

The temperature calibration is a single-point calibration. BGI determined that each probe's response to temperature changes under typical ambient conditions is linear. Because the operator is essentially adjusting the offset of a linear curve programmed into the sampler, a multipoint calibration is not necessary.

Upon completion of a calibration, the FS must verify the sampler's temperature probes using a separate NIST-traceable travel standard thermometer (NOT the standard thermometer used in the calibration). Using different (independent) standard thermometers to calibrate and verify ensures there are no erroneous measurements by either standard. The verification involves confirming that the reading is within an acceptable 2°C verification tolerance (Section 6.4).

10.2.3 **Cautions**

- The cautions given in Section 6.4.3 are also relevant here.
- Temperature calibration and verification activities must be completed before conducting a flow calibration on the sampler.
  - Because ambient temperature enters into the flow rate calculation, DO NOT perform a flow calibration if the barometric pressure and/or temperature is outside of acceptable verification limits.
- Exercise care if using a mercury-in-glass thermometer, which can break easily.
  - If such a thermometer is broken, avoid contact with mercury and avoid breathing the mercury vapors. Clean up the mercury and dispose of it properly.
  - A NIST-traceable digital thermometer with probe is an alternative measurement method that avoids mercury.
- Ensure that the temperature reference standard used to verify the sampler's probes has been calibrated within the past year against a NIST-certified standard.
- The calibration device must be different (independent) from the verification device.
  - The independent calibration device is intended only for calibration. The working transfer standard is used to verify the calibration. The purpose of using different devices to calibrate and verify is to ensure there are no erroneous measurements by either device.

10.2.4 **Equipment and Supplies**

- 2 NIST-traceable temperature devices
- Small, slotted screwdriver (for adjust potentiometers)
- $PM_{2.5}$-PEP Calibration Worksheet (Appendix C).

10.2.5 **Procedure**

When performing the required annual temperature calibration on a sampler, a single-point verification (Section 6.4), using an independent NIST-traceable reference standard, is done both before and after the calibration. If in the initial verification, the measurements from the sampler and the standard differ by less than ±1°C for both ambient and filter temperature, it is not necessary to move forward with a calibration. The measurements and their differences are recorded on the "Temperature Ambient" and "Temperature Filter" lines within the "Initial Verification" section of the $PM_{2.5}$-PEP Calibration Worksheet.

The calibration proceeds if the initial verification fails (i.e., the difference in measurements is 1°C or larger for either ambient or filter temperature) or if the sampler is repeatedly failing verification tests in the field. The procedure for performing a calibration (and subsequent reverification) is as follows. (This process should be performed indoors if possible.)

1. Power on the sampler and allow the electronics to warmup for 30 to 60 minutes. Note where the ambient and filter temperature are displayed on the sampler's home screen.
2. Power on the transfer standards and let equilibrate for one hour.
3. If the calibration is necessary due to an unacceptable verification of either the filter or the ambient temperature (Section 6.4), then record the two originally observed readings (i.e., the sampler's reading and that taken from verification device) and their difference on the "Temperature Ambient" and/or "Temperature Filter" lines within the "Initial Verification" section of the $PM_{2.5}$-PEP Calibration Worksheet before proceeding.
   - The measurements for a verification should agree to within 2°C for either probe.
4. Place the calibrator's filter probe in the appropriate location within the sampler.
   a. For an ambient temperature calibration, place the calibration standard's attached filter probe into the sampler's gill screen within one (1) centimeter of the sampler's ambient probe.
   b. For a filter temperature calibration, place the calibration standard's filter probe within one (1) centimeter of the sampler's filter probe. Ensure that the probe is shaded.
5. Compare measurements from the NIST-traceable calibration thermometer's probe and the sampler's ambient temperature probe and compute their difference.
   a. Record measurements and their difference on the "Temperature Ambient" line within the "Initial Calibration Comparison" section of the $PM_{2.5}$-PEP Calibration Worksheet.
6. Compare measurements from the NIST-traceable calibration thermometer's probe and the sampler's filter temperature probe and compute their difference.
   a. Record measurements and their difference on the "Temperature Filter" line within the "Initial Calibration Comparison" section of the $PM_{2.5}$-PEP Calibration Worksheet.
7. If necessary, align the sampler's ambient readings to agree with the readings from the transfer standard to within 1°C by performing the following depending on the sampler's motherboard version:

a. "Rev T" board: Adjust the small brass screw on the ambient and/or filter temperature potentiometer until the ambient readings agree to within 1°C for each. A clockwise adjustment increases the reading, whereas a counterclockwise adjustment reduces the reading. The potentiometers are located on the bottom center left of the motherboard denoted by "AMBIENT" and "FILTER." Consult the sampler instruction manual for diagrams of the printed circuit boards, if necessary.

b. "Rev U" board: From the main menu, select **Calibrate Temperature & Pressure** and press **Select** to choose Ambient Temperature or Filter Temperature. Use the **UP** and **Down** buttons to change the value displayed by the sampler until the ambient filter readings agree to within 1°C the transfer standard.

8. Record both adjusted readings and their difference on the "Temperature Ambient" and/or "Temperature Filter" lines within the "Adjusted Calibration Comparison" section of the $PM_{2.5}$-PEP Calibration Worksheet.
9. Perform a post-calibration verification by applying the single-point verification described in Section 6.4 and recording the measurements and their differences on the "Temperature Ambient" and/or "Temperature Filter" lines within the "Post Verification" section of the $PM_{2.5}$-PEP Calibration Worksheet.

10.3 Flow Rate Calibration

10.3.1 Scope and Applicability

Each portable $PM_{2.5}$-PEP sampler is subject to a flow rate calibration annually, as well as upon failure of a single-point flow rate verification.

If calibration does not resolve the problem, then the FS must troubleshoot the problem further prior to using the sampler in a $PM_{2.5}$-PEP sampling event.

10.3.2 Summary of Method

A calibration of a sampler's flow rate is performed annually or upon failure of a one-point flow rate verification. The $PM_{2.5}$-PEP requires the sampler flow rate be calibrated to within two percent (2%) of a NIST-traceable flow rate standard at the sampler design flow rate of 16.67 LPM.

The $PM_{2.5}$-PEP flow rate calibration is a single point calibration, despite the BGI PQ200 Operators Manual which stated that a three-point calibration was necessary. Experienced operators have consistently encountered a drift in the calibrated flow at 16.67 LPM when the three target flow rates were calibrated in succession followed by a sampler reset to the FRM required flow rate. That is, the post-calibration verifications invariably failed when resetting the sampler to 16.67 LPM after the three-point calibration.

Upon completion of the calibration, the flow rate is verified with a separate NIST-traceable device (NOT the standard used in the calibration). Using different (independent) flow rate standard to calibrate and verify ensures there are no erroneous measurements by either standard. The verification involves confirming that the reading is within an acceptable ±4% field verification tolerance (Section 6.5).

Prior experience has noted that following recalibration, a one-point verification that exceeds four percent (4%) of the transfer standard is an indication that the calibration is drifting. This is likely the result of a mechanical issue with the BGI pump/motor or electronics which requires servicing.

10.3.3 **Cautions**

- The cautions given in Section 6.5.3 are also relevant here.
- Flow rate is calculated using the sampler's barometric pressure and ambient temperature readings. Therefore, these two parameters must achieve their respective verification criteria (from Sections 10.1 and 10.2, respectively) prior to moving forward with conducting a flow rate calibration.
  - If readings for these two parameters cannot be recalibrated successfully, the sensors will most likely need replacing. Contact BGI for advice on the most appropriate remedy.
- The $PM_{2.5}$-PEP sampler must also have passed a verification check for external leaks before performing a flow rate verification or calibration.
- The sampler and the sampling train (inlet, PM_{10}- separator, down tubes, and $PM_{2.5}$ separator) should be clean and free of dents or obstructions.
- Do not operate the sampler without a flow verification filter installed.
  - The transport filter can be used if it is in good condition.
- Calibration of the sampler's flow rate measurement system must be in the same units as the actual ambient volumetric flow rate.
  - Do not use either the "mass flow rate" or "flow rate at standard" conditions.
- Verify that tight connections exist between the verification and calibration device and the sampler. This includes all O-ring seals and hose connections.
- When the equipment is not in use, cap all entrance points on the flow rate standards and store them in a protective case or container.
- Ensure that the flow reference standard used to verify the instrument's sensors has been calibrated within the past year against a NIST-certified standard
- The calibration device must be different (independent) from the verification device.
  - The independent calibration device is intended only for calibration. The working transfer standard is used to verify the calibration. The purpose of using different devices to calibrate and verify is to ensure there are no erroneous measurements by either device.

10.3.4 **Equipment and Supplies**

- $PM_{2.5}$-PEP Calibration Worksheet (Appendix C).
- 2 NIST-traceable flow rate standard devices.
- A flow rate calibration adapter and tubing to connect the primary flow rate standard outlet to the $PM_{2.5}$ sampler down tube, if using equipment other than the deltaCal device.

10.3.5 **Procedure**

When performing the required annual flow rate calibration on a sampler, a single-point verification (Section 6.5), using an independent NIST-traceable reference standard, is done both before and after the calibration. If in the initial verification, the measurements from the sampler and the standard differ by less than ±2%, it is not necessary to move forward with a calibration. The measurements and their differences are recorded on the "Flow Rate" line within the "Initial Verification" section of the $PM_{2.5}$-PEP Calibration Worksheet.

The calibration proceeds if the initial verification fails (i.e., the difference in measurements is 2% or larger) or if the sampler is repeatedly failing verification tests in the field. The procedure for performing a calibration (and subsequent reverification) is as follows. (This process should be performed indoors if possible.)

1. Power on the sampler and allow the electronics to warmup for 30 to 60 minutes. Note where flow rate is displayed on the sampler's home screen.
2. Power on the transfer standards and let equilibrate for one hour.
3. If the calibration is necessary due to an unacceptable verification (Section 6.5), then record the two originally observed measurements (i.e., the sampler's reading and that taken from verification device) and their difference on the "Flow Rate" line within the "Initial Verification" section of the $PM_{2.5}$-PEP Calibration Worksheet before proceeding.
   - For a verification, the two measurements should agree to within ±4%.
4. From the sampler's Main Menu screen, use the arrow keys to scroll to the **Test and Calibration** menu and press **SELECT**.
5. Scroll to *** Select and Calibrate a Flow Rate** and press **SELECT**.
   - On older samplers (typically with serial numbers 001-399), the "Volume or Mass Control?" message is displayed. The current selection will be flashing on the second line.
   - Note that upgraded samplers perform as newer models.
6. Press the arrow button to select **(VOLUME)**.
   - If no "**Volume or Mass Control?"** option is available, then proceed to Step 12.
7. The next screen will display Target **Q: 16.7 LPM** and Volume on the first line. The numeric value will be flashing.
   - The second and third lines display the current ambient temperature and barometric pressure, as well as the ambient temperature and barometric pressure recorded within the "current" calibration (i.e., residing in memory from the most recent calibration).
8. Press **SELECT (NEXT)**. The value preceding the decimal place will stop flashing, indicating that it can be edited.
9. Use the arrow **(EDIT)** buttons to increase or decrease the selected value. When finished, press **SELECT (NEXT)**. The value following the decimal will then stop flashing. Again, use the arrow keys to select the decimal value.

a. Upon selecting the flow rate, press **(EXIT)**, and the calibration screen will be displayed.

10. Press the **ON/OFF (PUMP)** button to turn on the pump. "**Calibrate Target**" will be displayed. The **Corrected Q:** message will then be displayed. (The Corrected Q value shown is for reference only).
    a. Record the target flow and flow standard readings and their percent difference on the "Flow Rate" line within the "Initial Calibration Comparison" section of the $PM_{2.5}$-PEP Calibration Worksheet.
11. Adjust the pump speed to the desired flow rate as indicated by the flow verification device. The arrow keys are used for fine adjustments of the pump speed.
    a. To make coarse adjustments, hold the **SELECT** key and the up or down arrow key simultaneously. The target flow will remain the same, and the Corrected Q will adjust.
    b. The calibration target and the flow standard must be within 2% at the design flow rate of 16.67 LPM.
    c. Record the results of this calibration and their percent difference on the "Flow Rate" line within the "Adjusted Calibration Comparison" section of the $PM_{2.5}$-PEP Calibration Worksheet.
12. When satisfied that the flow rate is correct, as shown by the calibration device, press the blank **(OK)** button to lock the calibration into memory. The Main menu will now be displayed.
13. Perform a post-calibration verification by applying the single-point verification described in Section 6.5 and recording the measurements and their percent difference on the "Flow Rate" line within the "Post Verification" section of the $PM_{2.5}$-PEP Calibration Worksheet.
    - The sampler should verify within ±4% of the verification flow standard measurement.
    - The sampler indicated flow should be within ±4% of the design flow rate of 16.67 LPM (i.e., from 16.00 to 17.34 LPM).

11.0 References

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Appendix A: Glossary

Acceptance criteria—Specified limits that are placed on the characteristics of an item, process, or service defined in requirements documents (American Society of Quality Control definition).

Accuracy—This term refers to a measure of the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; the U.S. Environmental Protection Agency (EPA) recommends using the terms "*precision*" and "*bias,*" rather than "*accuracy*," to convey the information usually associated with accuracy.

Activity—This all-inclusive term describes a specific set of operations of related tasks to be performed, either serially or in parallel (e.g., research and development, field sampling, analytical operations, equipment fabrication) that, in total, result in a product or service.

Analyst—An analyst is a staff member who weighs the new and used filters and computes the concentration of $PM_{2.5}$ in $\mu g/m^3$.

ANSI/ASTM Class 1 and 2 standards—These are the standards for weighing operations with a microbalance that is certified by their manufacturer as being in conformance with ASTM's standard specification for laboratory weights and precision mass standards (E 617-9), particularly the Class 1 and 2 specifications. These standards are traceable to the National Institute of Standards and Technology (NIST).

Air Quality System (AQS)—The AQS, which is EPA's repository of ambient air quality data, stores data from more than 10,000 monitors, 5,000 of which are currently active. State, local, and Tribal agencies collect monitoring data and submit it to the AQS periodically. The AQS was formerly the Air Quality Subsystem of the AIRS, which also contained an Air Facility System (AFS) that stored information on pollution sources. After the AFS was separated from AIRS, the terms AIRS and AQS became frequently used as synonyms to refer to the ambient air quality database.

AQS Monitor ID—This is a 10-digit combination of the AIRS Site ID and POC (see each in this glossary) that together uniquely defines a specific air sampling monitor for a given pollutant. Some forms and dialog boxes may refer to this as an AIRS ID or 10-digit AIRS ID.

AQS Site ID—This is a unique identifier for an AQS sampling site. The AQS Site ID is frequently combined with the Parameter Occurrence Code (POC) (see POC in this glossary) to provide a unique 10-digit monitor ID. The first nine digits uniquely identify each air monitoring site (two-digit state code, three-digit county code, and four-digit site code). The tenth digit (POC) identifies the monitor at that site. The state and county codes are Federal Information Processing Standard (FIPS) codes. The four-digit site codes are assigned by the local agency, which may allocate them in any way it chooses, as long as there is no duplication in the county. AQS Site IDs are associated with a specific physical location and address. Any significant change in location will typically require a new site ID.

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

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

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

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

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

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

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

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

Cassette—A device that is supplied with $PM_{2.5}$ samplers to allow a weighed PTFE filter to be held in place in the sampler and manipulated before and after sampling without touching the filter and to minimize damage to the filter and/or sample during such activities.

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

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

Characteristic—Any property or attribute of a datum, item, process, or service that is distinct, describable, and/or measurable.

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

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

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

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

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

Conditioning environment—A specific range of temperature and relative humidity values in which unexposed and exposed filters are to be conditioned for at least 24 hours immediately preceding their gravimetric analysis.

Confidence interval—The numerical interval constructed around a point estimate of a population parameter, combined with a probability statement (the confidence coefficient) linking it to the population's true parameter value. If the same confidence interval construction technique and

assumptions are used to calculate future intervals, then they will include the unknown population parameter with the same specified probability.

Confidentiality procedure—A procedure that is used to protect confidential business information (including proprietary data and personnel records) from unauthorized access.

Configuration—The functional, physical, and procedural characteristics of an item, experiment, or document.

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

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

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

Control chart—A graphical presentation of quality control (QC) information over a period of time. If a procedure is "in control," the results usually fall within established control limits. The chart is useful in detecting defective performance and abnormal trends or cycles, which can then be corrected promptly.

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

Correlation coefficient—A number between −1 and 1 that indicates the degree of linearity between two variables or sets of numbers. The closer to −1 or +1, the stronger the linear relationship between the two (i.e., the better the correlation). Values close to zero suggest no correlation between the two variables. The most common correlation coefficient is the product–moment, which is a measure of the degree of linear relationship between two variables.

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

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

Data Quality Objectives (DQO) Process—A systematic planning tool to facilitate the planning of environmental data collection activities. DQOs are the qualitative and quantitative outputs from the DQO process.

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

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

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

Demonstrated capability—The capability to meet a procurement's technical and quality specifications through evidence presented by the supplier to substantiate its claims and in a manner defined by the customer.

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

Design change—Any revision or alteration of the technical requirements defined by approved and issued design output documents and by approved and issued changes thereto.

Design review—A documented evaluation by a team, including personnel such as the responsible designers, the client for whom the work or product is being designed, and a quality assurance (QA) representative, but excluding the original designers, to determine if a proposed design will meet the established design criteria and perform as expected when implemented.

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

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

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

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

Dry-bulb temperature—The actual temperature of the air, which is used for comparison with the wet-bulb temperature.

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

Electrostatic charge buildup—A buildup of static electrical charge on an item, such as the $PM_{2.5}$ filter, which makes it difficult to handle, attracts or repels particles, and can influence its proper weighing.

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

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

Environmental data operations—Any work performed to obtain, use, or report information pertaining to environmental processes and conditions.

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

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

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

Environmental technology—An all-inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be used to remove pollutants or contaminants from, or to prevent them from

entering, the environment. Examples include wet scrubbers (air), soil washing (soil), granulated activated carbon unit (water), and filtration (air, water). Usually, this term applies to hardware-based systems; however, it can also apply to methods or techniques used for pollution prevention, pollutant reduction, or containment of contamination to prevent further movement of the contaminants, such as capping, solidification or vitrification, and biological treatment.

Equilibration chamber—A clean chamber that is usually constructed of plastic or glass, held at near constant temperature and relative humidity, and is used to store and condition $PM_{2.5}$ filters until they and their collected particulate sample (if the filters have been exposed) have reached a steady state of moisture equilibration.

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

Evidentiary records—Any records identified as part of litigation and subject to restricted access, custody, use, and disposal.

Expedited change—An abbreviated method of revising a document at the work location where the document is used when the normal change process would cause unnecessary or intolerable delay in the work.

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

Field blank filter—New, randomly selected filters that are weighed at the same time that presampling weights are determined for a set of $PM_{2.5}$ filters and used for QA purposes. These field blank filters are transported to the sampling site in the same manner as the filter(s) intended for sampling, installed in the sampler, removed from the sampler without sampling, stored in their protective containers inside the sampler's case at the sampling site until the corresponding exposed filter(s) is (are) retrieved, and returned for postsampling weighing in the laboratory, where they are handled in the same way as an actual sample filter and reweighed as a QC check to detect weight changes due to filter handling.

Field (matrix) spike—A sample prepared at the sampling point (i.e., in the field) by adding a known mass of the target analyte to a specified amount of the sample. Field matrix spikes are used, for example, to determine the effect of the sample preservation, shipment, storage, and preparation on analyte recovery efficiency (the analytical bias).

Field split samples—Two or more representative portions taken from the same sample and submitted for analysis to different laboratories to estimate inter-laboratory precision.

File plan—A file plan lists the records in your office, and describes how they are organized and maintained. For more information about EPA's File Plan Guide, see http://www.epa.gov/records/tools/toolkits/filecode (see also *records schedule*).

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

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

Global Positioning System (GPS)—A space-based global navigation satellite system that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver.

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

Grade—The category or rank given to entities having the same functional use but different requirements for quality.

Graded approach—The process of basing the level of application of managerial controls applied to an item or work according to the intended use of the results and the degree of confidence needed in the quality of the results (see also *Data Quality Objectives (DQO) Process*).

Guidance—A suggested practice that is not mandatory; it is intended to be an aid or example in complying with a standard or requirement.

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

Holding time—The period of time a sample may be stored prior to its required analysis. Although exceeding the holding time does not necessarily negate the veracity of analytical results, it causes the qualifying or "flagging" of any data not meeting all of the specified acceptance criteria.

Hygrothermograph—An instrument that results from the combination of a thermograph and a hygrograph and furnishing, on the same chart, simultaneous time recording of ambient temperature and relative humidity.

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

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

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

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

Item—An all-inclusive term that is used in place of the following: appurtenance, facility, sample, assembly, component, equipment, material, module, part, product, structure, subassembly, subsystem, system, unit, documented concepts, or data.

Laboratory analyst—The generic term used to describe the Environmental Sampling and Assistance Team (ESAT) contractor(s) responsible for the activities described in the SOPs.

Laboratory blank filters—New filters that are weighed at the time of determination of the presampling (tare) weight of each set of $PM_{2.5}$ filters intended for field use. These laboratory blank filters remain in the laboratory in protective containers during the field sampling and are reweighed in each weighing session as a QC check.

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

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

Local Standard Time—The time used in the geographic location of the sample site that is set to standard time. Standard time is used in the Federal Reference Method (FRM) program to match continuous instruments to filter-based instruments. During the winter months, all areas of the country use standard time; however, in the summer months, some areas may go to daylight savings time (1 hour ahead of standard time).

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

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

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

Mass reference standard—The NIST-traceable weighing standards, generally in the range of weights expected for the filters.

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

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

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

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

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

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

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

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

Microbalance—A type of analytical balance that can weigh to the nearest 0.001 μg (i.e., one microgram, or one-millionth of a gram).

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

Mixed waste—A hazardous waste material as defined by 40 CFR 261 and the Resource Conservation and Recovery Act (RCRA) and mixed with radioactive waste subject to the requirements of the Atomic Energy Act.

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

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

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

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

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

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

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

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

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

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

$PM_{2.5}$—Particulate matter (suspended in the atmosphere) having an aerodynamic diameter less than or equal to a nominal 2.5 μm, as measured by a reference method based on 40 CFR Part 50, Appendix L, and designated in accordance with 40 CFR Part 53.

$PM_{2.5}$ sampler—A sampler that is used for monitoring $PM_{2.5}$ in the atmosphere that collects a sample of particulate matter from the air based on principles of inertial separation and filtration. The sampler also maintains a constant sample flow rate and may record the actual flow rate and the total volume sampled. $PM_{2.5}$ mass concentration is calculated as the weight of the filter catch divided by the sampled volume. A sampler cannot calculate $PM_{2.5}$ concentration directly.

POC (Parameter Occurrence Code)—A one-digit identifier used in AIRS/AQS (see both defined in this glossary) to distinguish between multiple monitors at the same site that are measuring the same parameter (e.g., pollutant). For example, if two different samplers both measure $PM_{2.5}$, then one may be assigned a POC of 1 and the other a POC of 2. Note that replacement samplers are typically given the POC of the sampler that they replaced, even if the replacement is of a different model or type.

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

Polonium-210 (^{210}Po) anti-static strip—A device that contains a small amount of ^{210}Po that emits α particles (He^{2+}) that neutralize the static charge on filters, making them easier to handle and their weights more accurate.

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

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

Procedure—A specified way to perform an activity.

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

Project—An organized set of activities within a program.

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

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

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

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

Quality Assurance Program Description/Plan—See *Quality Management Plan*.

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

Quality Assurance (QA) Supervisor or Coordinator—A staff member who assists in preparation of the reporting organization's quality plan, makes recommendations to management on quality issues (including training), oversees the quality system's control and audit components, and reports the results.

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

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

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

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

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

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

Radioactive waste—This refers to waste material that contains or is contaminated by radionuclides and is subject to the requirements of the Atomic Energy Act.

Readability—The smallest difference between two measured values that can be read on the microbalance display. The term "*resolution*" is a commonly used synonym.

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

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

Records schedule—This schedule constitutes EPA's official policy on how long to keep Agency records (retention) and what to do with them afterwards (disposition). For more information, refer to http://www.epa.gov/records/policy/schedule on EPA's Web site or see *file plan*.

Recovery—The act of determining whether the methodology measures all of the analyte contained in a sample.

Remediation—The process of reducing the concentration of a contaminant (or contaminants) in air, water, or soil media to a level that poses an acceptable risk to human health.

Repeatability—This refers to a measure of the ability of a microbalance to display the same result in repetitive weighings of the same mass under the same measurement conditions. The term "*precision*" is sometimes used as a synonym. Repeatability also refers to the degree of agreement between independent test results produced by the same analyst, using the same test method and equipment on random aliquots of the same sample within a short time period.

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

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

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

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

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

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

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

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

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

Sampling event—A single 24-hour $PM_{2.5}$-PEP sampling run at a given monitoring site and date.

Sampling trip—The period in which a FS is travelling and transporting portable $PM_{2.5}$ samplers and equipment to conduct one or more sampling events. A single sampling trip includes all sampling events that occur before the FS returns to the Regional Office.

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

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

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

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

Shall—A term that denotes a requirement is mandatory whenever the criterion for conformance with the specification permits no deviation. This term does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled.

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

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

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

Source reduction—Any practice that reduces the quantity of hazardous substances, contaminants, or pollutants.

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

Specification—A document that states requirements and refers to or includes drawings or other relevant documents. Specifications should indicate the means and criteria for determining conformance.

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

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

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

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

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

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

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

Technical Direction Form [TDF]—A form designed to be a contractual instrument, whereby the TOCOR in a Region directs the PEP contractor to participate in or perform activities of the PEP, and therefore the contractor is able to bill EPA for resulting work product, service or activity.

Technical Systems Audit (TSA)—A thorough, systematic, on-site qualitative audit of facilities, equipment, personnel, training, procedures, recordkeeping, data validation, data management, and reporting aspects of a system.

Technical review—A documented critical review of work that has been performed within the state of the art. The review is accomplished by one or more qualified reviewers who are independent of those who performed the work but are collectively equivalent in technical expertise to those who performed the original work. The review is an in-depth analysis and evaluation of documents, activities, material, data, or items that require technical verification or validation for applicability, correctness, adequacy, completeness, and assurance that established requirements have been satisfied.

Traceability—This term refers to the ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. This term also refers to the property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons, all having stated uncertainties. Many QA programs demand traceability of standards to a national standard. In most cases this can be achieved through a standard traceable to NIST.

Trip blank—A clean sample of a matrix that is taken to the sampling site and transported to the laboratory for analysis without having been exposed to sampling procedures.

Validation—Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use have been fulfilled. In design and development, validation refers to the process of examining a product or result to determine conformance to user needs.

Variance (statistical)—A measure or dispersion of a sample or population distribution. Population variance is the sum of squares of deviation from the mean divided by the population size (number of elements). Sample variance is the sum of squares of deviations from the mean divided by the degrees of freedom (number of observations minus one).

Verification—Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. In design and development, verification refers to the process of examining a result of a given activity to determine conformance to the stated requirements for that activity.

Wet-bulb thermometer—A thermometer with a muslin-covered bulb, which is moistened and used to measure the wet-bulb temperature.

Wet-bulb temperature—The temperature of the wet-bulb thermometer at equilibrium with a constant flow of ambient air at a rate of from 2.5 meters to 10.0 meters per second.

Wide Area Augmentation System (WAAS)—An air navigation aid developed by the Federal Aviation Administration to augment the Global Positioning System (GPS), with the goal of improving its accuracy, integrity, and availability.

Appendix B: Data Qualifiers/Flags

A sample qualifier or a result qualifier consists of three alphanumeric characters that act as an indicator of the reason that the subject data collection activity (a) did not produce a numeric result, (b) produced a numeric result that is qualified in some respect relating to the type or validity of the result, or (c) produced a numeric result but for administrative reasons is not to be reported outside the laboratory.

Table B-1. Field-related data qualifiers

Code	Definition	Description
CON	Contamination	Contamination, including observations of insects or other debris
DAM	Filter damage	Filter appeared damaged
EST 1/	Elapsed sample time	Elapsed sample time out of specification
EVT	Event	Exceptional event expected to have affected sample (dust, fire, spraying)
FAC	Field accident	Field accident either destroyed the sample or rendered it not suitable for analysis
FLR 1/	Flow rate	Flow rate out of specification
FLT 1/	Filter temperature	Filter temperature differential, 30-second interval out of specification
FMC	Failed multipoint calibration verification	Failed the initial multipoint calibration verification
FPC	Failed pressure check	Barometric pressure check out of specification
FSC	Failed single-point calibration verification	Failed the initial single-point calibration verification
FVL	Flow volume	Flow volume suspect
GFI	Good filter integrity	Filter integrity, upon post-sampling field inspection looks good
LEK	Leak suspected	Internal/external leak suspected
SDM	Sampler damaged	Sampler appears to be damaged, which may have affected the filter

1/- Flag generated by sampling equipment.

Table B-2. Laboratory-related data qualifiers

Code	Definition	Description
ALT	Alternate measurement	The subject parameter was determined using an alternate measurement method. Value is believed to be accurate but could be suspect.
AVG	Average value	The average value that is used to report a range of values.
BDL	Below detectable limits	There was not a sufficient concentration of the parameter in the sample to exceed the lower detection limit in force at the time the analysis was performed. Numeric results field, if present, is at best an approximate value.
BLQ	Below limit of quantitation	The sample was considered above the detection limit, but there was not a sufficient concentration of the parameter in the sample to exceed the lower quantitation limit in force at the time the analysis was performed.
CAN	Canceled	The analysis of this parameter was canceled and not performed.
CBC	Cannot be calculated	Analysis result cannot be calculated because an operand value is qualified.
EER	Entry error	The recorded value is known to be incorrect, but the correct value cannot be determined to enter a correction.
FBK	Found in blank	The subject parameter had a measurable value above the established QC limit when a blank was analyzed using the same equipment and analytical method. Therefore, the reported value may be erroneous.
FCS	Failed collocated sample	The collocated sample exceeded the acceptance criteria limits.
FFB	Failed field blank	Field blank samples exceeded acceptance criteria limits.
FIS	Failed internal standard	Internal standards exceeded acceptance criteria limits.
FLB	Failed laboratory blank	Laboratory blank samples exceeded acceptance criteria limits.
FLD	Failed laboratory duplicate	Laboratory duplicate samples exceeded acceptance criteria limits.
FLH	Failed laboratory humidity	Laboratory relative humidity exceeded acceptance criteria limits
FLT	Failed laboratory temperature	Laboratory temperature exceeded acceptance criteria limits.
FQC	Failed quality control	The analysis result is not reliable because quality control criteria were exceeded when the analysis was conducted. Numeric field, if present, is estimated value.
FTB	Failed trip blank	Trip blank sample exceeded acceptance criteria limits
GSI	Good shipping integrity	Integrity of filter upon receipt by shipping/receiving looked good
HTE	Holding time exceeded	Filter holding time exceeded acceptance criteria limits
ISP	Improper sample preservation	Due to improper preservation of the sample, it was rendered not suitable for analysis.
INV	Invalid sample	Due to single or a number or flags or events, the sample was determined to be invalid.
LAC	Laboratory accident	There was an accident in the laboratory that either destroyed the sample or rendered it not suitable for analysis.
LLS	Less than lower standard	The analysis value is less than the lower quality control standard.
LTC	Less than criteria of detection	Value reported is less than the criteria of detection (which may differ from instrument detection limits).
NAR	No analysis result	There is no analysis result required for this subject parameter.
REJ	Rejected	The analysis results have been rejected for an unspecified reason by the laboratory. For any results where a mean is being determined, this data was not utilized in the calculation of the mean.
REQ	Re-queue for re-analysis	The analysis is not approved and must be re-analyzed using a different method.
RET	Return(ed) for re-analysis	The analysis result is not approved by laboratory management and reanalysis is required by the bench analyst with no change in the method.
RIN	Reanalyzed	The indicated analysis results were generated from a re-analysis
STD	Internal standard	The subject parameter is being used as an internal standard for other subject parameters in the sample. There is no analysis result report, although the theoretical and/or limit value(s) may be present.
UND	Analyzed but undetected	Indicates material was analyzed for but not detected.

Appendix C: $PM_{2.5}$-PEP Forms for Field Activity

Note that each Region may have specific record keeping requirements that require the use of other forms than those provided in this appendix. Herein are examples of the information typically recorded and stored within a Region's TDF based programs.

$PM_{2.5}$-PEP Field Inventory Form (INV-01)

Region or Self-Implementing Agency: ____________________________

Signature: _________________________________ Date: ____________________________

Item	Vendor	Model Number	Quantity	Purchase Date	Warranty
Form INV-01					**Rev. 10/19**

$PM_{2.5}$-PEP Field Equipment/Consumable Receiving Report (REC-01)

Region or Self-Implementing Agency: _____			Date: _____	
Received By:				
Shipped From:				
Shipped Via:				
Shipping Charge:	Prepaid:	Collect:	Freight Bill Number:	
Purchase Order Number				

Quantity	Description of Item	Condition

Remarks: Accept Shipment _____ Problem _____
Notes:
Form REC-01 **Rev. 10/19**

PM2.5-PEP Field Procurement Log (PRO-01)

Item	Model No.	Quan-tity	Purchase Order Number	Vendor	Date		Cost	Initials	Accept/ Reject
					Ordered	Received			
Form PRO-01									**Rev. 10/19**

$PM_{2.5}$-PEP Site Data Sheet (SD-01)

Page 1 of _____

AQS Site ID (xx-yyy-zzzz):_____ Site name (as stated in AQS):	Site's $PM_{2.5}$ monitoring frequency: ___Once per six days ___Once per three days ___Daily ___Other (specify): _____
AQS method code of primary $PM_{2.5}$ site sampler: _____	Primary $PM_{2.5}$ site sampler make/model: _____
Other samplers permanently present at the site:	
Site Coordinates Latitude: Longitude:	Site Type (circle one): SLAMS, SLAMS/NCore, Tribal, Special Purpose, Other _____
Site's State/local/Tribal (SLT) organization address:	Site's SLT organization contact: Name: _____ Phone number: _____ E-mail address: _____
Safety concerns:	Additional equipment needed:
Closest hospital address and directions from site:	Closest courier facility (company, address):
Closest hardware store to site:	Recommended hotel (Address/Phone Number):
Closest $PM_{2.5}$ monitoring site: AQS Site ID: _____ Site Name: _____	Second closest $PM_{2.5}$ monitoring site: AQS Site ID: _____ Site Name: _____
Form SD-01 (1)	**Rev. 10/19**

$PM_{2.5}$-PEP Site Data Sheet (cont.)

Page _____ of _____

AQS Site ID:_____

Site name: _____

Directions to site from Regional field office:

Directions from closest major thoroughfare to site:

Additional site-specific notes, diagrams, etc.

Form SD-01 (2) **Rev. 10/19**

Attach as many sheets as needed. Include photos as relevant.

$PM_{2.5}$-PEP Sampler Quarterly Maintenance and Repair Checklist

Check	**$PM_{2.5}$-PEP Sampler Serial No.: _____Date: _____FS: _____**
	Clean sampler inlet surfaces: Disassemble main (first-stage) size-selective inlet; use a soft brush, wipes, and water/alcohol to clean the surfaces. Check the O-ring, wipe dry, and re-assemble.
	Clean main (first-stage) size-selective inlet (PM_{10} head): Check the O-ring in the inlet, as well as those at the bottom where it connects to the downtube. Apply a light coat of vacuum grease, if necessary, and wipe off excess.
	Clean impactor housing (if applicable) and impactor jet surfaces: Inspect opened impactor housing. Wipe down surfaces with wipes. Use pipe cleaners to clean out the impactor jet. Check O-rings, looking for cracks and ensuring a snug fit. Check that O-rings are not warped or deformed from repeated use. Also, check the O-ring and water seal gasket, which are located where the upper portion of the impactor housing sticks out of the top of the main unit.
	Clean interior of sampler unit: Use lint-free wipes and isopropyl alcohol to clean all surfaces that are accessible inside the sampler unit body. Clean the sample area (area with silver cam) and the area behind the display.
	Clean very sharp-cut cyclone (VSCC): Use mineral-free water and lint-free lab wipes to clean. In cases, where stubborn deposits are observed, ultrasonic cleaning in soap and water is recommended.
	Check condition of sampler transport containers: Ensure that all containers and compartments are in good condition to protect the individual sampler components. Also, check for cleanliness to reduce the chance for contamination on the components that contact the sample pathway.
	Clean the downtube: Use a wooden dowel to push moistened wipes through the tube, covering all of the interior surface. Allow to dry. Check O-rings and apply vacuum grease, if needed.
	Inspect cooling air intake fan(s) and filter; replace if necessary: To check the cooling fan, unscrew the ambient probe connection from the sampler body. The fan should turn on and blow air after a few seconds. If the fan does not turn on, it should be replaced.
	Inspect all O-rings, visible and hidden, and reapply vacuum grease as needed: Consult the operator's manual to identify all O-ring locations. Some O-rings are integral to certain systems in the sampler, such as the O-rings in the pump, and should not be disturbed unless during troubleshooting.
	Inspect vacuum tubing, tube fittings, and other connections to pump and electrical components, nuts and screws; service if necessary: All rubber tubing should securely grip each fitting and extend over the full length of the fitting or port. Tubing should not be cracked or brittle. All connections, wire or tubing, should securely fit to all connections. Ensure that all shunts, dip switches, and jumpers are securely attached and are in the proper position. Tighten loose nuts and screws; replace those lost.
Comments/Notes:	
	Rev. 10/19

PM$_{2.5}$-PEP Filter Chain of Custody form (COC)

PEP Chain-of-Custody Form for BGI PQ200A

☐ PM 2.5 event ☐ PM 10 Event

PART I – WEIGHING LABORATORY

Filter Weighing and Shipping Information from Weighing Lab or Shipping Log				
Filter ID		Filter Cassette ID		☐ TB - Trip Blank
Weighing Lab		Cassette Type		
Analyst/Custodian		Tare Weight Date		
Shipment Date		Tracking No.		
Sent to (PE Org)		Shipping Company		
Date This Filter Must be Used by:		Return to:		

Normally, the weighing laboratory completes Part I, keeps 1 copy and sends 2 copies to the field office with the unexposed filter cassette.

PART II – FIELD OFFICE

Date Received:	Received by:	Location:
Package Condition: ☐ Good ☐ Reject (Why?)		

If rejected, the filter cassette should be returned to the weighing laboratory with the next outgoing shipment.

PART III – FIELD SITE

Sampling Event Information		
Arrival Date at Site		PEP Field Scientist:
Site Name & Description		
Primary SLT PM-2.5 Sampler	Make/Model:	Serial No.:
Primary SLT PM-10 Sampler	Make/Model:	Serial No.:
AQS Site ID		POC:
Other Operators or Observers		

Sampling Event Filter Data		
Sampling Date:	Retrieval Date:	Time:
Event Filter Integrity: ☐ OK ☐ Reject (describe)		
Sample Type		
☐ RO – Routine PEP ☐ FB - Field Blank (Associated RO Cassette ID:_____) ☐ Other (describe) ☐ CO - Collocated PEP ☐ Expired Filter (not used) ☐ TB - Trip Blank (Record last RO Cassette ID used in this audit trip: _____)		
☐ Void (why?)		
PEP Cut Point: ☐ PM-2.5 ☐ PM-10	PEP PM-2.5 Separator Type: ☐ WINS ☐ VSCC	

PART IV – FIELD FILTER SHIPPING TO WEIGHING LAB

Shipment Date		Affiliation:	
Shipped by		Shipping Destination:	
Tracking No.		Shipping Company:	

On completion of Part II-IV, the field scientist keeps one copy and sends the top (original) copy to the laboratory with the filter.

PART V – WEIGHING LABORATORY

Date Received		Received by:		Integrity Flag:
Shipment Integrity OK?	☐ Yes ☐ No	Max Temperature: °C	Cold Pack Condition:	☐ Frozen ☐ Cold ☐ Ambient

The weighing laboratory will DATE-STAMP and attach the COC form to the receiving log-book, in which same info is recorded.

Notes:

09-22-2021 version

Form COC

$PM_{2.5}$-PEP Field Data Sheet (BGI PQ200 sampler) (FDS)

PEP Field Data Sheet for BGI PQ200A

PEP Event Type: ☐ FRM PM-2.5 ☐ PM-Coarse

Sampling Event Information			
AQS Site ID		Setup Date	
Site Name		PEP Field Scientist	
GPS Latitude	__ __ __ . __ __ __ __ __	Primary SLT Sampler Serial No.	
GPS Longitude	__ __ __ . __ __ __ __ __	PEP PQ200A Serial No.	

Parameter Check Device	Make/ Model	Serial No.	Last Calibration Date
Multi-Standard[1]			
Temperature Standard			
Barometric Pressure Standard			
Flow Rate Standard			
Time Checks OK?	☐ Yes ☐ No (describe)		
Monitoring Site Criteria OK?	☐ Yes ☐ No (describe)		

[1] *Use this line for multi-standard instruments (e.g., BGI TriCal and DeltaCal) when used for all three checks.*

PQ200A PEP Sampler Verification Checks [2]				Date:
Leak Check	Criteria	Beginning P	Ending P	Verification OK?
2-Minute Interval	Change < 5 cmH_2O	cmH_2O	cmH_2O	☐ Yes ☐ No
Bar. Pressure	Criteria	Ref Standard	Sampler	Verification OK?
Ambient	± 10 mmHg	mmHg	mmHg	☐ Yes ☐ No
Temperature	Criteria	Ref Standard	Sampler	Verification OK?
Ambient Sensor	± 2°C	°C	°C	☐ Yes ☐ No
Filter Sensor	± 2°C	°C	°C	☐ Yes ☐ No
Flow Rate Verification				
Audit Standard FR (Cal.) Check	Criteria	Ref Standard	Sampler	Verification OK?
	< 4% difference	Lpm	Lpm	☐ Yes ☐ No
Design Flow Rate "Q" Check	Criteria (±4%)	Ref Standard	Design	Verification OK?
	16.00 ≤ Q ≤ 17.34	Lpm	16.67 Lpm	☐ Yes ☐ No

[2] *Indicate only the final result of the check after all troubleshooting has been done. Document troubleshooting in the "Notes" section below and/or in the field notebook. If troubleshooting is unsuccessful, the sampler must be recalibrated or repaired before conducting a sampling event. Fill out a new Field Data Sheet for the replacement sampler.*

PEP Exposure Data			
Filter Cassette ID		Cassette Retrieval Date/Time:	
PM Cut Point	☐ PM-2.5 ☐ PM-10	PEP PM-2.5 Separator Type:	☐ WINS ☐ VSCC
Elapsed Time (ET)		Filter Integrity OK?	☐ Yes ☐ No (describe)
Total Volume (m^3)			
Flow Rate (Lpm)	Q: 16.7	Avg:	CV:
Start Date/Time		Data Download OK?	☐ Yes ☐ No (describe)
Stop Date/Time			
Temperature (°C)	Max:	Min:	Avg:
Bar. Pressure (mm Hg)	Max:	Min:	Avg:
Field Blank Cassette ID		Sampler Flags[3]:	
Trip Blank Cassette ID		Field Flags:	
Companion Cassette ID[4]			
Collocated Cassette ID(s)[5]			

[3] *Make sure to add (EST) flag in "Sampler Flags" if runtime is outside of 1380- 1500 minute range.*
[4] *For PM-coarse sampling event, if PM-2.5 is routine filter type, then list the companion PM-10 filter cassette ID and vice versa.*
[5] *For parking lot studies, all the IDs can be listed on one form. Be sure to indicate PM cut point.*

Notes:

05-11-2017 version

Form FDS

$PM_{2.5}$-PEP Phone Communication Form (COM-01)

Date:	**Time:**	**Recorder:**
Personnel on Call:		
Issue(s):		
Decisions(s):		
Follow-up Action(s):		
Follow-up Responsibilities:		
Completion Dates for Follow-up Actions:		
Form COM-1		**Rev. 10/19**

$PM_{2.5}$-PEP Monthly Field Progress Report Form (COM-02)

Page _____of _____

Reporting Period: **Start date:** _____ **End date:** _____	**Reporter:**
Progress made on $PM_{2.5}$-PEP field activities within the Reporting Period	
$PM_{2.5}$-PEP sampling events scheduled:	**$PM_{2.5}$-PEP sampling events completed:**
Old issues remaining unresolved, and new issues arising during the Reporting Period (include action items, responsible person(s), and anticipated dates when action will be completed)	
Old:	**New:**
Action items:	**Action items:**
Free-form Notes:	
Form COM-2	**Rev. 10/19**

$PM_{2.5}$-PEP Field Data Verification/Validation/Correction Form (FDV)

Filter ID	Cass. ID	Filter Type	Sample Date	Parameter	Current Value	Correct Value	Units	FS Initial	FS Date	Lab Correction Initials	Lab Date	Comment
Examples												
T1234567	*2415*	*RO*	*12/29/98*	*Amb. Temp. Sampler*	*25.8*	*28.5*		*AAA*	*10/15/98*			
“	*“*	*“*	*“*	*Amb. Temp. Standard*	*25.8*	*28.5*		*AAA*	*10/15/98*			
T1235678	*2319*	*RO*	*1/5/98*					*AAA*	*10/15/98*			
Form FDV												**Rev. 10/19**

PM2.5-PEP Calibration Worksheet

PM2.5 Performance Evaluation Program

Calibration Worksheet

Sampler Type: | **Sampler ID:**

Field Scientist: | **Date:**

Location:

Calibration Standard Information

	Standard	Standard Make and Model	Standard Serial Number	Last Calibration Date of Standard
Verification Device:				
Calibration Device:				

	Initial Verification			Initial Calibration Comparison			Adjusted Calibration Comparison			Post Verification		
Parameter	**Sampler**	**Standard**	**%Diff or Difference**	**Sampler**	**Standard**	**%Diff or Difference**	**Sampler**	**Standard**	**%Diff or Difference**	**Sampler**	**Standard**	**%Diff or Difference**
Temperature Ambient:												
Temperature Filter:												
Calibration Acceptance Criteria +/- 2°C Verification Acceptance Criteria +/- 2°C				*record measurement before adjusting*			*use only if adjustment is needed*					
Barometric Pressure:												
Calibration Acceptance Criteria +/- 5mmHg Verification Acceptance Criteria +/- 10mmHg				*record measurement before adjusting*			*use only if adjustment is needed*					
Flow Rate:												
Calibration Acceptance Criteria '+/- 2% of 16.67 L/min Verification Acceptance Criteria '+/- 4% of 16.67 L/min				*record measurement before adjusting*			*use only if adjustment is needed*					

Calculations and Notes:

Field Scientist Signature: **Date:**

Appendix D: $PM_{2.5}$-PEP Field Performance Examination Checklist for Field Scientists

Trainee/Operator's Name _____Date_____

$PM_{2.5}$-PEP Field Performance Examination Checklist

STANDARD OPERATING PROCEDURE		
Section 2.1 Equipment Inventory and Storage	**ACCEPT**	**RETEST**
1. Field Scientist has a general understanding of the requirements for inventorying and procuring equipment		
Notes:		
Section 2.2 Preparation for $PM_{2.5}$-PEP Sampling Events	**ACCEPT**	**RETEST**
1. Field Scientist understands the requirements and uses for the Site Data Sheet		
2. Field Scientist understands the purpose for a site visit		
3. Field Scientist knows the procedure for $PM_{2.5}$-PEP sampling event equipment preparation		
4. Field Scientist understands the notification procedures for scheduling a $PM_{2.5}$-PEP sampling event		
5. Field Scientist understands when and how often to talk with the State, local, or Tribal entity		
6. Field Scientist knows the appropriate days to sample and when it is possible to sample at a different schedule		
Notes:		
Section 3.0 Chain-of-Custody and Field Data Sheet Forms	**ACCEPT**	**RETEST**
1. Field Data Sheet(s) have been appropriately and completely filled out		
2. Chain-of-Custody Form(s) have been appropriately and completely filled out		
Notes:		
Section 4.0 Filter Cassette Receipt, Storage, and Handling	**ACCEPT**	**RETEST**
1. Field Scientist knows the procedure for receiving filters from the laboratory		
2. Field Scientist understands the critical filter holding time requirements		
3. Field Scientist knows the procedure for storing filters at the field office, during transport to the field, and if samples must come back to the field office		
4. Field Scientist knows the procedure for handling unexposed and exposed filters		
Notes:		

STANDARD OPERATING PROCEDURE			
Section 5.0 Transportation of the Sampler and Installation at the Site		**ACCEPT**	**RETEST**
Field Scientist understands the procedure for safe transport of the main sampler unit and travel cases to the sampling location			
Notes:			
Section 6.1 Sampler Assembly, Section 7.5 Sampler Disassembly		**ACCEPT**	**RETEST**
1. Field Scientist properly assembles the unit (overall)			
	Legs		
	AC power supply		
	Weather shroud (back plate)		
	Gill screen		
	Inlet assembly and downtube		
	WINS impactor assembly or VSCC inspection		
	Removal of transport filter cassette		
2. Field Scientist properly powers the unit			
3. Field Scientist properly sets date and time; explains how to test the clock's proper operation.			
4. Field Scientist properly disassembles the unit by storing components in correct travel cases.			
5. Field scientist understands the significance of the newer Mesa BGI PQ200 model's supercapacitor and how to ensure it maintains the sampler's on-board clock.			
Notes:			
Section 6.2 Leak Check Procedures		**ACCEPT**	**RETEST**
1. Field Scientist properly configures sampler for leak check			
2. Field Scientist navigates to the correct "screen"			
3. Field Scientist slowly releases vacuum			
4. Field Scientist has an awareness of the internal leak check procedure			
5. Field Scientist records data on the Field Data Sheet correctly			
6. Field Scientist has an awareness of troubleshooting procedures			
Notes:			

STANDARD OPERATING PROCEDURE		
Section 6.3 Barometric Pressure Verification	**ACCEPT**	**RETEST**
1. Field Scientist installs the barometric pressure transfer standard correctly and allows time for the equipment to equilibrate to ambient conditions		
2. Field Scientist navigates to the correct sampler "screen"		
3. Field Scientist records data on the Field Data Sheet correctly		
4. Field Scientist has an awareness of troubleshooting procedures		
Notes:		
Section 6.4 Temperature Verification	**ACCEPT**	**RETEST**
1. Field Scientist installs the temperature transfer standard correctly and allows time for equipment to equilibrate to ambient conditions		
2. Field Scientist navigates to the correct sampler "screen"		
3. Field Scientist performs the ambient temperature verification properly		
4. Field Scientist performs the filter temperature verification properly		
5. Field Scientist records data on the Field Data Sheet correctly		
6. Field Scientist has an awareness of troubleshooting procedures		
7. Field Scientist has an awareness of the filter overheat ("F") flag.		
Notes:		
Section 6.5 Flow Rate Verification	**ACCEPT**	**RETEST**
1. Field Scientist correctly installs and zeroes the flow transfer standard		
2. Field Scientist correctly installs the test/transport filter cassette		
3. Field Scientist navigates to the correct sampler "screen"		
4. Field Scientist performs the flow rate verification properly		
5. Field Scientist calculates percent difference for comparison to flow rate acceptance criteria (if flow transfer standard is the primary or back-up flow standard)		
6. Field Scientist compares the flow transfer standard with the sampler flow rate		
7. Field Scientist compares the flow transfer standard with the design flow rate		
8. Field Scientist records data on the Field Data Sheet correctly		
9. Field Scientist returns the sampler to normal operation		
10. Field Scientist has an awareness of troubleshooting procedures		
Notes:		

STANDARD OPERATING PROCEDURE		
Section 6.6 Post-Verification Sampler Assembly	**ACCEPT**	**RETEST**
1. Field Scientist attaches the inlet assembly		
2. Field Scientist installs the WINS impactor assembly or VSCC		
3. Field Scientist completes the installation (checks that the sampler is secure and that the inlet is level, puts away installation tools and shipping materials, covers electrical connections)		
Notes:		
Section 7.1 Preparing for $PM_{2.5}$-PEP Sampling	**ACCEPT**	**RETEST**
1. Field Scientist installs the field blank filter cassette into the sampler (performs additional steps, including inspection, documentation of Cassette ID, and placement into a 3" x 5" bag)		
2. Field Scientist has an awareness of trip blank procedures		
3. Field Scientist installs the Routine $PM_{2.5}$-PEP sample filter cassette into the sampler		
4. Field Scientist programs the Cassette ID and the AQS Site Code into the sampler		
5. Field Scientist programs the sampler to run for the next day		
6. Field Scientist programs the sampler to run the day after next		
Notes:		
Section 7.2 Sample Recovery and Data Download	**ACCEPT**	**RETEST**
1. Field Scientist records information on the Field Data Sheet from the sampling run		
2. Field Scientist removes the filter cassette from the sampler (performs additional steps, including inspection, documentation, and placement into a 3" x 5" bag)		
3. Field Scientist performs data download onto a laptop computer and explains when and how a flash drive should be used.		
Notes:		
Section 7.3 Filter Packing and Shipment	**ACCEPT**	**RETEST**
1. Field Scientist performs packing procedure correctly, including taping seams of box		
2. Field Scientist includes all necessary items in the shipping cooler (filter cassettes, ice substitutes, documentation,		
3. Field Scientist demonstrates knowledge of the time and temperature requirements for shipment		
4. Field Scientist knows the shipping policies that have evolved for Holiday periods		
Notes:		

STANDARD OPERATING PROCEDURE			
Section 7.5 Sampler Maintenance and Cleaning		**ACCEPT**	**RETEST**
Field Scientist properly identifies and performs maintenance areas to be checked each visit (overall)			
	Water collector		
	Impactor well or VSCC		
	O-rings of impactor assembly or VSCC assembly		
	Downtube		
Field Scientist properly identifies and performs maintenance on the O-rings of the inlet			
Notes:			
Section 8.0 Quality Assurance/Quality Control		**ACCEPT**	**RETEST**
1. Field Scientist demonstrates general knowledge of the required QA activities for the $PM_{2.5}$-PEP			
2. Field Scientist has awareness of how frequently the QA/QC activities should be conducted			
3. Field Scientist knows procedures for scheduling, ordering filters, sampler set-up, and conduct of "parking lot" collocation studies. Field Scientist understands how to interpret results with respect to their Region's samplers.			
Notes:			
Section 8.4 Field Data Verification and Validation		**ACCEPT**	**RETEST**
1. Field Scientist has awareness of field data verification procedures and how frequently they should be performed			
Notes:			
Section 9.0 Information Retention		**ACCEPT**	**RETEST**
1. Field Scientist demonstrates general knowledge of the information retention requirements			
Notes:			
Section 9.2 Communications		**ACCEPT**	**RETEST**
1. Field Scientist demonstrates general knowledge of the communication requirements			
2. Field Scientist understands how to document communications (e.g., e-mails, phone calls)			
3. Field Scientist understands requirements for the monthly progress report and the expected information needed for it			
Notes:			

Instructor's or Auditor's Name _____

Instructor's or Auditor's Name _____

Instructor's or Auditor's Name _____

Instructor's or Auditor's Name _____