



# Quality Assurance Guidance Document

## Method Compendium

Field Standard Operating Procedures  
for the  
PM<sub>2.5</sub> Performance Evaluation Program



## *Foreword*

The intent of this document is to describe and to provide detailed standard operating procedures (SOPs) for the field activities of the PM<sub>2.5</sub> Federal Reference Method (FRM) Performance Evaluation Program (PEP).

The document was developed with the assistance of the various workgroups that will be responsible for implementing or overseeing the field aspects of the PEP, as well as State and local organizations that have a vested interest in the quality of routine ambient air monitoring data. The personnel involved in these workgroups are listed in the acknowledgments.

This document is accessible as a PDF file on the Internet on the Ambient Monitoring Technology Information Center (AMTIC) Bulletin Board under the PM<sub>2.5</sub> QA area (<http://www.epa.gov/ttn/amtic/pmqa.html>). The document can be read and printed using Adobe Acrobat™ Reader software, freeware available from many Internet sites, including the U.S. Environmental Protection Agency (EPA) web site. The Internet version is write-protected. Hardcopy versions are available by writing or calling:

David Musick  
Office of Air Quality Planning and Standards  
MD-14  
RTP, NC 27711  
(919-541- 2396)  
[Email:musick.david@epa.gov](mailto:musick.david@epa.gov)

**The document mentions trade names or brand names. Mention of corporation names, trade names, or commercial products does not constitute endorsement or recommendation for use.**

## *Contents*

<b>Section</b>	<b>SOP Number</b>	<b>Page</b>	<b>Revision</b>	<b>Date</b>
Forward		ii		
Contents		iii		
Acknowledgments		iv		
Acronyms and Abbreviations		v		
Tables and Figures		vi		
0 Introduction			1	11/98
1 Overview of FRM Performance Evaluation Field Activities	PEPF-1.01		1	11/98
2. Planning and Preparing for Site Visits				
Equipment Inventory and Storage	PEPF-2.01		1	11/98
Communications	PEPF-2.02		1	11/98
Site Visit Preparation	PEPF-2.03		1	11/98
3 Cassette Receipt, Storage and Handling	PEPF-3.01		1	11/98
4 Sampler Transport and Placement	PEPF-4.01		1	11/98
5 Sampler Assembly and Maintenance				
Sampler Assembly/Disassembly	PEPF-5.01		1	11/98
Sampler Maintenance and Cleaning	PEPF-5.02		1	11/98
6 Verifications				
Leak Check Procedures	PEPF-6.01		1	11/98
Barometric Pressure Verification	PEPF-6.02		1	11/98
Temperature Verification	PEPF-6.03		1	11/98
Flow Rate Verification	PEPF-6.04		1	11/98
7 Calibrations				
Pressure Calibration	PEPF-7.01		1	11/98
Temperature Calibration	PEPF-7.02		1	11/98
Flow Calibration	PEPF-7.03		1	11/98
8 Sample Filter Handling				
Conducting the Filter Exposure	PEPF-8.01		1	11/98
Filter Sample and Data Retrieval	PEPF-8.02		1	11/98
Filter Packing and Shipment	PEPF-8.03		1	11/98
9 Filter Chain-of-Custody and Field Data Sheet	PEPF-9.01		1	11/98
10 Quality Assurance Quality Control	PEPF-10.01		1	11/98
11 Information Retention	PEPF-11.01		1	11/98
<b>Appendices</b>				
A Glossary			1	11/98
B Data Qualifiers/Flags			1	11/98
C Data Forms			1	11/98

## ***Acknowledgments***

This compendium of standard operating procedures (SOPs) is the product of the combined efforts of the U.S. Environmental Protection Agency (EPA) Office of Air Quality Planning and Standards (OAQPS), the EPA National Exposure Research Laboratory (NERL), the EPA Regional Offices, and State and local organizations. The initial development of this material comes from James Flanagan and Cary Eaton of Research Triangle Institute. The review of the material found in this document was accomplished through the activities of the PM<sub>2.5</sub> QA Workgroup and the Environmental Services Assistance Team (ESAT) Workgroup. The following individuals are acknowledged for their contributions.

### **State and Local Organizations**

George Apgar, State of Vermont, Waterbury, VT  
Randy Dillard, Jefferson County Department of Health, Birmingham AL  
Kevin Goohs, Gordon Pierce, and Pat McGraw, CO Dept. of Public Health & Environment, Denver, CO  
Alice Westerinen, Russell Grace, and Tom Pomales, California Air Resources Board, Sacramento, CA  
Jeff Miller, Pennsylvania Department of Environmental Protection, Harrisburg, PA  
Richard Heffern, State of Alaska Department of Environmental Conservation, Juneau, AK  
Dan Harman, North Dakota Department of Health, Bismarck, ND  
Dave Wallenberg, STAPPA/ALAPCO

### **EPA Regions**

#### Region

- 1 Norman Beloin, Mary Jane Cuzzupe, Tony Palermo
- 2 Clinton Cusick, Dick Coleates
- 3 Victor Guide, Theodore Erdman, Fred Foreman
- 4 Jerry Burger, Herb Barden, Mike Birch
- 5 Mary Ann Suero, Gordon Jones, Mike Rizzo, Basim DiHu, Jay Thakkar
- 6 Mary Kemp, Mark Sather, Kuenja Chung, Timothy Dawson, Ruth Tatom, Melvin Ritter
- 7 Leland Grooms, Mike Davis, Shane Munsch, Harold Brown
- 8 Ron Heavner, Gordan MacRae, Joe Delwiche, Barbara Daboll
- 9 Mathew Plate, Manny Aquitania, Bob Pallarino, Rose Fong
- 10 Barry Towns, Karen Marasigan, Bill Puckett, Gerald Dodo

### **National Exposure Research Laboratory**

Frank McElroy, David Gemmill

### **ESAT Organization**

Monica McEaddy, Kathleen Engel, Angela Edwards, Colleen Walling, Sam Jamison

### **Research Triangle Institute**

James B. Flanagan, Cary Eaton, Robert Wright, Steve O'Brien

### **Office of Air Quality Planning and Standards**

Tim Hanley, David Musick

## *Acronyms and Abbreviations*

AIRS	Aerometric Information Retrieval System
APTI	Air Pollution Training Institute
CFR	<i>Code of Federal Regulations</i>
CMD	Contracts Management Division
CO	Contracting Officer
COC	chain of custody
CS	Contracting Specialist
DAS	data acquisition system
DQA	data quality assessment
DQOs	data quality objectives
EDO	environmental data operation
EMAD	Emissions, Monitoring, and Analysis Division
EPA	Environmental Protection Agency
ESAT	Environmental Services Assistance Team
FEM	Federal Equivalent Method
FRM	Federal Reference Method
FS	field scientist- Performance Evaluation Program
GLP	good laboratory practice
LA	laboratory analyst (ESAT contractor)
LAN	local area network
MQAG	Monitoring and Quality Assurance Group
MQOs	measurement quality objectives
NAAQS	National Ambient Air Quality Standards
NAMS	national air monitoring station
NERL	National Exposure Research Laboratory
NIST	National Institute of Standards and Technology
OAQPS	Office of Air Quality Planning and Standards
ORD	Office of Research and Development
PC	personal computer
PE	performance evaluation
PEP	Performance Evaluation Program
PM <sub>2.5</sub>	particulate matter $\leq 2.5$ microns
PO	Project Officer (headquarters)
PTFE	polytetrafluoroethylene
QA	quality assurance
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QMP	quality management plan
RPO	Regional Project Officer
SLAMS	state and local monitoring stations
SOP	standard operating procedure
SOW	statement or scope of work
STAG	State and Tribal Air Grants
TSA	technical systems audit
WAM	Work Assignment Manager

## *Tables*

<i>Number</i>		<i>SOP</i>	<i>Page</i>
0-1	Required Reading for the Performance Evaluation Program	0	7
2-1	Equipment and Supplies	2.01	3
2-1	ESAT Contacts	2.02	9
2-1	Implementation Summary	2.03	6
5-1	Summary of PM2.5 Sampler Maintenance Activities	5.02	3
10-1	Field Quality Control Checks	10.01	2
11-1	PM2.5 Reporting Package Information	11.01	2
11-2	Field Measurements	11.01	4

## *Figures*

<i>Number</i>		<i>SOP</i>	<i>Page</i>
0.1	Definition of independent assessment	0	3
0.2	Performance Evaluation Program implementation summary	0	4
1.1	Field activities in relation to SOPs	1.01	5
2.1	Line of Communication	2.02	2
2.1	Critical filter holding times	2.03	5
4.1	Back of main unit	4.01	4
4.2	Travel case No. 1 with legs	4.01	4
4.3	Travel case No. 2 for inlet and accessories	4.01	5
4.4	Travel case No. 3 for Gill screen and accessories	4.01	6
5.1	BGI PQ200A sampler, legs installed	5.01	4
5.2	Back of main unit	5.01	10
5.3	Travel case No. 2 for inlet and accessories	5.01	11
5.4	Travel case No. 3 for Gill screen and accessories	5.01	12
5.5	Exploded view inlet unit	5.01	13
5.6	BGI PQ200A Sampler with filter chamber open	5.01	14
5.7	BGI PQ200A Sampler with filter chamber closed	5.01	14
5.8	Exploded view of PM2.5 Impactor Well (WINS) and filter holder assembly	5.01	15
5.1	Exploded view inlet unit	5.02	6
6.1	Flow rate adapter	6.01	5
8.1	Filter cassette equipment and filter cassette in antistatic sample bag	8.01	4
8.2	Sampler control panel	8.01	7
8.1	Datatrans	8.0.2	8

## 0 INTRODUCTION

The purpose of this section is to provide the ESAT field scientist (FS) with background information on the PM<sub>2.5</sub> program and the Federal Reference Method Performance Evaluation Program (PEP) as an introduction to standard operating procedures (SOPs) for field personnel involved in the PEP.

### PM<sub>2.5</sub> Program

In general, the measurement goal of the PM<sub>2.5</sub> Ambient Air Quality Monitoring Program is to estimate the concentration, in units of micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ), of particulates of aerodynamic diameters less than or equal to 2.5 micrometers ( $\mu\text{m}$ ) that have been collected on a 46.2mm polytetrafluoroethylene (PTFE) filter. In order to understand the size of 2.5  $\mu\text{m}$ , a human hair is approximately 50  $\mu\text{m}$  in diameter. One major objective for the collection of the data is to compare PM<sub>2.5</sub> concentrations to the annual (15.0  $\mu\text{g}/\text{m}^3$  annual arithmetic mean concentration) and 24-hour (65  $\mu\text{g}/\text{m}^3$  24-hour average concentration) National Ambient Air Quality Standard (NAAQS). A description of the NAAQS and its calculation can be found in the July 18, 1997 *Federal Register* notice. In addition, Appendix L of 40 *Code of Federal Regulations* (CFR) part 50 also provides the following summary of the measurement principle:

An electrically powered air sampler draws ambient air at a constant volumetric flow rate into a specially shaped inlet and through an inertial particle size separator (impactor) where the suspended particulate matter in the PM<sub>2.5</sub> size range is separated for collection on a polytetrafluoroethylene (PTFE) filter over the specified sampling period. The air sampler and other aspects of this reference method are specified either explicitly in this appendix or generally with reference to other applicable regulations or quality assurance guidance.

Each filter is weighed (after moisture and temperature equilibration) before and after sample collection to determine the net weight (mass) gain due to collected PM<sub>2.5</sub>. The total volume of air sampled is determined by the sampler from the measured flow rate at actual ambient temperature and pressure and the sampling time. The mass concentration of PM<sub>2.5</sub> in the ambient air is computed as the total mass of collected particles in the PM<sub>2.5</sub> size range divided by the actual volume of air sampled, and is expressed in micrograms per actual cubic meter of air ( $\mu\text{g}/\text{m}^3$ ).

### The Federal Reference Method Performance Evaluation Program

Because the data for the State and local air monitoring stations and national air monitoring stations (SLAMS/NAMS) network are used for NAAQS comparisons, the quality of these data is very important. Therefore, a quality system has been developed to control and evaluate the quality of data in order to make NAAQS determinations within an acceptable level of confidence. During the development of the PM<sub>2.5</sub> NAAQS, the EPA used the data quality objective (DQO) process to determine the allowable measurement system imprecision and bias that would not significantly affect a decision-maker's ability to compare pollutant concentrations to the NAAQS. The precision requirement (10%CV) and bias requirement ( $\pm 10\%$ ) are based on total measurement uncertainty, which incorporates errors coming from all phases (field sampling, handling, analysis, and so on) of the measurement process. The collocated samples provide adequate estimates of precision. The FRM performance evaluation (PE), if properly implemented, can provide the bias estimate.

The PEP is a quality assurance (QA) activity that will be used to evaluate measurement system bias of the PM<sub>2.5</sub> monitoring network. The pertinent regulations for this PE are found in 40 CFR Part 58, Appendix A, Section 3.5.3. The strategy is to collocate a portable FRM PM<sub>2.5</sub> air sampling instrument within 1 to 4 meters of a routine NAMS/SLAMS PM<sub>2.5</sub> air monitoring instrument, operate both monitors, and then compare the results.

The implementation of the FRM PE is a State/local responsibility. However, due to a number of comments made during the review period for the December 13, 1997, PM<sub>2.5</sub> NAAQS proposal, the Agency assessed the FRM PEP and consequently made the following revisions:

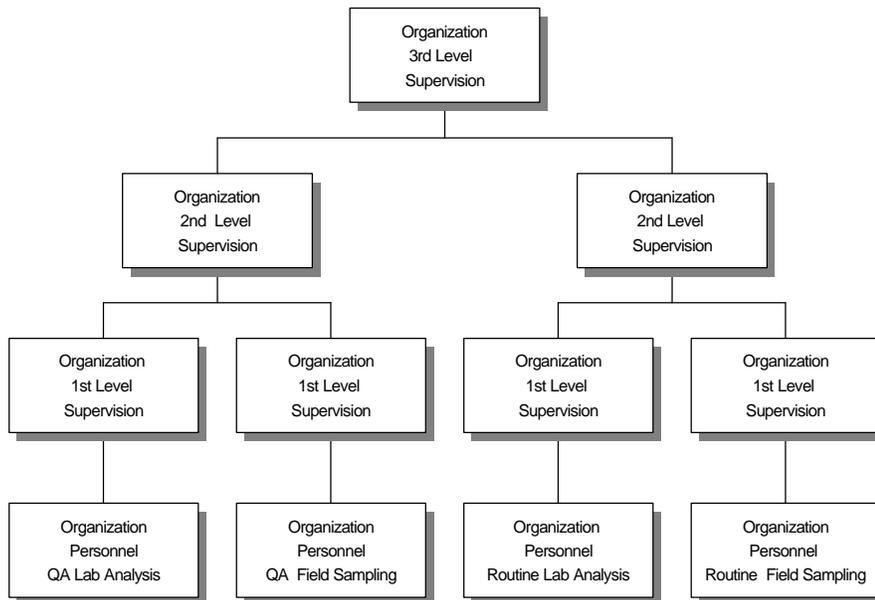
- ▶ modified the system to include an independent FRM PE,
- ▶ reduced the burden of this program by changing the audit frequency from all sites to 25% of the PM<sub>2.5</sub> sites,
- ▶ reduced the audit frequency from six times a year to four times a year; and
- ▶ made allowances to shift the implementation burden from the State and local agencies to the Federal government.

A PE is defined as 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 the analyst or laboratory. In the case of the PEP, the goal is to evaluate total measurement system bias, which includes measurement uncertainties from both field and laboratory activities. Independent assessment (Figure 0.1) was defined by the PM<sub>2.5</sub> QA Workgroup to ensure that the appropriate level of independence is maintained during State and local implementation of the PEP.

The goal of the PM<sub>2.5</sub> program is to establish a national monitoring network by December 31, 1999. Sites in the network will include those using FRM/FEM samplers, sites employing continuous analyzers, chemical speciation sites, visibility measurement sites, and special-purpose monitoring sites. Each year 25% of the SLAMS/NAMS monitors will be identified for PEs at a frequency of 4 times per year.

During the months of August through October, 1997 the EPA discussed the possibility of Federal Implementation of the PEP with the EPA Regions, SAMWG and various State and local organizations (NESCAUM, MARAMA, WESTAR, individual organizations). The majority of the responses from these organization were towards federal implementation of the PEP.

**Independent assessment** - An assessment performed by a qualified individual, group, or organization that is not part of the organization directly performing and accountable for the work being assessed. This auditing organization must not be involved with the generation of the routine ambient air monitoring data. An organization can conduct the FRM Performance Evaluation if it can meet the above definition and has a management structure that, at a minimum, allows for the separation of its routine sampling personnel from its auditing personnel by two levels of management, as illustrated in Figure 1. In addition, the pre and post sample weighing of audit filters must be performed by separate laboratory facility using separate laboratory equipment. Field and laboratory personnel would be required to meet the FRM Performance Audit field and laboratory training and certification requirements.



**Figure 1**

Organizations planning to implement the FRM Performance Evaluation must submit a plan demonstrating independence to the EPA Regional Office responsible for overseeing quality assurance related activities for the ambient air monitoring network.

**Figure 0.1. Definition of independent assessment.**

EPA investigated potential contracting mechanisms to help implement this activity and will use the ESAT contract currently in place in each Region to provide the necessary field and laboratory activities. Each

EPA Region will implement the field component of this activity, while Regions 4 and 10 will also operate the laboratory component.

The FRM PEP can be segregated into a field component and a laboratory component. The following information provides a brief description of these activities. Figure 0.2 provides a basic description of the PEP in five steps:

1. EPA will send filters to Region 4 and 10 laboratories, where they will be checked, equilibrated, labeled, weighed, and prepared for the field.
2. Regions 4 and 10 will ship the filters and accompanying chain of custody (COC) forms to the Regions.
3. The field scientists (FS) will take the filters, field data sheets, and COC Forms to the field and operate the portable sampler.
4. The FS will send the filter, data (diskette), field data sheets and COC Forms back to the appropriate laboratory (as well as keep a set of data and records).
5. Region 4 and 10 laboratories will equilibrate /weigh filters, validate data and upload information to Aerometric Information Retrieval System (AIRS).

**Field Activities:**

The FRM portable audit samplers will be used in a collocated manner to perform the evaluations. These samplers have been approved by EPA as a FRM and are designed to be durable, rugged, and capable of frequent transport. These samplers are constructed in modules, with each module weighing no more than 40 lb. The total weight of the sampler itself must not be more than 120 lb. Although these samplers have

been specifically designed to perform these evaluations, precautions must be taken to ensure the quality of the data. Specific detailed instructions can be found in the PEP Quality Assurance Project Plan (QAPP) and the standard operating procedures (SOPs). A brief summary of the field activities follows:

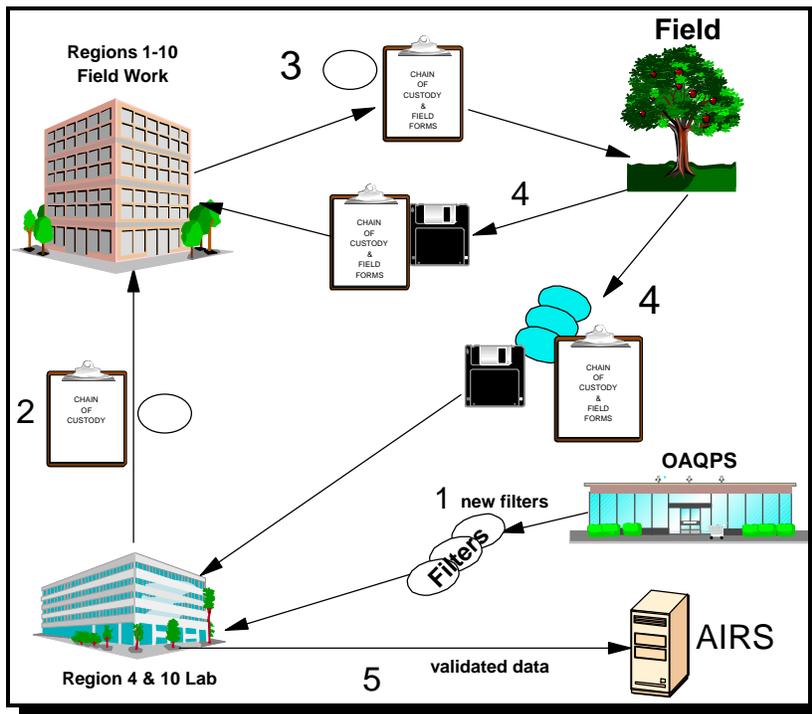


Figure 0.2. Performance Evaluation Program implementation summary.

- ▶ One fully trained field scientist will transport a portable PM<sub>2.5</sub> FRM performance evaluation sampling device to an established PM<sub>2.5</sub> site, which shall be located at any of the SLAMS/NAMS sites within each EPA Region.
- ▶ The field scientist will assemble the instrument,

collocate the sampler, perform a verification/ calibration following the SOPs, install a filter, and operate the instrument following EPA requirements (midnight to midnight).

- ▶. If scheduling allows, the field scientist will leave this location to set up an additional 24-hour PE at another routine sampling location. If the schedule does not allow for another set up, the field scientist may perform additional activities at the site. The field scientist may also perform any required maintenance or repair of the portable PM<sub>2.5</sub> sampling device followed by a calibration verification.
- ▶. The field scientist will return to each site after the 24-hour sampling time, download the stored electronic monitoring data, remove and properly store the filter for transport, and disassemble the instrument.
- ▶. The field scientist will properly package the filter, field data sheets, COC Forms and data diskettes following the SOPs for transport to the predetermined laboratory.

### **Laboratory Activities:**

The FRM PE also requires extensive laboratory activities, including filter handling, equilibration, weighing, data entry/management and archival. Regions 4 and 10 will develop the laboratories for this program. Specific detailed instructions will be found in the PEP QAPP and this SOP document. In addition to the good laboratory practices (GLP) which must be followed, the following activities must also be observed:

- ▶ adherence to the vendor's operations manual for the proper operation of the weighing devices; this includes the proper assembly, transport, calibration, and operation of the microbalances
- ▶ adherence to the SOPs for this program
- ▶ adherence to the standards, principles, and practices outlined in the PEP QAPP
- ▶ completion of the required certification training program
- ▶ special attention to any activity involving filter handling (presampling equilibration, weighing, postsampling equilibration, transport); this area contains the greatest potential for measurement uncertainty and care must be given to the proper handling of the 46.2 mm Teflon™ filter used in the PE

#### **Presampling weighing—**

- ▶ filters will be received from EPA and examined for integrity based upon EPA approved SOPs.
- ▶ filters will be enumerated for data entry.
- ▶ filters will be equilibrated and weighed according to SOPs.
- ▶ filters will be prepared for field activities or stored according to SOPs.
- ▶ the laboratory will develop and maintain shipping/receiving supplies and consumables, including containers, cold packs, max/min thermometers, and COC requirements/documentation.

#### **Postsampling weighing—**

- ▶ filters will be received in the laboratory, checked for integrity (damage-temperature, COC), and logged in
- ▶ filters will be archived (cold storage) until ready for weighing
- ▶ filters will be brought into the weighing facility and equilibrated for 24 hours (per SOPs)
- ▶ filters will be weighed according to SOPs and data entered

- ▶ field data will be entered into the data entry system in order to calculate a concentration
- ▶ filters will be stored in archive for 1 year at 4 °C and 2 years at ambient temperature
- ▶ required data will be transferred to the AIRS database

## Purpose of this Document

The purpose of the FRM PEP field SOPs is to provide detailed procedures to follow when performing the following field activities:

- ▶ Overview
- ▶ Planing/Preparation Equipment inventory/maintenance
- ▶ Cassette Receipt/Storage/Handling
- ▶ Sampler Transport and Placement
- ▶ Sampler Assembly and Maintenance
- ▶ Verifications
- ▶ Calibrations
- ▶ Sample Filter Handling
- ▶ Filter COC
- ▶ Quality Assurance/Quality Control
- ▶ Information Retention

All methods are to be followed completely. Any deviation must be reported in writing and submitted to the ESAT Work Assignment Manager (WAM). Method improvements are encouraged. **If any deviations or modification offer a more efficient method or technique or serve to maintain or improve data quality, these proposed changes shall be made in writing to the ESAT WAM.**

Each section is written as a stand-alone procedure to assist in training and certification activities and can be removed from the document and made readily available at the station where the activity takes place. The SOPs follow the format for technical SOPs outlined in *Guidance for the Preparation of Standard Operating Procedures (SOPs) EPA QA/G-6*. The *QA/G6* requirements include the following topics:

- A. Scope and Applicability
- B. Summary of Method
- C. Definitions (acronyms, abbreviations and specialized forms used in the SOPs)
- D. Health & Safety Warnings
- E. Cautions
- F. Interferences
- G. Personnel Qualifications
- H. Apparatus and Materials
- I. Instrument or Method Calibration
- J. Sample Collection
- K. Handling and Preservation
- L. Sample Preparation and Analysis
- M. Troubleshooting
- N. Data Acquisition, Calculations & Data Reduction
- O. Computer Hardware & Software

P. Data Management & Records Management.

**Each method addresses only the topics relevant for that method.** The methods are numbered as follows:

*PEPF-X.YY*

Where:

- PEPF - indicates the **Performance Evaluation Program Field SOPs**,
- X- indicates the section in which the method is found (based on the table of contents), and
- YY- indicates the method number.

## Prerequisites

### Training and Certification

All field personnel funded by the OAQPS PEP work assignment must be trained and certified to perform the activities. Training and recommendation for certification can be provided by the Regional WAM or by OAQPS.

### Background Reading

Prior to implementing field activities, field personnel are expected to be familiar with the documents listed in Table 0-1. The knowledge level is rated from 1, having in-depth knowledge, to 5, having a basic understanding.

**Table 0-1. Required Reading for the Performance Evaluation Program**

Document	Knowledge Level
FRM Performance Evaluation Program Field SOPs	1
FRM Performance Evaluation Program QA Project Plan	1
Portable Sampler Operating Manuals	1
FRM Performance Evaluation Program Laboratory SOPs	3
QA Guidance Document 2.12	3
FRM Performance Evaluation Program Implementation Plan	3
PM <sub>2.5</sub> Data Quality Objective Process	3
QA Hand Book Vol. II Part 1	3
40 CFR Part 50 Appendix L	4
40 CFR Part 58 Appendix A	4

## Definitions

Appendix A contains a glossary of the terms used in the PEP. Acronyms and abbreviations can be found in the front of this compendium.

## Cautions

### Filters

Care in all aspects of filter/cassette handling cannot be overemphasized. The filters used for the PM<sub>2.5</sub> sampler are comparatively small; each filter weighing around 150 mg. Due to the size and weight of the particles that will be collected on these filters, net weights will be measured in micrograms ( $\mu\text{g}$ ). The loads on the filter may be anywhere from 10 to 2000  $\mu\text{g}$  ( $83 \mu\text{g}/\text{m}^3$ ) with most sample loads around 300  $\mu\text{g}$ . In order to give one a sense of this weight, a 4 cm-long human hair weighs  $\sim 312 \mu\text{g}$ . This average 300  $\mu\text{g}$  sample load value represents 0.2% of the weight of the blank filter. In addition, it is expected that the laboratory analyst (LA) will be able to duplicate weighings of the same filter to within 15  $\mu\text{g}$ . A single thumbprint on a filter weighs 15  $\mu\text{g}$ . It should be apparent that any small loss or gain (i.e., finger oils, dust) will affect filter weights. Additional details of filter handling are discussed in Section 3.

# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 1**

### **Overview of FRM Performance Evaluation Field Activities**

## Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

### Operation: Overview of FRM Performance Evaluation Field Activities

#### SOP: PEPF-1.01

Name: Printed	Signature	Date

*Contents*  
(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Cautions	2
5. Interferences	3
6. Personnel Qualifications	4
7. Equipment and Supplies	4
8. Procedure	4
9. References	6

## 1.0 Scope and Applicability

This SOP applies to performing field operations for the FRM Performance Evaluation Program (PEP). This SOP provides an overview of the detailed SOPs that follow. Many of these SOPs apply specifically to operation of the BGI PQ200A Air Sampler.

## 2.0 Summary of Method

A PE for determining total bias for PM<sub>2.5</sub> collection and gravimetric analysis involves collocating a portable FRM sampler adjacent to a monitoring site's routine sampler and sampling for a 24-hour period. The concentrations for the two samplers are then compared in order to assess bias. FRM PEs will be conducted four times each year at one-fourth (25%) of the sampling sites in a reporting organization and will begin with those sampler locations documented or expected to have concentrations near the annual National Ambient Air Quality Standard (NAAQS) for PM<sub>2.5</sub> (40 CFR Part 58, Appendix A, Section 3.5).

The basic operations involved with conducting the field portion of the FRM PEP are described in the SOPs contained in this document.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Cautions

- ▶ To prevent personal injury, all personnel must heed any warnings that are associated with installation and operation of the PM<sub>2.5</sub> sampler and any supporting equipment and supplies. Specific health and safety warnings will generally be found at the point in the operating manual or troubleshooting guide where they are most applicable.
- ▶ Because the portable FRM PM<sub>2.5</sub> sampler will be moved from site to site, it is of critical importance that it be maintained and calibrated as required and that all aspects of its operation be checked and verified after it is set up at each new site. To function as a reliable standard of comparison, its operational parameters must be kept within tight control limits. Consequently, procedures for verifying a portable FRM sampler's calibration and operability are an important part of the field SOPs.
- ▶ The FRM PM<sub>2.5</sub> sampler will be installed and dismantled many times in the course of the PE trips. Caution must be taken to install and maintain the sampler properly to prevent damage. Be particularly attentive to maintenance of the pump, ensuring the soundness of electrical and pneumatic connections that will be repeatedly assembled and disassembled and to cleaning of the interior and exterior surfaces of the inlet and WINS. Pack the sampler components securely for safe transport by vehicle or by air. Refer to the operations manual for exact instructions for packing the portable sampler. Immediately after installation, leak checks must be performed and verification checks of temperature, barometric pressure, and flow rate sensors must be made and

recorded. All necessary corrective actions must be taken before sampling can begin with the portable FRM device.

- ▶ The 46.2 -mm PTFE filters used for sampling are especially delicate and easily damaged. Exercise care in handling new and used filters. Never touch the filter surfaces; handle the filters only by touching the cassette surfaces. Never remove the filters from their cassettes; this is done only at the weighing laboratory. If details concerning labeling and transporting of filters are not followed precisely, errors will result. Rough handling of used filters during packaging or transport may dislodge PM<sub>2.5</sub> material. Exposed filters must be shipped at approximately  $\leq 4$  °C to reduce weight loss.
- ▶ Each manufacturer provides filter cassettes that can be used only with its particular model. Cassettes will be labeled in a manner that identifies the specific sampler for which they are to be used. Be certain to use the proper type of cassette for the make and model of FRM device to be used. Do not intermix the cassettes of various brands or types of samplers.
- ▶ When the sampler is dismantled, be sure to remove any debris adhering to the base or legs before storing it for transport. To minimize contamination, pack the base or leg portion of the sampler separately from the sampler collection module.
- ▶ Protect all barometers from mechanical shock and sudden changes in pressure. A barometer subjected to either of these events must be recalibrated.

## 5.0 Interferences

The interferences associated with this method are those factors that can cause alterations in the weight of the filter and/or sampled PM<sub>2.5</sub> and alterations to the flow rate of the sampler. A small particle of dust or pollen, if inadvertently transferred to the filter surface in the sample collection filter enclosure, will alter the sample weight dramatically. Interferences can be avoided by following these guidelines:

- ▶ Avoid handling unexposed or exposed filters in any way that could add or subtract weight. For example, rough handling could cause weight loss, exposing of the filter to dusts or pollen could cause weight gain and allowing the face of the filter to touch surfaces could cause either weight gain or loss.
- ▶ Package the filter promptly following a sampling period and return it to the weighing laboratory within the specified time.
- ▶ Some types of particulate matter are somewhat volatile; therefore, exposed filters must be shipped in a package cooled ideally at or below 4 °C to minimize loss of volatile material.
- ▶ Ensure proper cleaning of the inlet, downtube, and WINS impactor to avoid any contamination of the flow devices; use required techniques for the leak check to identify and correct any leaks found within the flow system.

## 6.0 Personnel Qualifications

All personnel responsible for conducting FRM PEs at field sites must be certified by the U.S. EPA as completing a required training program. These persons are designated as Field Scientists (FS). During this training program, the operators of the samplers must successfully complete an extensive, hands-on training session specified by EPA/OAQPS. A FS must pass both written and performance tests before he or she is eligible to conduct FRM PEs. These training programs will be conducted as required at locations throughout the U.S. to ensure all operators of the portable samplers are certified and an adequate number of PE field scientists are available in each EPA Region. Contact the Regional EPA Office or OAQPS for more information about training schedules and locations. Supplemental courses such as those offered by Air Pollution Training Institute (APTI) may be useful in providing general background to personnel with limited prior experience with air monitoring and/or quality assurance.

The FS shall be prepared to transport the FRM device to various sampling platforms, including the tops of buildings or distant rural settings. For ease of operations and the safety of the operators, the portable FRM sampler was designed in sections, with each individual section weighing no more than 40 lbs. Field personnel must be able to lift and carry these sections up stairs and/or ladders.

## 7.0 Equipment and Supplies

Each organization responsible for performing the FRM PE will develop a standard "kit" of equipment, materials, and supplies suitable for the make(s) and model(s) of portable FRM sampler(s) to be used. The contents of this "kit" will also be determined by the different requirements of the sites to be visited for FRM PEs. For example, mounting equipment will, in part, be dictated by how the sites are constructed and where they are mounted (building roof, wooden platform, concrete pad, and so on).

SOP PEPF-2.01 contains a complete field inventory list and discusses the procedures for field equipment and resupply. That list of generic equipment and supplies must be translated into a specific checklist of equipment and materials that can be customized as necessary. Communications between the FS and site personnel prior to the visit are essential and assist greatly in knowing what will be required at each site.

## 8.0 Procedures

The FS will perform the following activities as illustrated in Figure 1.1:

1. The FS will receive equipment and consumables, inventory each item and ensure supplies are adequate to perform field activities.
2. The FS will receive filters from a national laboratory (Region 4 or 10). The FS will confirm receipt of the filters by informing the laboratory and use them in the order they are received.
3. The FS will assist in developing a plan for the implementation of field activities and gather pertinent information for each site on a Site Data Sheet.

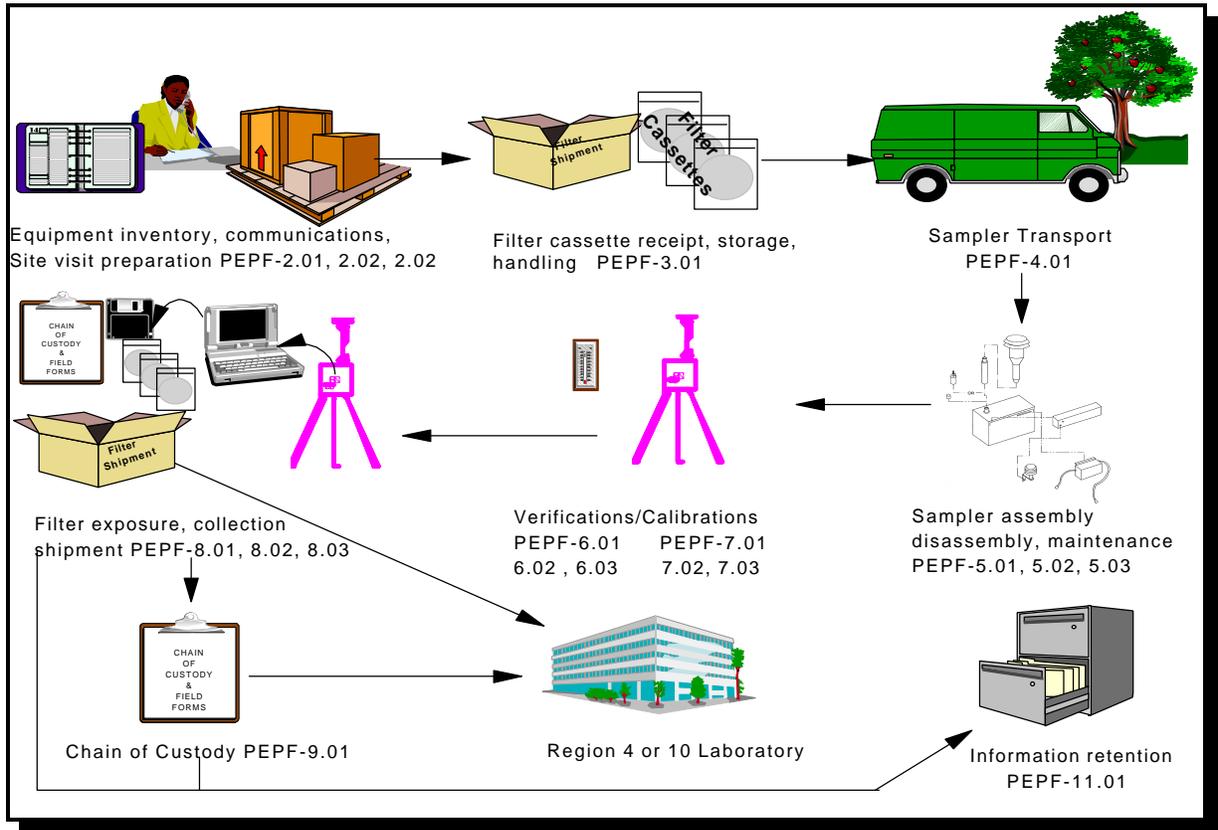


Figure 1.1. Field activities in relation to SOPs.

4. The FS will transport the appropriate portable sampling equipment to sites.
5. The FS will assemble the portable sampler, collocate the sampler, perform verifications following SOPs, install a filter and operate the instrument for 24 hours (midnight to midnight).
6. If scheduling allows, the FS may leave this location to set up an additional 24-hour PE at another routine sampling location or perform additional activities at the site if so tasked. The FS may also perform any required maintenance or repair of the portable PM<sub>2.5</sub> sampling device.
7. The FS will return to each site after the 24-hour sampling period, remove and properly store the filter for transport, download the stored electronic monitoring data, enter additional information as required, and disassemble and pack the sampler.
8. The FS will properly package the filter ( i.e., use of ice substitutes), the COC Forms, Field Data Sheets and diskettes, follow the COC and shipping procedures for transport to the predetermined laboratory.
9. The FS shall participate in or assist with scheduled quality assurance activities of the FRM PEP.

## 9.0 References

1. BGI Inc. May, 1998. PQ200 Air Sampler Instruction Manual,
2. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring  $PM_{2.5}$  in Ambient Air Using Designated Reference or Class I Equivalent Methods.
3. U.S. Environmental Protection Agency. 1998. Implementation Plan:  $PM_{2.5}$  Federal Reference Method Performance Evaluation Program
4. U.S. Environmental Protection Agency.1997. Part 50 promulgated as 50 FR62138 amendments to Title 50.
5. U.S. Environmental Protection Agency. 1997. Part 58 promulgated as 50 FR62138 amendments to Title 58.

# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 2.0**

### **Planning and Preparing for a Site Visit**

**2.01 Equipment Inventory**

**2.02 Communications**

**2.03 Site Visit Preparation**

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Equipment Inventory and Storage

### SOP: PEPF-2.01

Name: Printed	Signature	Date

*Contents*  
(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Definitions	2
3. Personnel Qualifications	2
4. Equipment and Supplies	2
5. Procedure	2

## **1.0 Scope and Applicability**

This SOP explains the activities involved in inventorying existing laboratory equipment, receiving new equipment and consumables, and maintaining the equipment.

## **2.0 Definitions**

Appendix A contains a glossary of the terms that will be used in the PEP.

## **3.0 Personnel Qualifications**

Certification by having passed the written examination and the hands-on practical examination for the laboratory component in the PM<sub>2.5</sub> Federal reference method PE training.

## **4.0 Equipment and Supplies**

The FS will use the following apparatus and materials to perform the procedures in this section:

- ▶ Table 2-1 providing a listing of the equipment and consumables needed for the field.
- ▶ Field Inventory Form INV-01
- ▶ Field Procurement Log PRO-01

## **5.0 Procedure**

### **5.1 Equipment Inventory**

During the summer and fall of 1998, OAQPS purchased the necessary equipment and consumables for the field activities. Table 2-1 provides a listing of the capital equipment and consumables required. The FS will follow the procedure below:

1. Select Field Inventory Form INV-01.
2. Take a complete inventory of all equipment and supplies.
3. Keep an original copy and file under AIRP/486. Provide a copy of the inventory to the Work Assignment Manager (WAM.).

The FS should maintain a 2-months' supply of consumables. During the first weeks of implementation, the FS will determine how quickly he/she is using consumable equipment and develop a purchasing schedule to ensure an adequate supply is maintained.

Table 2-1 must be translated into a specific checklist of equipment and materials that can be customized as necessary. Communications between the FS and site personnel prior to the visit are essential and assist greatly in knowing what will be required at each site.

**Table 2-1. Equipment and Supplies**

Qty.	PEP Field Equipment and Supplies	Vendor/Catalog #	Make/Model #	✓
	<b><u>Monitoring Equipment and Supplies</u></b>			
	Transport cases for loose equipment/consumables	Forestry Suppliers/31113	Collapsible crate	
	Back pack frame for carrying samplers	Forestry Suppliers/35913	Camp Trails Freighter Frame	
	Portable FRM PM <sub>2.5</sub> sampler(s) with carrying case			
	Pre-weighed 46.2-mm diameter filters in the proper cassette.			
	Chain of Custody form for <u>each</u> filter			
	Impactor oil and dropper			
	Impactor filters (37 mm diameter glass fiber)			
	Sample shipping containers (coolers)			
	min/max thermometer	Daigger / AX24081B	Sentry	
	cold packs (ice substitutes) 36/box		Utek- 1°C/ 429	
	Electric transport cooler with 12 volt to ac transformer	Globe Mart/ 5615-807	Coleman 16 qt	
	Filter Transport Coolers (6 quart)	Forestry Suppliers /31179	Rubbermaid 6 pack	
	Bubble Wrap			
	FRM Operations manual			
	Field notebook(s)			
	Clipboard (8 x 14")	Forestry Suppliers /53283	Cruiser mate	
	Grip Binders	Office Depot/501-627	Presstex	
	Data Diskettes		BASF 2HD	
	Silicone grease for O-rings (Vacuum Grease)	Daigger/ AX23061A		
	FRM PEP Field SOPs (this document)			
	Documentation forms or data sheets, preprinted			
	Laptop computer with PQ200A job control software)			
	Datatrans to download data	BGI /DC201		
	Cables for connecting the data download device to the Portable FRM sampler			
	Magnetic compass or other means of determining site orientation (optional)	Forestry Suppliers/ 37177	Suunto Partner II	
	Tape Measure (metric)	Forestry Suppliers/ 39651	Lufkin/ W 9210ME	
	Cellular phone			

Qty.	PEP Field Equipment and Supplies	Vendor/Catalog #	Make/Model #	✓
	Mechanical Pencils	Skilcraft	9mm	
	Markers (indelible)	Sharpees	Ultrafine	
	<b><u>Mounting Equipment and Tools</u></b>			
	Ladder, rope for hoisting equipment			
	Bubble level for checking the portable FRM sampler	Mayes (torpedo)	10198	
	Wooden shims or other means for leveling the Portable FRM sampler			
	Tool box with basic tools			
	Flashlight with spare batteries			
	Heavy-duty, grounded, weatherproof electrical extension cord with multiple outlets (25 ft. length)	Unicor	Style3 Class2 Series2	
	Heavy-duty, grounded, weatherproof electrical extension cord with multiple outlets (12 ft. length)	Unicor	Style3 Class2 Series2	
	Tie-down cables, anchors, plywood sheet, bungee cords etc., to anchor and stabilize the portable FRM sampler and to dampen vibration. (optional)			
	Masking tape Packaging tape Strapping tape	GSA-7510-00-283-0612 GSA-7510-00-079-7906 GSA-7510-00-159-4450		
	<b><u>Calibration/Verification Standards and Related Equipment</u></b>			
	Downtube flow rate adapter			
	Flow-check device (NIST-traceable)	Chinook Streamline FTS Dwyer Series Mark III	475-D	
	Flow multipoint verification/calibration device (NIST-traceable)	Bios- dry cal	DC-lite	
	Portable barometric pressure verification device (NIST-traceable)	DPI Absolute		
	Barometric pressure multipoint verification/calibration device (NIST-traceable)	Meri-cal	LP200	
	Temperature verification/calibration standard (NIST-traceable) with probe	VWR	61220-601	
	Thermos container for temperature calibrations			
	Flow-check filter in transport cassette			
	Impermeable "filter" disk for internal leak checks			
	Accurately set timepiece			
	Hand calculator (scientific)	Office Depot/397-554	Casio	
	<b><u>Spare Parts and Optional Equipment</u></b>			

Qty.	PEP Field Equipment and Supplies	Vendor/Catalog #	Make/Model #	✓
	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 for troubleshooting			
	Spare impactor(s)			
	<b>Cleaning Supplies and Equipment</b>			
	Low-lint laboratory wipes for cleaning WINS and other sampling equipment	Daigger/AX5661	Kay-Pees Disposable paper towels	
	Large locking plastic bag for cleanup of debris, wipes, etc			
	Soft brush,			
	Supply of deionized water for cleaning and rinsing equipment			
	Isopropyl alcohol to aid in removal of grease and dirt			
	Penetrating oil			
	Lint-free pipe cleaners			
	Safety pin dental pick			
	Lint-free cotton-tipped swabs			
	wooden dowel, and cloth wads to clean downtube			
	Spray Bottle			

## 5.2 Procurement

As consumables run low or new equipment purchases are necessary, the FS will be responsible for assisting in the procurement of these items following the policy and requirements described in the ESAT scope of work. The FS should continue purchasing consumable equipment with the same model numbers as initially procured unless the WAM suggests a different item due to improved quality, reduced contamination, ease of use, or lower cost (without sacrificing quality). The following procedures will be required.

1. The FS will develop procurement requests as per EPA requirements.
2. Upon order, add items to the Field Procurement Log PRO-01.
3. Once a month provide a copy of Form PRO-01 to the WAM.
4. File Form PRO-01 in file AIRP/486.

### **5.3 Equipment Consumable Receipt**

Upon receiving equipment and consumables, the FS will perform the following activities:

1. Pull the appropriate purchase order for the incoming items from the files.
2. Fill out a Field Receiving Report Form REC-01 comparing the items and quantity against the purchase order and inspecting the condition of each item.
3. If the items received match the purchase order and the condition of the equipment or consumables is acceptable, signify this on the form and file it in AIRP/486.
4. If the quantity, items, or condition are not acceptable, complete REC-01 with appropriate remarks and send a copy of the form to the WAM.
5. Add receipt information to the Field Procurement Log Form PRO-01

### **5.4 Equipment Storage**

When equipment is not in use, store it in a clean, dry, and safe location. After 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 trip. All equipment should be clearly identified, and readily available for the next scheduled field trip.



<b>Field Equipment/Consumable Receiving Report</b>			
Date: _____			
Received From:			
Shipped From:			
Shipped Via:			
Shipping Charge	Prepaid	Collect	Freight Bill #
Purchase Order Number			
Quantity	Description Of Item	Condition	
Remarks:                      Accept Shipment _____                      Problem _____			
Notes:			
<b>Form REC-01</b>			



# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Communications

### SOP: PEPF-2.02

Name: Printed	Signature	Date

*Contents*  
(applicable to this SOP)

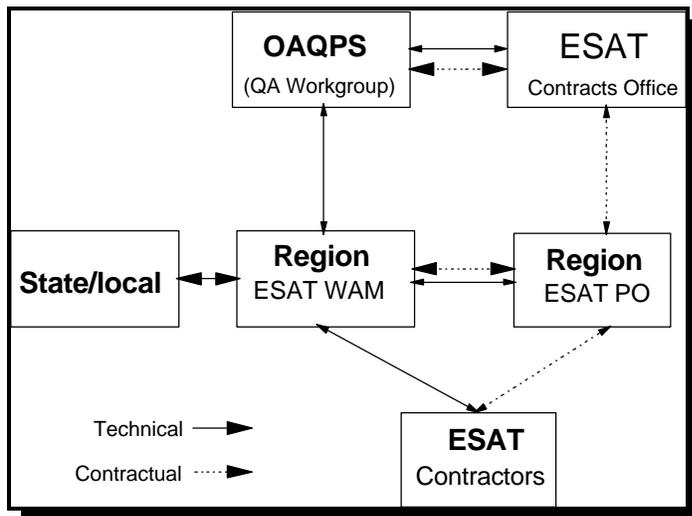
Section	Page
1. Scope and Applicability	2
2. Summary	2
3. Definitions	3
4. Apparatus/Materials	3
5. Procedure	3
6. Records Management	6

## 1.0 Scope and Applicability

This procedure describes the required activities for PEP FS to communicate technical information to organizations intimately involved in the PEP and includes:

- ▶ ESAT WAM for the FS
- ▶ ESAT WAMs for the Laboratory Analyst (LA)
- ▶ ESAT LAs
- ▶ OAQPS

This SOP does not describe additional ESAT communication obligations described in the ESAT Scope of Work. Communications will include reports, e-mail messages and phone calls.



**Figure 2.1** Line of communication

## 2.0 Summary of Method

An organized communications framework is needed to facilitate the flow of information among the participating organizations as well as among other users of the information produced by the PM<sub>2.5</sub> network. Figure 2.1 represents the principal communications pathways. In general, ESAT contractors will be responsible for informing Regional WAMs and Project Officers (POs) on technical progress, issues, and contractual obligations. On the technical side, the EPA Regional WAMs will be responsible for communicating with State and local agencies and informing OAQPS on issues that require technical attention. Contractual

issues will be conveyed from the ESAT contractor through POs to the ESAT Contracts Office and, if necessary, to OAQPS. Table 2-1 at the end of this SOP lists the important EPA ESAT contacts.

The ESAT contractors will have frequent communication with the Regional WAMs about the progress of their activities and any problems/issues associated with them. Resolution of these issues should take place in the Regions unless the issue could affect the implementation of the program at a national level, where it should be discussed and resolved through an ESAT Workgroup conference call.

### **3.0 Definitions**

Appendix A contains a glossary of terms used in the PEP.

### **4.0 Equipment and Supplies**

The following capital and consumable equipment will be required for communications:

- ▶ Telephone
- ▶ Laboratory PC - with Internet and EPA E-Mail capabilities
- ▶ Printer
- ▶ Field Communication Notebook
- ▶ Writing utensils
- ▶ Appropriate Forms
  - COM-1 - Phone Communication Form
  - COM-2 - Monthly Progress Report

### **5.0 Communication Procedures**

#### **5.1 Phone Communications**

##### **5.1.1 Issue-Related Calls**

A call may be initiated by the WAM(s), the FS, or the laboratory at any time during implementation. During the conversation, the phone communication form (COM-1), in the field communications notebook, will be used by the FS to record the highlights of the conversation. Notes will include the following:

- ▶ Date
- ▶ Time
- ▶ Personnel involved
- ▶ Issue(s)
- ▶ Decision(s)
- ▶ Follow-up action(s)
- ▶ Follow-up action responsibility
- ▶ Follow-up action completed by (date)

If follow-up action is required by the FS, these actions will be included in the monthly progress reports (see Section 5.2). At a minimum, the FS will keep the original hardcopy in the field communications notebook. The FS may also choose to keep an electronic record of this information on a PC.

##### **5.1.2 Field Communications**

Field communications can take place either by phone or e-mail. Phone messages or conversations will be recorded in the field communications notebook. E-mail messages should be printed and stored in the field communications notebook

### **5.1.2.1 Filter Shipment Receipt**

Every 2 weeks, filters will be shipped to the field offices by the LA. On the day of receipt, the FS will contact the LA and provide the following information:

1. date of receipt
2. number of filters in shipment
3. number of boxes in shipment
4. air bill number

### **5.1.2.2 Equipment Shipment Receipt**

Once a month, the laboratory will ship coolers, max/min thermometers, and gel packs back to the field offices. On the day of receipt, the FS will contact the LA and provide the following information:

1. date of shipment
2. number of boxes in shipment
3. tracking number

### **5.1.2.3 ESAT Conference Calls**

The FS may be asked to participate in ESAT Workgroup conference calls to discuss progress or resolution of issues. The WAM will inform the FS of information that needs to be prepared for the call at least 3 days prior to the call. During the call, the FS will use the Phone Communication Form (COM-1) to record issues and action items that pertain to his or her activities. These items will be included in the next monthly progress report.

### **5.1.2.4 Communicating with Reporting Organizations and Site Operators**

Dates for the FRM PE visits should be coordinated with the site's normal operating schedule. This coordination must be done in advance so that both the FS and the site operator have ample advance notice and time to prepare for the on-site visit. The procedure for such communications follows:

1. The WAM (FS in attendance) will contact each site operator (by telephone) no less than 1 month prior to the site visit. Points to be covered include the following:
  - ▶ field implementation schedule; setting a location and time to meet
  - ▶ providing assistance in setting up the portable instrument and other assistance such as providing freezer space for ice substitutes (if necessary)
  - ▶ briefing the operator on what will occur during the evaluation
  - ▶ discussing the tasks that the site operator will be requested to do to assist with the evaluation
  - ▶ additional information needed for the Site Data Sheet
  - ▶ answering any questions that the site operator may have
  - ▶ emphasizing that the site's PM<sub>2.5</sub> sampler will not be adjusted in any way and that the operator should do nothing out of the ordinary routine to prepare for the PE

- 
- ▶ ensuring that all clearances have been obtained so that the site can be accessed as necessary. A site representative must be there. If a representative other than the site operator plans on being at the site the name and number of this representative must be identified and recorded.
  - ▶ verifying that sufficient electric power is available for the portable FRM sampler and other equipment
  - ▶ determining if special logistic concerns exist (training, equipment, etc.)

If problems are identified in the preliminary discussions with the site operator, arrangements will be made to take corrective actions. Below are some suggested corrective actions for various commonly encountered problems:

- ▶ Climbing or other special safety equipment required:
    - buy or rent appropriate equipment prior to the site visit
    - borrow the necessary equipment from the site operator or the operator's organization
    - postpone visit until the situation requiring special safety equipment is remedied (if feasible)
  - ▶ Insufficient power at the site to operate the FRM and the routine sampler (and other site monitors and equipment) simultaneously:
    - obtain permission to run an extension power cord from a nearby outlet
    - cancel the site visit and request that adequate power be installed
  - ▶ The site will not accommodate the portable FRM sampler within siting requirements:
    - perform the evaluation, flag the situation and resulting data; and contact the EPA Regional Office about the situation.
  - ▶ Special restrictions on site access are in force, such as a requirement for a lengthy background check at certain high-security Federal installations. (Note: FS are required to observe laws, rules, regulations, and policies regarding access to restricted sites on public or private land. The Performace Evaluator shall not "borrow" the operator's key or access card without the knowledge and permission of the site owner.) Options for dealing with this type of situation include:
    - obtain necessary permissions, keycards, etc. in advance
    - request that the reporting organization or the EPA Regional Office to secure the necessary permissions to access the site on behalf of the FS
    - make arrangements for a "cleared" escort to accompany the Evaluator at all times (if this is acceptable at the particular site)
2. About one week prior to the actual evaluation, the FS will call the site operator to confirm that the PE visit remains on schedule and to confirm meeting arrangements.

## 5.2 Monthly Progress Reports

The FS will provide to the WAM a progress report in writing at the end of each month. The monthly progress report Form COM-2 will be used to convey the following information:

- ▶ Reporting Date - beginning and end date that report covers
- ▶ Reporter - person writing reports

- ▶ Progress - progress on field activities
  - Evaluations scheduled within reporting date
  - Evaluations conducted within reporting date
- ▶ Issues -
  - Old issues- issues reported in earlier reports that have not been resolved
  - New issues- arising within reporting date
- ▶ Actions- Action necessary to resolve issues including: the person(s) responsible for resolving them and the anticipated dates when they will be resolved.

## **6.0 Records Management**

Monthly progress reports will be archived in the field reporting package file under AIRP/484. Phone communications will be archived in the field reporting package file under SAMP/502/COM. See Section 11 for details.

<b>Phone Communication Form (COM-1)</b>		
<b>Date:</b>	<b>Time:</b>	<b>Recorder:</b>
<b>Personnel on call:</b>		
<b>Issue(s):</b>		
<b>Decisions(s):</b>		
<b>Follow-up Action(s):</b>		
<b>Follow-up Responsibilities:</b>		
<b>Completion Dates for Follow-up Actions:</b>		

<b>Monthly Progress Report (COM-2)</b>	
<b>Reporting Date: Start:</b>	<b>End:</b>
<b>Reporter:</b>	
<b>Progress</b>	
<b>Sites Scheduled for Month:</b>	<b>Sites Evaluated during Month:</b>
<b>Issues</b>	
<b>Old:</b>	<b>New:</b>
<b>Actions:</b>	<b>Actions:</b>
<b>Free Form Notes:</b>	

**Table 2-1 ESAT Contacts**

<b>Name</b>	<b>Address</b>	<b>Phone Number</b>	<b>Electronic Mail</b>
<b>ESAT</b>			
Angela Edwards Kathleen Engel Monica McEaddy Colleen Walling	U.S. EPA 401 M Street, SW. Washington, DC 20460.  Monica and Colleen 5203G Kathleen and Angie 3805R	(703) 603-8709 (202) 564-4504 (202) 564-4503	edwards.angela@epa.gov engel.kathleen@epa.gov mckeaddy.monica@epa.gov walling.colleen@epa.gov
<b>OAQPS</b>			
Michael Papp David Musick Tim Hanley Mark Shanis Mike Jones	USEPA Office of Air Quality, Planning & Standards MQAG (MD-14) RTP, NC 27711	(919) 541-2408 (919) 541-2396 (919) 541-4417 (919) 541-1323 (919) 541-0528	papp.michael@epa.gov musick.david@epa.gov hanley.tim@epa.gov shanis.mark@epa.gov jones.mike@epa.gov
<b>REGIONS</b>			
<b>Region 1</b> <b>WAM</b> Mary Jane Cuzzupe  <b>PO</b> Tony Palermo	USEPA-Region 1 New England Regional Laboratory 60 Westview Street / EMALEX Lexington, MA 02173	(781) 860-4383   (781) 860-4682	cuzzupe.maryjane@epa.gov   palermo.anthony@epa.gov
<b>Region 2</b> <b>WAM</b> Clinton Cusick <b>PO</b> Dick Coleates	USEPA-Region 2 Raritan Depot / MS103 2890 Woodbridge Ave Edison, NJ 08837-3679	(908) 321-6881   (732) 321-6662	cusick.clinton@epa.gov   coleates.dick@epa.gov
<b>Region 3</b> <b>WAM</b> Theodore Erdman  <b>PO</b> Fred Foreman	USEPA-Region 3 841 Chestnut Building / 3ES11 Philedelphia, PA 19107  USEPA-Region 3 office of Analytical Services/3ES- 20 839 Bestgate Road Annapolis, MD 21401-3013	(215) 597-1193   (215) 566-2766	erdman.ted@epa.gov   foreman.fred@epa.gov
<b>Region 4</b> <b>WAM</b> Herb Barden Steve hall  <b>PO</b> Mike Birch	US-EPA Reg 4 Science and Ecosystem Support Division 980 College Station Road Athens, Georgia 30605-2720  USEPA-Region 4 APTMD Atlanta Federal Center 61 Forsyth St. SW Atlanta, GA 30303-3104	(706) 355-8737 (706) 355-8615   (706) 355-8552	barden.herbert@epa.gov hall.johns@epa.gov   birch.mike@epa.gov

<b>Name</b>	<b>Address</b>	<b>Phone Number</b>	<b>Electronic Mail</b>
<b>Region 5</b> <b>WAM</b> Gordon Jones	USEPA-Region 5 77 West Jackson Blvd. / AR18J Chicago, IL 60604-3507	(312) 353-3115	jones.gordon@epa.gov
<b>PO</b> Jay Thakkar	/ SM5J	(312) 886-1972	thakkar.jay@epa.gov
<b>Region 6</b> <b>WAM</b> Kuenja Chung	USEPA-Region 6 First Interstate Bank Tower at Fountain Place 1445 Ross Avenue Dallas, TX 75202-2733	(214) 665-8345	chung.kuenja@epa.gov
<b>PO</b> Melvin Ritter	USEPA Region 6 Laboratory Houston Branch/ 6MD-HC 10625 Fallstone Road Houston TX 77099	(281) 983-2146	ritter.melvin@epa.gov
<b>Region 7</b> <b>WAM</b> Mike Davis	USEPA-Region 7 ENSV / EMWC 25 Funston Road Kansas City, KS 66115	(913) 551-5081	davis.michale@epa.gov
<b>PO</b> Harold Brown	USEPA Region 7 726 Minnesota Ave/ENSV/RLAB Kansas City, KS 66101	(913)-551-5127	brown.harold@epa.gov
<b>Region 8</b> <b>WAM</b> Joe Delwiche	USEPA-Region 8 999 18th Street /8P2-A Suite #500 Denver, CO 80202-2466	(303) 312-6448	delwiche.joseph@epa.gov
<b>PO</b> Barbara Daboll	/8TMS-L	(303) 236-5057	daboll.barbara@epa.gov
<b>Region 9</b> <b>WAM</b> Mathew Plate	USEPA-Region 9 75 Hawthorne St. /PMD-3 San Francisco, CA 94105	(415) 744-1493	plate.mathew@epa.gov
<b>PO</b> Rose Fong		(415) 744-1534	fong.rose@epa.gov
<b>Region 10</b> <b>WAM</b> Karen Marasigan	USEPA-Region 10 1200 Sixth Ave / ES-095 Seattle, WA 98101	(206) 553-1792	marasigan.karen@epa.gov
<b>PO</b> Gerald Dodo	USEPA Region 10 Manchester Laboraory 7411 Beach Drive East Port Orchard, WA 98366	(206) 553-8728	dodo-gerald@epa.gov

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Site Visit Preparation

### SOP: PEPF-2.03

Name: Printed	Signature	Date

### *Contents* (applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	2
7. Procedure	3
8. References	6

## **1.0 Scope and Applicability**

This SOP applies to preparing for the FRM PE site visits.

## **2.0 Summary of Method**

Preparation for site visits in the FRM PEP requires attention to many details and interaction among several different organizations. This SOP outlines the planning steps necessary to successfully conduct PEs at one or more sites.

## **3.0 Definitions**

Appendix A contains a glossary of terms used in the PEP.

## **4.0 Personnel Qualifications**

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## **5.0 Cautions**

- ▶ the FS must obey all laws, ordinances, and policies regarding access to monitoring sites and use of the property of others
- ▶ the FS shall not represent himself or herself as an employee of EPA or of the Federal Government
- ▶ the FS may not gain access to a monitoring site without the knowledge and permission of the site owner or site operator
- ▶ in transporting equipment and supplies, the FS must comply with all applicable laws and regulations, including those of the FAA and DOT
- ▶ FS must comply with licensing requirements and "union shop" agreements, where applicable. In general, the FS is expected to perform the tasks necessary to install and operate the FRM PE equipment. However, electrical rewiring or other modifications to monitoring site equipment must be done by qualified and properly licensed tradesmen

## **6.0 Equipment and Supplies**

- ▶ Implementation Schedule
- ▶ Site Data Sheet(s) (SD-01)
- ▶ Reporting Organization contact information

## 7.0 Procedure

### 7.1 Development of Implementation Schedule

State and local organizations will work with the EPA Regions to select and develop a list of sites for the evaluations conducted in each calendar year on or before October 1, of the previous year. The Regional WAMS, with the assistance of the ESAT contractors, will attempt to determine the most efficient site visit schedule. This schedule should be based upon the following:

- ▶ the criteria in CFR
- ▶ meeting the same monitoring schedule as the routine sampler being evaluated
- ▶ the sites that are closest in proximity to each other (can be visited within the same day or week)

Once this site schedule is developed, it must be sent to all affected reporting organizations. Based upon this schedule, the FS will make appropriate travel arrangements.

### 7.2 Development of the Site Data Sheet

For each site, the FS contractor will develop a Site Data Sheet (Form SD-01) that contains information such as:

AIRS Monitor Site ID	Monitor ID
Method Designation	Monitor Make and Model
Site Coordinates	Site Type (NAMS/SLAMS)
Reporting Organization	Reporting Organization Contact
Street address	Directions to the site (from Regional Office)
Directions to the site from major thoroughfare	Safety concerns
Additional equipment needed (ropes, ladders etc.)	Closest Hospital (address)
Closest Express Mail Facility	Closest Hardware Store
Recommended Hotel (address/phone)	Important free form notes
Closest site	2 <sup>nd</sup> closest site

The information listed above will be kept in a site file (filed by AIRS Site ID) and included in a site notebook for each FS. Software such as MapQuest™ (Internet accessible) can help provide information on directions to sites. In addition, maps for each State and city where a monitor is located will be acquired. Site locations can be placed on these maps along with the site IDs.

Preparation for one or more PE trips will involve communication among various organizations including the FS's organization (ESAT), the monitoring reporting organization, and the site operator. A schedule will need to be set; operators notified; travel arrangements made, and all equipment and supplies gathered, packed, inventoried, and readied for shipping. The following sections discuss the necessary steps.

### 7.3 Site Visits Preparation

It is difficult to give a general procedure for scheduling site visits because of the number of variables such as the number of sites, the number of samplers at each site, the distance between sites, the sampling schedule, and the site access restrictions.

FRM PEs should be implemented on a normal sampling day so that it does not create additional work for the State and local agencies. Thus, for sites that only sample one day in three or one day in six, this schedule must be taken into account when scheduling a PE site visit. However, if the State and local agency is amenable to perform a PE on a day other than a routine sampling day, the visit can be scheduled.

The scheduling approach should attempt to minimize travel costs and maximize the number of sites visited. Some suggestions for efficient scheduling include the following:

- ▶ prioritizing sites that are expected to be near or above the NAAQS
- ▶ carrying two or more portable FRMs, setting up one or two on day one, then moving to another site to set up another, then returning to the first site to retrieve the sample, etc.
- ▶ prioritizing sites that are sampled less than every day. Visits to sites on a daily sampling cycle can be more flexible because the PE sample can be taken on any day. Because delays and schedule changes tend to accumulate during a circuit of sites, it may be best to prioritize sites on less frequent sampling cycles.
- ▶ selecting the sites to be evaluated by geographic area so that travel between sites is minimized.
- ▶ building in “downtime” for weather, sickness, or other unplanned delays.

**NOTE:** See SOP PEPF-2.02 for procedures on communicating with reporting organization site operators prior to a site visit

### 7.4 Site Visit Travel Arrangements

The FS and/or the contractor administrative staff is responsible for making travel arrangements, which should be made early enough to provide a convenient location for the field sampler to access the site(s) he/she will visit. Step-by-step procedures for making travel arrangements are beyond the scope of this SOP. Here are some suggestions:

- ▶ a car or van is the preferable method for transporting sensitive equipment because of the potential for rough handling by airlines or commercial carriers
- ▶ make arrangements well in advance to ensure the availability of hotel rooms, and rental vehicles
- ▶ for trips involving multiple sites, leave some flexibility in the schedule in case of bad weather and other unexpected delays.
- ▶ plan adequate time at each site to perform the FRM PE, remembering that PEP filters are to be exposed from midnight to midnight

## 7.5 Site Visit Equipment Preparation

Prior to an evaluation excursion and based upon the number of sites to be visited, the following will occur:

- ▶ sampling equipment and consumables will be inspected to ensure proper operation and adequate supplies.
- ▶ at least one spare portable sampler and calibration equipment should be on hand.
- ▶ filters will be selected and stored appropriately (per SOPs) for transport to the sites.
- ▶ filter chain-of custody sheets should be started and the filters should be checked to ensure they have not gone past their 30 day pre-sampling time period.
- ▶ Site Data Sheets will be available for each site. For initial visits some of the information on the Site Data Sheets may be blank and must be completed during the first visit.
- ▶ the FS will review the site schedule to be sure that they understand which tasks will be implemented at the sites they are visiting that week.

Upon completion of preparation activities, the Regional WAM should be contacted or a meeting scheduled to review the preparation activities.

### Ice Substitutes-

As many ice substitutes as needed for the excursion should be packed (frozen) in the electric cooler in order to maintain their frozen state. The cooler can also be taken into the hotel during the evening. However, if more ice packs than can fit in the electric cooler are required, the FS must provide a means of keeping the ice substitutes frozen. The reporting organization or the motel may be able to keep ice substitutes frozen and should be contacted ahead of time in order to ensure arrangements can be made.

## 7.6 Other Advance Planning

The FS should find out in advance the address and hours of operation for Federal Express shipping facilities.

### Critical Filter Holding Time Requirements

One aspect of the implementation process that is time critical is the filter holding time dates. As illustrated in Figure 2.1 and stipulated in the CFR, filters must be used within 30 days of presampling weighing or they must be reconditioned and preweighed. Figure 2.1 indicates that filters must be collected within 96 hours of the end of the sample period. In most instances, the FS will collect the filters within 8 to 48 hours of the end of

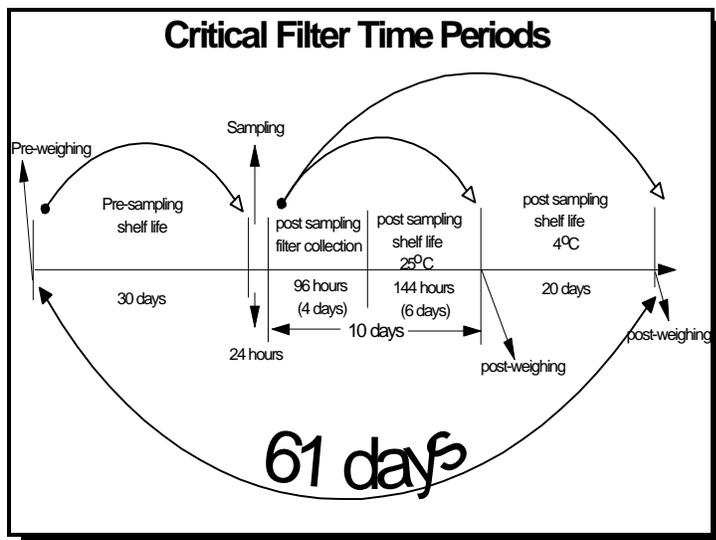


Figure 2.1. Critical filter holding times.

the sample period. Samples will be sent the day of removal to the appropriate laboratory via next-day delivery. Data will be immediately downloaded from the portable sampler and stored in two mediums (hard drive and two diskettes). One diskette of the data will be shipped with the sample. Data may also be transmitted, via modem, to the appropriate laboratory. Table 2-1 provides a summary of the key activities discussed above.

**Table 2-1. Implementation Summary**

<b>Implementation Phase</b>	<b>Activity</b>	<b>Acceptable Time frame</b>
Laboratory	Presampling weighing	30 days
	Postsample weighing	10 days
	Data input/review/validation	10 working days
	AIRS upload	5 working days
Field	Filter use	30 days of presample weighing
	Filter collection	8-48 hours from sample end date/time
	Filter/data shipment	within 8 hours of sample removal

## 8.0 References

1. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring PM<sub>2.5</sub> in Ambient Air Using Designated Reference or Class I Equivalent Methods. Draft.
2. U.S. Environmental Protection Agency. August 1998. Implementation Plan: PM<sub>2.5</sub> Federal Reference Method Performance Evaluation Program. Office of Air Quality Planning and Standards.
3. U.S. Environmental Protection Agency.. August 1998 Quality Assurance Guidance Document. Method Compendium: PM<sub>2.5</sub> Mass Weighing Laboratory Standard Operating Procedures for the Performance Evaluation Program..Office of Air Quality Planning and Standards
4. US Environmental Protection Agency.1997. Part 58 promulgated as 50 FR62138 amendments to title 58



# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 3**

### **Cassette Receipt, Storage, and Handling**

## Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

### Operation: Cassette Receipt, Storage and Handling

#### SOP: PEPF-3.01

Name: Printed	Signature	Date

#### *Contents* (applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	2
7. Procedure	3
8. References	5

## 1.0 Scope and Applicability

This SOP applies to the receipt of PEP filters, sent by the National Laboratories (Region 4 or 10) to the FS at the field office, the storage of the cassettes in the field office and in the field, and the proper handling of these filters throughout field activities.

## 2.0 Summary of Method

Two weeks, worth of routine, field blank, and collocated sampler filters will be sent by the laboratories to the field office along with a COC Forms for each filter. The FS will receive the filters and initiate the proper portions of the COC Form. The FS will store the filters in a filter shipping container, along with the COC Forms, until they are ready for use. Filters must be handled in a manner to prevent them from being damaged or contaminated and to prevent the particulate loading that has been collected on the exposed filters from being dislodged.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ handle each filter in its cassette carefully to avoid damage to the filter or contamination. Never remove a filter from its cassette
- ▶ do not touch the filter material
- ▶ handle the filter caps by their exterior; do not touch the interior of the filter caps or leave them exposed to potential contaminants
- ▶ prior to cassette insertion, clean your hands thoroughly with an alcohol wipe or distilled water.

## 6.0 Equipment and Supplies

- ▶ Field notebook
- ▶ COC Form(s)
- ▶ Cassettes containing 46.2 mm diameter teflon filters, filter caps on, in antistatic plastic cassette bags

## 7.0 Procedure

### 7.1 Filter Cassette Receipt

This procedure describes the method for receiving filters sent by the national laboratory to the field office. The national laboratory will notify the FS of a filter shipment the day of shipping. Filters may be shipped in postsampling shipping containers, or Federal Express envelopes.

1. Log receipt of filter cassette shipment in the field notebook (e.g., "Filter cassette shipment received from Region 4, 1/1/99").
2. Upon receipt, inspect the shipping container for damage and record any noted damage in the field notebook.
3. Open the shipping container and check that the COC Form "Part 1 Weighing Laboratory" is completed. Notify the lab of any apparent discrepancies.
4. Match each COC Form with the filter cassette number that is printed on the antistatic self sealing plastic cassette bag. If there is a one-to-one match between cassettes and forms, proceed to step 6.
5. If they do not match or if there are extra COC Forms or filter cassettes, identify the discrepancy in the field notebook and notify the national laboratory of the discrepancy. Do not use any filter cassettes which do not have an accurate COC record.
6. Under the COC Form titled "Part II Field Office", fill in "Date Received", "PE Organization", "Shipment Integrity" and "Field Scientist".
7. Contact the national laboratory to confirm receipt of shipment and, if necessary, rectify any problems.
8. See Section 7.2 for filter cassette storage.
9. Place the COC Forms with the other COC Forms for unused samples and arrange them in order of the date in which they must be used. This date is found on each COC Form Part I **"This Filter Must Be Used By"**

### 7.2 Filter Cassette Storage

#### 7.2.1 Storage Prior to Transportation to the Field

1. Store all unused samples in one clean postsampling shipping container and place the container in a secure area to avoid tampering by unauthorized individuals. Filters will remain in the cassettes, with filter caps on, in the antistatic filter cassette bags and be double bagged into 9 x 12" self-sealing shipping bags.

2. Check COC dates and remove any samples from the container mentioned in Step 1 that have not/or will not be used by the date listed in the “**This filter Must Be Used By**” section of the COC Form. Place a void in the “void” box on the COC Form and describe the reason for doing so in the comments section (e.g., “not used by filter expiration date”).
3. Send the filter cassette and the COC Form back to the national laboratory.

### **7.2.2 Storage of Unused Filter Cassettes During Field Transport**

1. Store all samples being transported to the field in one clean postsampling shipping container and place the container in a secure area to avoid tampering by unauthorized individuals and to shield it from extreme hot or cold conditions. Filters will remain in the cassettes, with filter caps on, in the antistatic filter cassette bags and be double bagged into 9 x 12" self-sealing shipping bags.

### **7.2.3 Storage of Postsampled Filter Cassettes During Field Transport**

1. Follow SOP PEPF-8.03, which describes the packing of postsampled filter cassettes for field transport to the Federal Express shipping office.

### **7.2.4 Storage of Postsampled Filter Cassettes at the Field Office**

The following procedure will be used if samples cannot be shipped to the national laboratory the day they are collected and must remain for some period at the field office:

1. Unpack the frozen ice substitutes from the postsampling shipping container and place them in the freezer
2. Remove the 9 x 12" plastic shipping bag containing the COC Form, Field Data Sheets, and the data diskettes from the postsampling shipping container and secure them in a safe place.
3. Place the shipping container in the refrigerator with the top off in order to cool the sampled filter cassettes to 4°C. The filters will remain in the cassettes with filter caps on, in the antistatic filter cassette bags and be double bagged into 9 x 12" self sealing shipping bags
4. When the cassettes are ready to be shipped, follow SOP PEPF-8.03

## **7.3 Filter Cassette Handling**

**NOTE:** This procedure does not include pertinent COC procedures, inspections, or data entry procedures that take place during various stages of sample handling.

1. Filter cassettes will remain with filter caps on, in the antistatic filter cassette bags and be double bagged into 9 x 12" self sealing shipping bags until they are ready to be put into the portable sampler.

2. Upon preparing to insert the cassette, clean your hands with an alcohol wipe or distilled water.
3. Remove the cassette by removing one from the 9 x 12" shipping bag.
4. Remove the cassette from the antistatic self-sealing plastic cassette bag. **Save this bag!** Place this bag in the interior of the portable instrument main unit.
5. Carefully remove the filter caps and place them on top of antistatic self-sealing plastic cassette bag, interior side down.
6. Hold the cassette in a manner that will avoid touching any part of the filter and install it per SOP PEPF-8.01.
7. Place filter caps together (exterior side out) in the same antistatic self-sealing plastic cassette bag from which they came, seal the bag, and store the bag in the portable sampler main unit until sample collection.

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual,
2. BGI Inc. August 1998. PQ200 Air Sampler Instruction Manual, "Appendix H - PQ200A Audit Sampler."
3. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring PM<sub>2.5</sub> in Ambient Air Using Designated Reference or Class I Equivalent Methods.

# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 4**

### **Transporting the Sampler and Installation at the Site**

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Sampler Transport and Placement

### SOP: PEPF-4.01

Name: Printed	Signature	Date

### *Contents* (applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	3
7. Procedure	7
8. References	8

## 1.0 Scope and Applicability

This SOP applies to the transportation of the BGI PQ200A portable FRM sampler to field sites for the FRM PEP.

**NOTE:** The following information is applicable to the BGI Model PQ200A portable FRM sampler. Specific information herein may not be applicable to other makes and models of samplers.

## 2.0 Summary of Method

Prior to a sampling excursion, a number of portable samplers will be checked at the field office to ensure that all parts are available and packed into their carrying cases for transport to the field. At the field site, the equipment will be transported to the location where it will be assembled and placed to meet siting criteria.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ It is important that movement/jostling of the main unit of the portable sampler be minimized during transportation. Secure this unit in the transportation vehicle.
- ▶ Follow the manufacturer's instructions carefully to avoid damage to the sampler and to ensure that it operates properly.
- ▶ The portable sampler may be hoisted to a rooftop or an elevated platform. As part of the planning process, determine what particular equipment is required to transport the portable sampler to the sampling platform. This information should be included in the Site Data Sheet.
- ▶ The equipment must be packed and shipped so as to avoid damage to fragile components. It is particularly important to remove the AC power supply and the battery from the main unit and pack them correctly in the Travel Case. These components could loosen and cause damage to circuit boards and other delicate components if they are improperly packed

## 6.0 Equipment and Supplies

- ▶ Main unit and three travel cases containing the BGI PQ200A portable FRM sampler. These are as follows:

The Main Unit and important attachments are illustrated in Figure 4.1. It is shipped without an outside container. However, this unit may be packed in a soft case. The accessories shown in the figure are all contained in the travel cases.

Travel Case No. 1 is designed for transporting the legs, as shown in Figure 4.2. Because of the simple arrangement of the case there is ample room for other small equipment.

Travel Case No. 2, shown in Figure 4.3, is designed to carry the following:

- the inlet with attached water trap
- a 2-inch downtube
- six filter cassette transport cases
- three WINS impactor wells with transport cases
- one bottle of oil for the WINS impactor (Dow 704 diffusion oil)

Travel Case No. 3, shown in Figure 4.4, is designed to carry the following:

- the Gill screen (ambient temperature sensor housing)
- the power supply/battery charger
- the battery and battery holder
- the weather shroud

- ▶ Assorted hand tools: screwdrivers, pliers, wrench
- ▶ Spirit level (an ordinary bubble level is sufficiently accurate)
- ▶ Measuring tape, metric
- ▶ Hoisting equipment (ladders, rope) for transporting equipment to the sampling platform

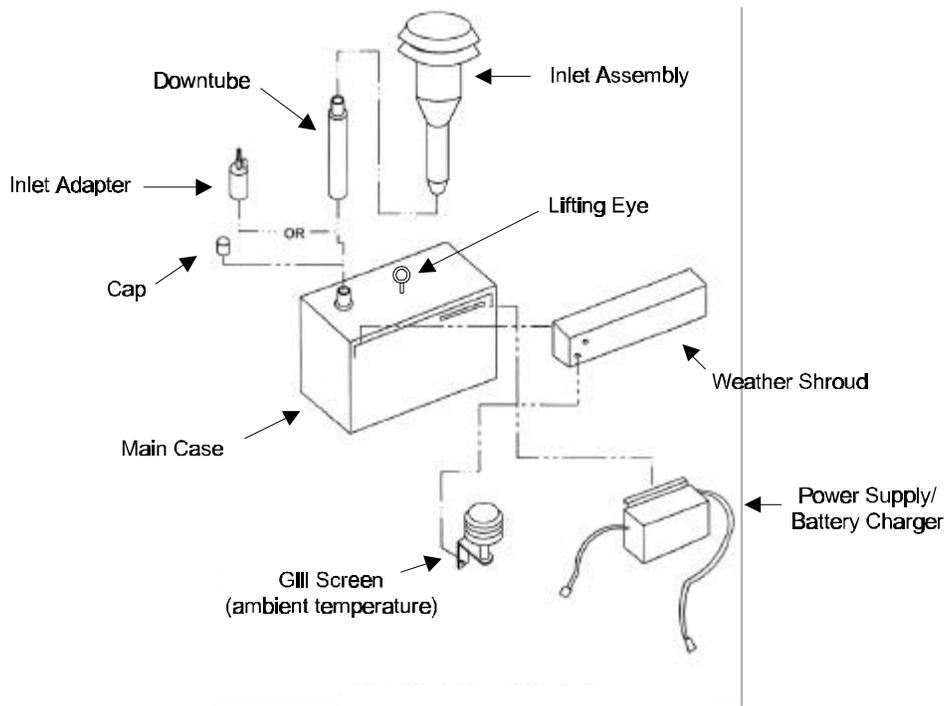


Figure 4.1. Back of main unit.

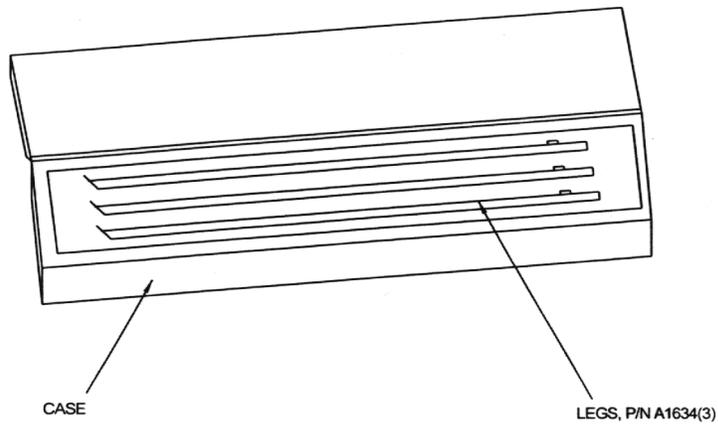


Figure 4.2. Travel case No. 1 with legs.

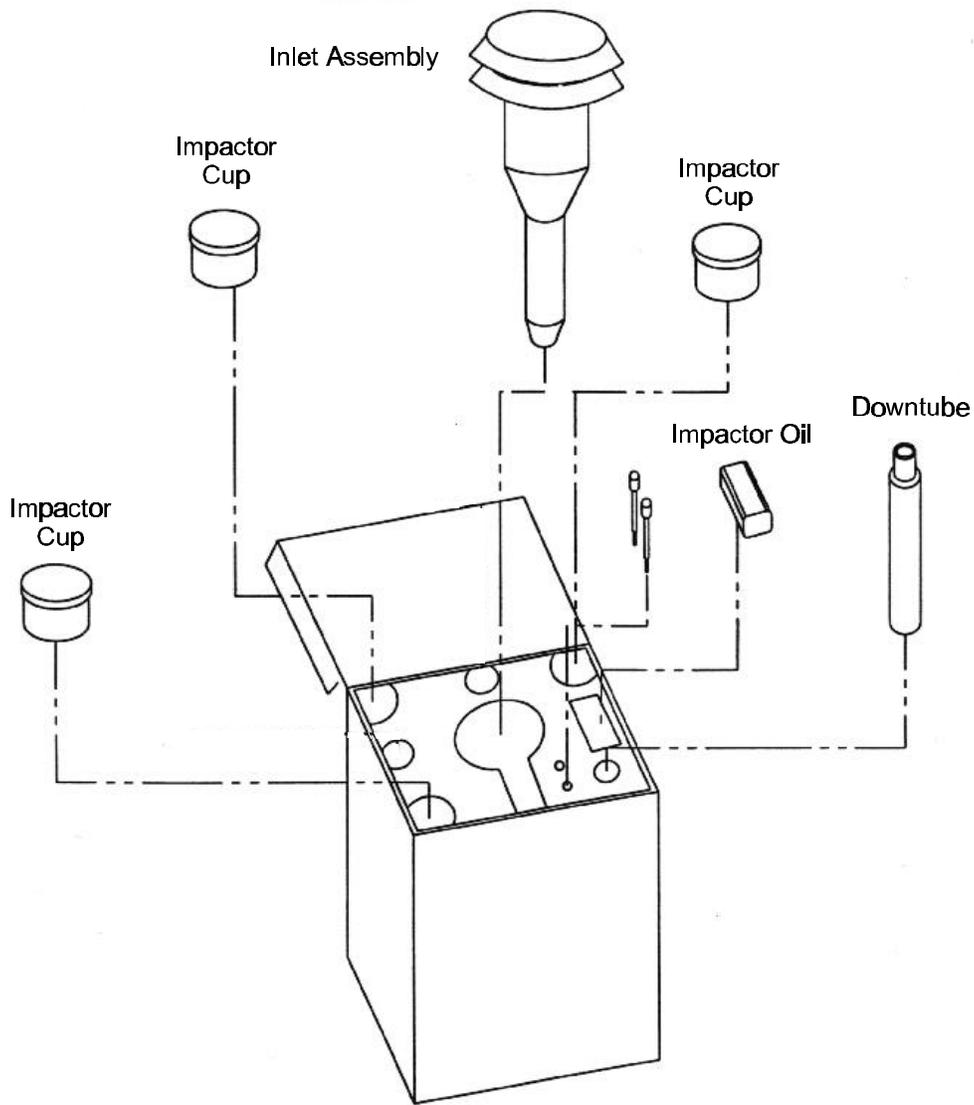
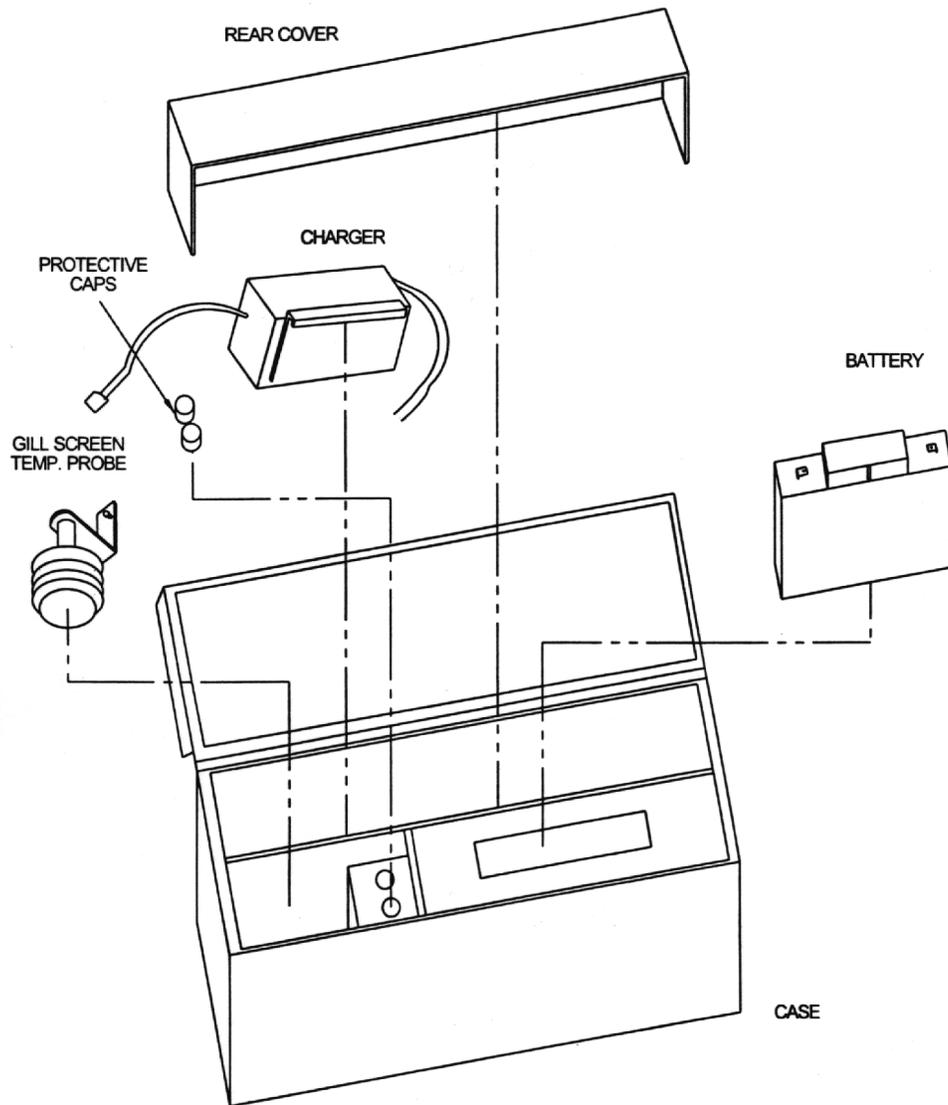


Figure 4.3. Travel case No. 2 for inlet and accessories.



1955

Figure 4.4. Travel case No. 3 for Gill screen and accessories.

## 7.0 Procedures

### 7.1 Transportation of Equipment to the Site

The portable FRM samplers will normally be transported along with the transfer standards and other tools and equipment. The main unit and the three travel cases are used to transport the portable samplers safely and securely and to minimize the effects of rough handling. Observe the following guidelines in transporting equipment for the PEP. The PEP encourages the use of ground transportation to sites, due to the nature of the sampling equipment, the possibility of rough handling during air transportation, and the cost of shipping.

1. Before leaving, take an inventory of the field equipment with the number of sites in mind to:
  - determine how many portable samplers will be required for the time out in field. Take one additional portable sampler as a spare. Inventory each travel case to ensure all parts are there and acceptable for use.
  - ensure that there are filter cassettes for routine, field blanks, and collocated samples
  - ensure there are enough field transport containers, ice substitutes, max/min thermometers, and preprinted Federal Express labels.
2. Place the equipment into the vehicle in a manner that minimizes movement of the main unit and the filter cassettes.

### 7.2 Transportation of Equipment to the Sampling Platform and Placement

Upon arriving at the sampling site:

1. Visit the actual location on the sampling platform where the portable sampler will be set-up. The reporting organization representative should indicate this location or it should be marked.
2. Verify that placing the portable sampler at the location indicated meets the siting requirements. See Addendum 1 of this SOP for a list of the required placement criteria.
3. If the site does not appear to conform to the siting requirements, inform the reporting organization representative and see if the siting requirement can be rectified.
4. If the reporting organization representative decides that the original location is suitable and the FS deems the site location questionable, set up the site in the location indicated and note the siting concerns in the field notebook.
5. Once the location is set, determine how best to transport the equipment to the site.
6. Transport the equipment in its traveling cases to the sampling platform.
7. Transport all verification equipment to the sampling platform to give this equipment an opportunity to equilibrate to ambient conditions (~ 1 hour).

---

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual.
2. BGI Inc. August 1998. PQ200 Air Sampler Instruction Manual, "Appendix H - Audit Version - PQ200A.
3. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring PM<sub>2.5</sub> in Ambient Air Using Designated Reference or Class I Equivalent Methods.

### **Addendum 1 Performance Evaluation Sampler Placement Criteria**

This Addendum summarizes the criteria that must be met to place the PE sampler at a site. The location for installing the PE sampler shall have been preselected and prepared before the FS arrives. The FS must note whenever the preselected location for the PE sampler appears to violate the criteria given below. The FS shall confirm the measurements with a tape measure if there is any doubt.

1. Site selection criteria for the portable FRM sampler must meet all the general requirements for PM<sub>2.5</sub> sampling, including the following:

The PM<sub>2.5</sub> sampler must have unobstructed air flow for a minimum of 1 m in all directions.

The sampler inlet will be placed at a height of 2 to 15 m above ground level (2-7 meters if the routine sampler is designated as a micro-scale sampler).

If a PM<sub>2.5</sub> sampler is collocated with any other particulate matter sampler, the spacing between sampler inlets must be greater than 1 meter for other PM<sub>2.5</sub> samplers and greater than 2 meters for total suspended particulate (TSP) and PM-10 type samplers. All samplers must be within 4 meters.

The sampler inlet must be level.

Vertical distance between the two inlets must be less than or equal to 1 m.

# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 5**

- 5.01 Sampler Assembly/Disassembly,**
- 5.02 Sampler Maintenance and Cleaning**

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

**Operation: Assembly/Disassembly**

**SOP: PEPF-5.01**

Name: Printed	Signature	Date

### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	3
7. Procedure	3
8. References	10

## 1.0 Scope and Applicability

This SOP describes the routine procedures for assembling and disassembling the sampler. This SOP contains material specific for the BGI PQ200A Air Sampler, and may not be applicable to other sampler makes and models..

## 2.0 Summary of Method

The FRM PM<sub>2.5</sub> samplers will be installed and dismantled many times in the course of PE trips. Assembly involves placing the component parts together properly to avoid leaks and other problems. During disassembly after an exposure, it is equally important to follow proper procedures to avoid damage and minimize wear and tear.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ Always be careful when attaching the AC power connection. Do not attempt to connect the main power if any power connectors or wires appear cracked, frayed, or wet. Do not immerse power cords in water or other liquids.
- ▶ Avoid unnecessarily opening the control panel or touching internal electrical components while the AC power is applied. Be very careful when it is necessary to make adjustments while the power is on, such as when adjustments are made on the circuit boards during some calibration procedures.
- ▶ When attaching the legs to the sampler's main body, do not allow the unit to become unbalanced and fall. If necessary, ask another person for assistance in attaching the legs.
- ▶ Be careful to **ensure that the studs do not come in contact with the printed circuit board because physical damage may occur!** Secure the battery by threading the two wing nuts onto the studs. Connect the color-coded wires to the color-coded terminals on the battery (red on red, black on black).
- ▶ The FS must properly install 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.
- ▶ Check the numerous O-rings periodically. Clean and lubricate their surfaces as required for ease of assembly and to maintain leak-free seals. Replace O-rings that are split, brittle, or cracked. Use only O-rings specified for this equipment.
- ▶ When the sampler is dismantled, be sure to remove any debris adhering to the base or legs before storing them for transport. To minimize contamination, always pack the base or leg portion of the

sampler apart from the sampler collection module. A small particle of dust or pollen, if inadvertently transferred to the sample collection filter enclosure, will alter the sample weight dramatically.

- ▶ Care must be taken during handling not to crack or break the water collector jar attached to the side of the inlet. To minimize the chance of accidental breakage, the glass water collector jar may be replaced with a plastic jar or it may be wrapped with insulating tape to lessen the shock of rough handling.
- ▶ The operating area for the FS may include more than one time zone. The FS needs to be aware of time zone changes and set up monitors based on local time.

## 6.0 Equipment and Supplies

- ▶ BGI PQ200A Air Sampler and instruction manual
- ▶ 25 ft extension cord
- ▶ Bubble leveling device
- ▶ Shims for leveling instrument
- ▶ Assorted tools including screwdrivers, pliers, etc.
- ▶ Flashlight (inspection of various sampler assemblies)
- ▶ Pen or pencil for marking the sampler for reassembly
- ▶ Soft brush,
- ▶ Lint-free wipes
- ▶ Alcohol wipes
- ▶ Distilled water
- ▶ Spare O-rings and vacuum grease
- ▶ Diffusion oil
- ▶ Dropper for diffusion oil

## 7.0 Procedure

This procedure applies to placement and installation at the field site; however, it is recommended that each PQ200A sampler be assembled initially in the field office or in another indoor environment so that it can be thoroughly checked before it is used in the field.

### 7.1 Assembling the Legs and Anchoring the Sampler (one-man assembly)

1. Lay the portable sampler equipment as close to the actual sampling location as possible.
2. Lay the sampler main unit on Side 1 or 3 (See Figure 5.1).
3. Attach two legs to the unit at the two accessible points of attachment on the underside of the sampler. The legs are identical and interchangeable. Make sure the connectors are seated properly and that the legs are securely attached (making a “click” sound)
4. Place the third leg in a convenient place to be able to access it.

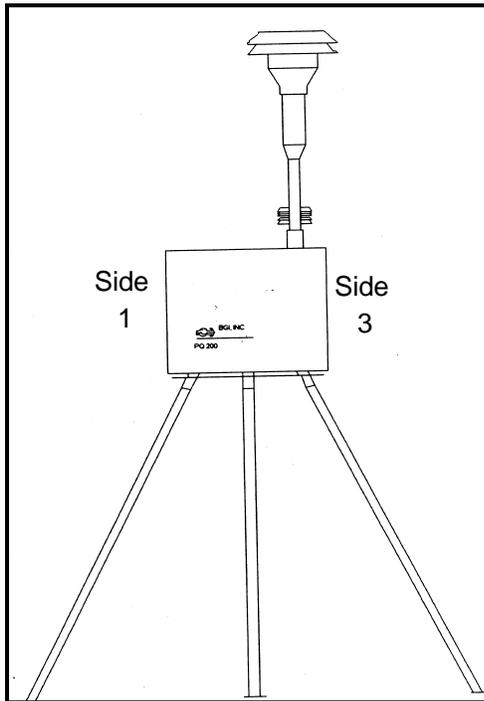


Figure 5.1. BGI PQ200A sampler, legs installed.

5. Securely hold the main unit and slowly “walk” the unit and the two legs to an upright position.
6. Take the third leg and attach it properly.
7. Place the portable sampler in its designated location. The legs of the PQ200A form a stable tripod, so bolting or clamping is normally not required. However, if there is any question about the sampler's stability at a particular location, the FS must affix the sampler to the platform or flooring so that the following installation criteria are met:
  - ▶ The sampler must not tip over due to high winds, vibration, or other event that might be expected to occur during the 24-hour exposure period.
  - ▶ The sampler must not be subject to excessive vibration, whether due to external sources (e.g., a nearby train track), or internal sources (e.g., pump motor vibrations).
  - ▶ The sampler must remain level throughout the filter exposure

## 7.2 Assembling the Sampler Main Unit

1. Remove the weather shroud (rear cover) from Travel Case No. 3 (Figure 5.4) and install it on the back of the sampler's main unit as shown in Figure 5.2.
2. Attach the AC power supply to the rear of the unit under the weather shroud. Do not apply the power yet.
3. Run the female three-pin connector (from the AC power supply unit) beneath the sampler to the hole in the sampler case (near the front on the right side).
4. Open the front door on the PQ200A sampler and feed the female three pin power connector through the hole underneath the sampler case and attach it securely to the upper of the two ports inside the main unit.
5. While the front door is open, remove the two thumb nuts holding the instrument panel. Swing the panel forward on its hinge. Remove the wing nuts from the battery securing studs before inserting the battery. Lift the battery and holder from the travel case and install it at the rear of the instrument panel compartment. **CAUTION: Be careful to ensure that the battery or the studs do not come in contact with the printed circuit board because physical damage may occur!** Secure the battery by threading the two wing nuts onto the studs. Connect the color coded wires to the color coded terminals on the battery (red on red; black on black). Be sure all wires and cables are out of the way, close the panel, and reattach the two thumb nuts.

6. Attach the Gill screen (Figure 5.2) containing the ambient temperature sensor to the rear of the main unit; the attachment points are on the weather shroud (back cover) itself. Position the Gill screen assembly so that it sits above the top of the sampler case. Screw the connectors firmly into the attachment points.
7. Run the ambient temperature sensor cable with the three-pin connector underneath the sampler case and through the hole (just as with the power connector) and attach it to the lower of the two ports inside the main unit.

### **7.3 Attaching the Inlet Assembly**

1. Remove the size selective inlet assembly and the downtube from travel case #2 (see Figure 5.3).
2. Inspect the inlet assembly for obvious missing pieces or damage (See Figure 5.5).
3. Examine the two O-rings on the interior of the bottom end of the downtube that mates with the open tube on the top of the sampler case (Figures 5.2 and 5.3) . Ensure that the O-rings are present and in good condition and that the interior of the downtube is clean and clear of any debris.
4. Ensure that the filter assembly inside the main assembly is in the closed position (Figure 5.7).
5. Install the downtube on the sampler by placing it on the inlet tube.
6. Examine the two O-rings on the interior of the bottom side of the size-selective inlet (part #153, Figure 5.5) that mates with the downtube. Verify that both O-rings are present and in good condition. Install the inlet on the top of the downtube.
7. If it is not already attached, locate the water collection hardware (parts # 154-158, Figure 5.5) and attach it to the side of the inlet. Be sure the connecting pipe is not cross-threaded and that the jar is attached firmly.

### **7.4 Leveling the Sampler**

1. Adjust the PE sampler so that the top surface of the size-selective inlet is horizontal as indicated by the bubble level. Final leveling of the unit is done only after the major installation tasks described above have been completed. (Repeat the leveling process if any subsequent activities cause the sampler to shift.)
2. Inspect the sampler to be sure that the inlet is not out of alignment due to an improperly mounted downtube. The downtube should be perpendicular to the top of the sampler's main case. Make any necessary adjustments to the downtube mountings.

3. The sampler's horizontal angle can be adjusted by placing thin shims of wood or other solid material under the legs. Be sure to observe safety precautions; it may require two people to safely place the shims. Verify that the sampler remains secure after shims are put in place.

### 7.5 Installing the WINS Impactor Assembly

The WINS impactor assembly is shipped already installed in the sampler. During transport to a field site, the WINS impactor will remain installed. **HOWEVER, it will not contain diffusion oil, which must be added on site.**

1. Open the main unit door and carefully rotate the handle counterclockwise using both hands to expose the transport cassette and WINS assembly (Figure 5.6). **(CAUTION: Once the assembly has started to open, the weight of the two plates will tend to force the whole assembly open even further.)**
2. The transport filter cassette and empty (no oil) WINS impactor should now be visible. If not, gently separate the filter cassette or WINS impactor from its respective upper housing.
3. Remove the transport cassette, put it in a well marked plastic bag, and set it inside the main unit.
4. Inspect the impactor assembly for obvious missing pieces or damage ( See Figure 5.8.).
5. Confirm the presence and condition of the O-rings inside the upper impactor housing where it contacts the impactor well.
6. Remove the impactor well assembly (upper and lower) and set it aside in a clean space inside the main unit.
7. Confirm the presence and condition of the O-rings inside the lower impactor housing where it contacts the impactor well. Ensure the interior of the housing is clean and clear of any debris. Set the lower impactor housing down inside main unit

**NOTE:** Procedures 8-10 are used if the sampler is being prepared to sample.

8. Select an impactor well assembly and gently pull the mating upper and lower portions apart. Confirm the presence of an O-ring on the upper part of the impactor well.
9. For normal sampling operations, install a 37-mm-diameter glass fiber filter in the lower portion of the well.
10. With a dropper, add 1 mL (42 to 44 drops) of Dow 704 diffusion oil in the well and ensure that the 37- mm-diameter glass fiber filter is saturated with oil and no air is trapped beneath it. An alternate procedure is to install a preprepared impactor well that has been carefully transported to the site.
11. Reinstall the impactor well in the WINS impactor housing.

12. Before closing the unit, install a transport cassette with a cassette holder (or a sample cassette, see PEPF-8.01 if sampling).
13. Close the assembly by slowly rotating the handle clockwise  $\frac{3}{4}$  of a turn (Figure 5.2) until the cam follower clicks into the indent in the cam. Watch the filter cassette and WINS impactor to ensure that they are seated properly and that the assemblies close securely. If necessary to avoid air leakage, the compression between the upper and lower housings of the WINS assembly can be adjusted using the knurled ring.

### 7.6 Assembling the Filter Holder

Prior to working with cassettes, clean your hands with alcohol wipes or clean water.

1. The portable sampler is shipped with a transport cassette in place. The portable sampler will always be transported with a transport cassette in place. **However, it is not to be transported with actual filter cassettes that will be used for sampling.**
2. Remove the transport cassette and inspect for damage.
3. Inspect the filter housing for obvious missing pieces or damage (see Figure 5.8).
4. Confirm the presence and condition of the O-rings inside the upper and lower filter housings where they contact the filter cassette. Ensure the interior of the housing is clean and free of debris.
5. Once a filter cassette (either an actual sample cassette or a transport cassette) is installed, complete Steps 11-13 of Section 7.5 (above).

### 7.7 Powering the Unit

Connect the power as follows, depending on whether or not AC power is available:

1. For AC operation, plug the AC power supply unit into a 110/120 volt grounded outlet.
2. When AC power is not available and the WAM has approved the use of battery power, the unit may be operated from the battery backup system. When fully charged, battery power is sufficient to operate the PQ200A for 24 hours in all but the most extreme conditions (high particle loads, cold weather conditions). **NOTE: When operating from battery power, the control screen dims and it may be necessary to press the red LIGHT button to view the screen.**
3. Press the **ON/OFF** button on the PQ200A. The screen will light up and display the following message:

**PQ200 Air Sampling System**  
**(c)Copyright 1997 BGI Incorporated**  
**All Rights Reserved**  
**Version: X.XX Serial Number: XXXX**

The X's will appear as numbers indicating the actual version number and serial number.

4. After a few seconds, the Main screen will appear. The Main screen always displays the ambient barometric pressure, ambient and filter temperatures, date, time, power source, and any flags that may have occurred. Any error or status messages will also appear on the screen. For example:

<b>READY FOR NEW RUN!</b>	<b>[DC IN] □□□□□</b>
	<b>1997</b>
	<b>04jul</b>
<b>746mmHg A28.0°C F27.5 °C</b>	<b>(MENU) 14:53</b>

5. Confirm that the date and time displayed are accurate. (Note that the PQ200A operates exclusively on military time).
6. Press the blank **(MENU)** button on the PQ200A control panel to enter the Main menu. If necessary, follow the steps below to set the proper date and time.

### 7.8 Setting Date and Time

**NOTE:** The operating area for the FS may include more than one time zone. The FS needs to be aware of time zone changes and set samplers up based on the local time.

After the sampler has been successfully installed and powered-up, the date and time should be checked and, if necessary, adjusted to local time. All PEP samplers should be synchronized within 1 minute of a known time standard. Use the following procedure to set or adjust the BGI PQ200A's date and time:

1. From the Main menu, use the arrow keys until \* **Set-Ups and Download** flashes. Press **SELECT** to enter the Set-ups and Download menu.
2. From the Set-Ups and Download menu, with \* **More Selections** flashing, press **SELECT**, then press the down arrow until \* **Set Date and Time** flashes. Press **SELECT**.
3. The **Set the current DATE and TIME** message will be displayed. The current date and time will be flashing.
4. Press **SELECT (NEXT)**. The first value (date) will stop flashing (it can now be edited).

5. Use the arrow (**EDIT**) buttons to increase or decrease the selected value. When done, press **SELECT (NEXT)**.
6. Continue to press the **SELECT (NEXT)** and arrow (**EDIT**) buttons in this fashion to enter the desired date and time. When done, press the blank (**EXIT**) button to return to the second Set-Ups and Download screen. Select \* **More Selections**, then \* **Return to Main Menu Screen** or press the blank (**EXIT**) button.

### 7.9 Completing the Installation

1. When the sampler has been successfully installed, recheck that it is secure and that the inlet has remained level. Make any necessary adjustments.
2. Collect installation tools and shipping materials and put them in a place where they will be safe and out of the way.
3. Proceed with the leak check and other operational verifications described in SOP PEPF-6.01 through 6.04.

### 7.10 Sampler Disassembly

**NOTE:** This procedure occurs after samples have been collected (filter samples and data collection) and prepared for shipping (see SOP PEPF-8.03).

If the FRM sampler is being disassembled for transport to a new site, follow these steps:

1. Power the unit down and disconnect the electricity.
2. Remove the impactor well (7.5 above).
3. Clean the impactor well (see SOP PEPF-5.02).
4. Place the transport cassette into the filter compartment and install a clean impactor well (no oil or filter). The BGI PQ200A air sampler should always be shipped or stored with a filter/cassette in place.
5. Close the assembly by slowly rotating the handle clockwise 3/4 of a turn until the cam follower clicks into the indent on the cam. Watch the filter cassette and WINS impactor to ensure that they are seated properly and that the assembly closes securely.
6. Disassemble the sampler in the reverse order of set-up ( Sections 7.6, 7.5, 7.3, 7.2, and 7.1).
7. Police the sampling site to ensure no equipment and supplies are left at the site.

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual.
2. BGI Inc. August 1998. PQ200 Air Sampler Instruction Manual. "Appendix H - PQ200A Audit Sampler,"
3. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring  $PM_{2.5}$  in Ambient Air Using Designated Reference or Class I Equivalent Methods.

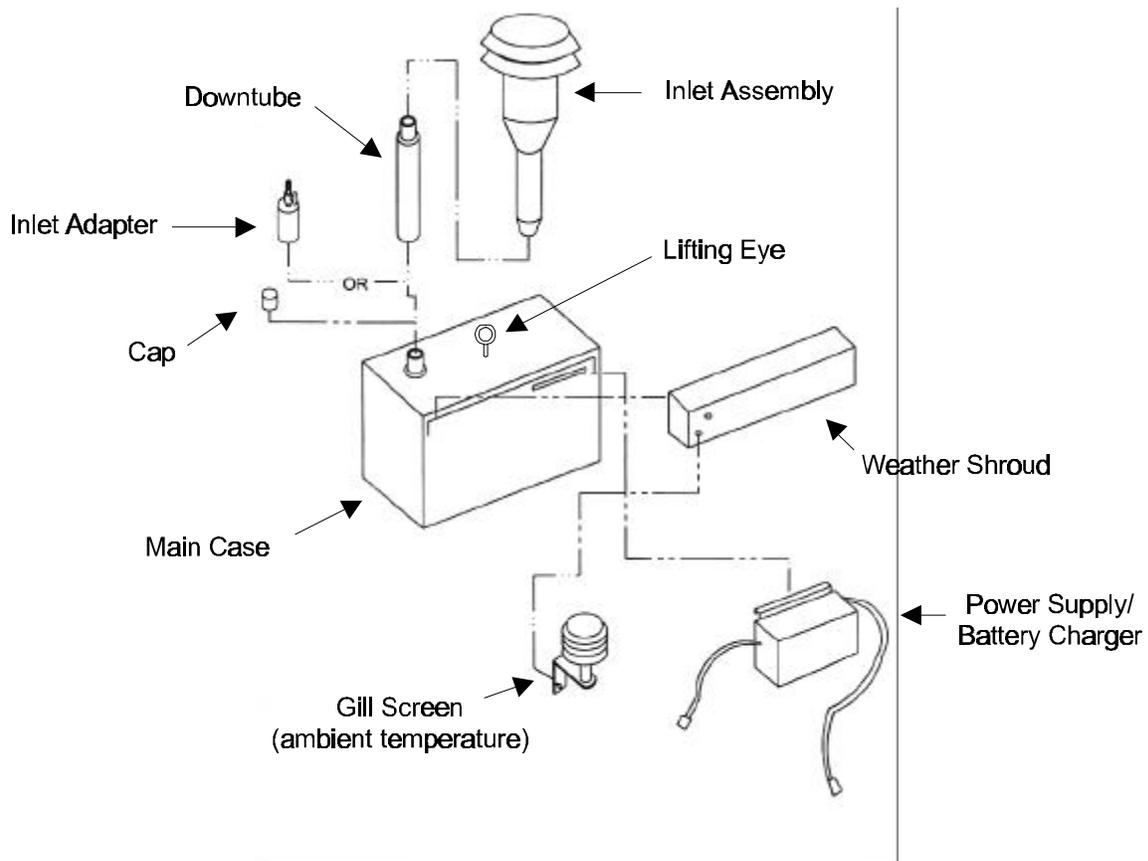


Figure 5.2. Back of main unit.

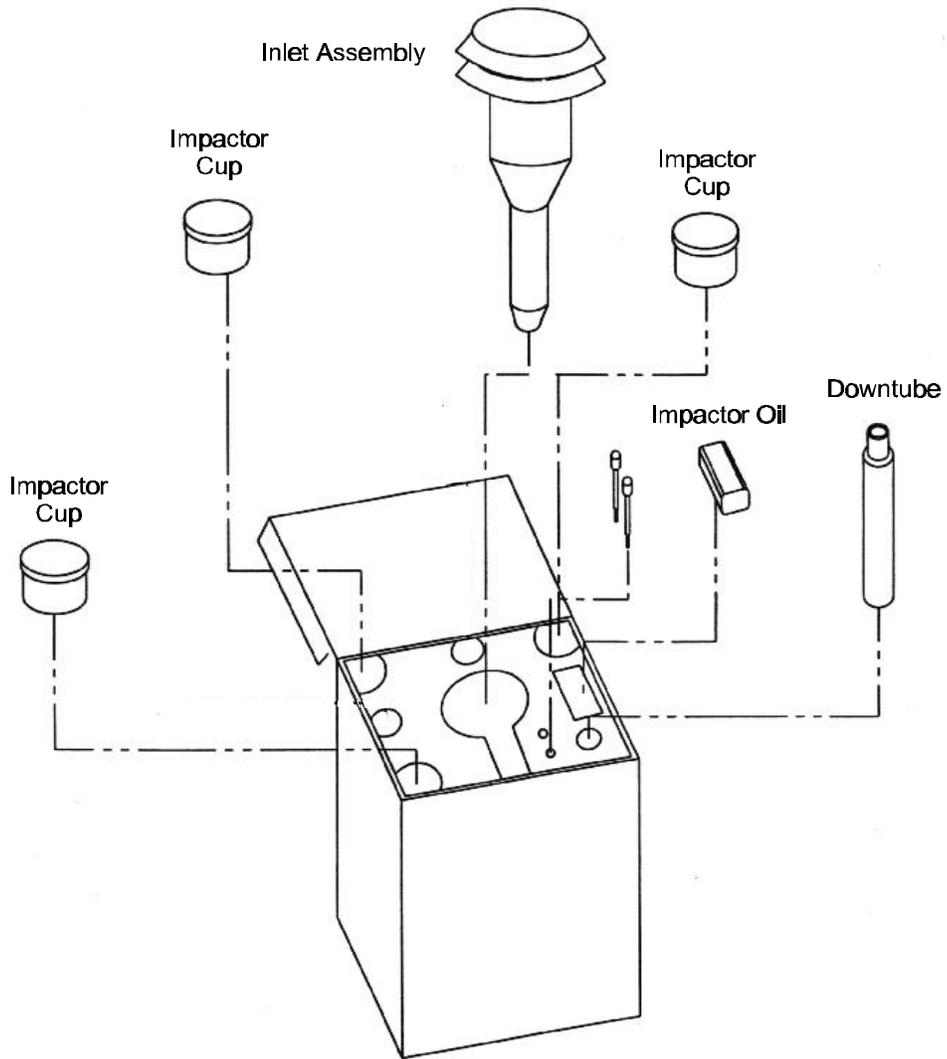
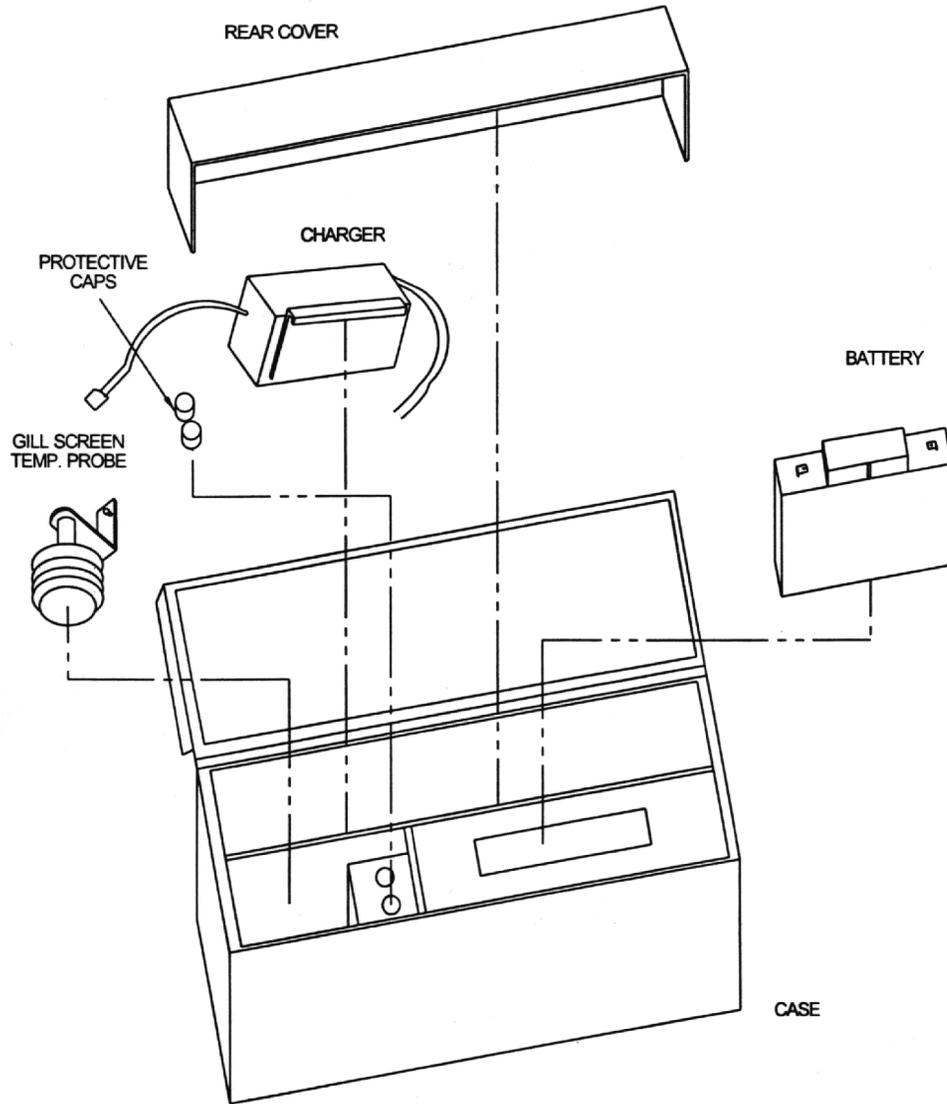
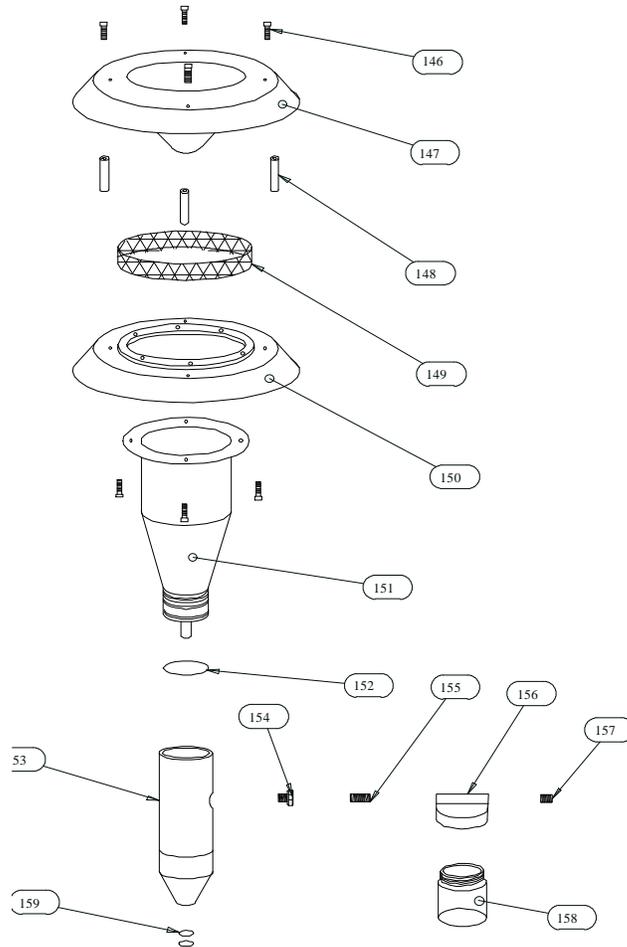


Figure 5.3. Travel case No. 2 for inlet and accessories.



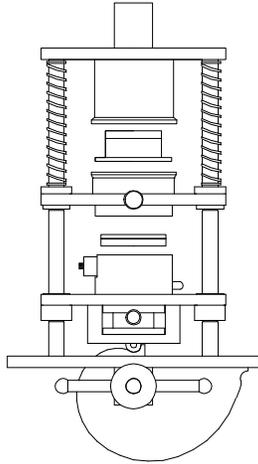
1955

Figure 5.4. Travel case No. 3 for Gill screen and accessories.

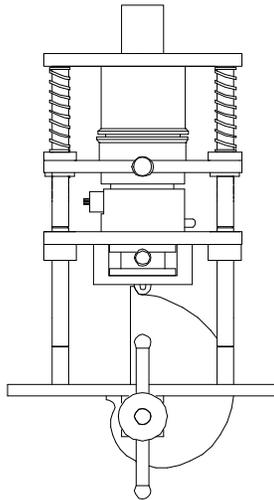


**Figure 5.5. Exploded view of inlet unit.**

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 5.6. BGI PQ200A sampler with filter chamber open.**



**Figure 5.7. BGI PQ200A Sampler with Filter Chamber closed.**

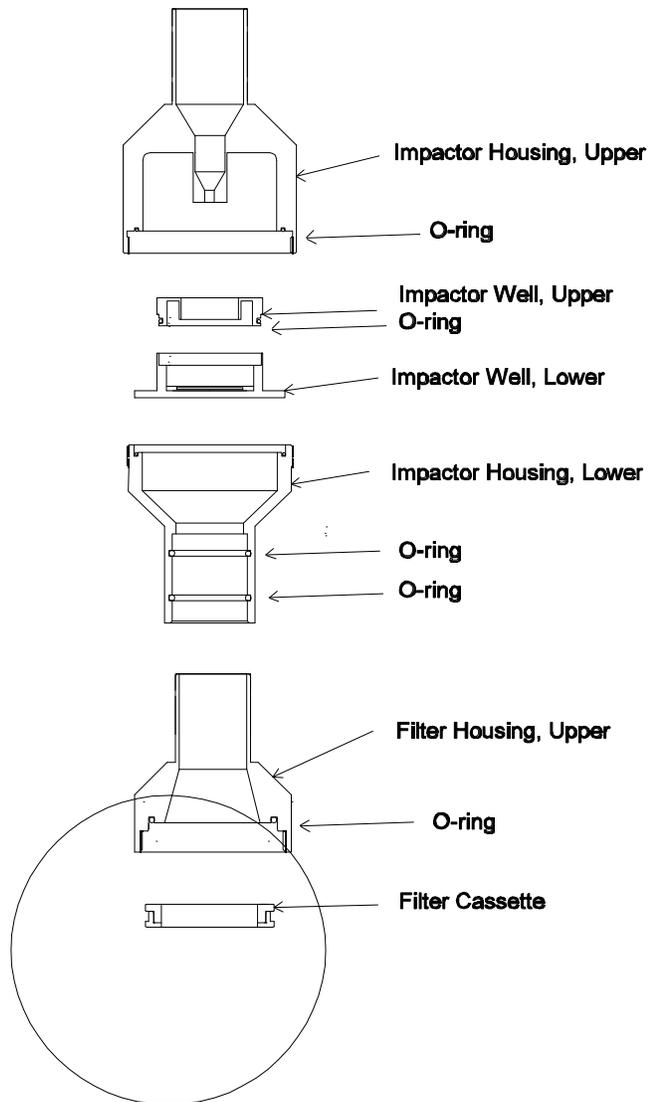


Figure 5.8. Exploded view of PM<sub>2.5</sub> impactor well (WINS) and filter holder assemblies.

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Sampler Maintenance and Cleaning

### SOP: PEPF-5.02

Name: Printed	Signature	Date

#### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	2
7. Procedure	3

## 1.0 Scope and Applicability

This SOP describes the routine procedures for maintaining and cleaning the sampler.

**NOTE:** This SOP contains material that is specific for the BGI PQ200A Air Sampler, and may not be applicable to other makes and models of sampler.

## 2.0 Summary of Method

The FRM PM<sub>2.5</sub> samplers will be regularly checked and cleaned to avoid contamination, which could affect the quality of resultant data, and to ensure reliable operation.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP

## 5.0 Cautions

## 6.0 Equipment and Supplies

- ▶ Low lint wipes
- ▶ Isopropyl alcohol
- ▶ Wooden dowel (downtube cleaning)
- ▶ lint free pipe cleaner
- ▶ Marking pencil
- ▶ Soft brush (interior cleaning)
- ▶ Plastic bristle baby bottle cleaner
- ▶ Distilled water (general use found at pharmacies/grocery store)
- ▶ Field Data Sheet
- ▶ Selections of O-rings
- ▶ Silicone vacuum grease
- ▶ safety pins or dental pick

**Table 5-1. Summary of PM<sub>s</sub> Sampler Maintenance Activities**

Frequency	Maintenance item
Every visit	<ol style="list-style-type: none"> <li>1. Inspect and empty water collector bottle.</li> <li>2. Clean or change-out impactor well.</li> <li>3. Inspect O-rings of impactor assembly.</li> </ol>
Every 10 sampling events or as needed.	<ol style="list-style-type: none"> <li>1. Clean sampler inlet surfaces.</li> <li>2. Clean impactor housing and impactor jet surfaces. Examine O-rings.</li> <li>3. Clean interior of sampler case.</li> <li>4. Check condition of sample transport containers.</li> <li>5. Clean impactor downtube.</li> <li>6. Inspect and service cooling air intake filter and fans.</li> </ol>
Quarterly (every 3 months)	<ol style="list-style-type: none"> <li>1. Inspect O-rings of inlet. Apply light coat of vacuum grease if required.</li> <li>2. Clean sampler downtube.</li> <li>3. Inspect and service O-ring and water seal gasket where downtube enters sampler case.</li> <li>4. Inspect and service O-rings of impactor assembly.</li> <li>5. Inspect and service vacuum tubing, tube fittings, and other connections to pump and electrical components.</li> </ol>

## 7.0 Procedure

Several of the sampler components will need to be maintained and cleaned periodically. Table 5-1 indicates the maintenance schedule of the important sampler components.

### 7.1 Impactor Well Cleaning.

To clean the impactor well, perform the following tasks:

1. Separate the upper and lower portions of the well.
2. Remove the used filter from the well.
3. Wipe the two halves of the well clean with lint-free wipes.
4. Reassemble the well and place it in the impactor holder.
5. Do not replace the filter and oil unless preparing to sample.

## 7.2 Size-Selective Sampler Inlet, Downtube, and Sampler Interior.

This part of the procedure is usually accomplished in the field office.

To dismantle and clean the sampler inlet and clean other components follow these steps:

1. Mark each assembly point of the sampler inlet with a pen or pencil to provide “match marks” during reassembly.
2. Disassemble the sampler’s size-selective inlet unit according to the manufacturer's instructions, taking care to retain all the parts. An exploded view of the inlet is shown in Figure 5.1. **NOTE:** If the assembly screws appear frozen, the application of penetrating oil or commercial lubricant will make removal easier. Be sure to wipe off any excess oil completely before proceeding.
3. Using a soft brush and lint-free wipes, lightly scrub all interior surfaces of the inlet and bug screen with distilled water. **CAUTION: Some edges may be sharp!** Pay particular attention to small openings and crevices. Lint-free wipes and/or a small soft brush are most helpful in these areas. Using wipes moistened with distilled water, remove any remaining deposits. Completely dry all components.
4. Reassemble the unit in reverse order by aligning the parts according to the previously scribed match marks. Take particular care to ensure that all O-ring seals are properly seated, sealed, and lubricated 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 impactor assembly open, inspect the interior of the impactor housing, both above and below the impactor well. These areas 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 them, check all the O-rings for distortion, cracks, fraying, lack of a light coating of vacuum grease, or other problems. Replace or recondition as necessary.
8. Close the impactor and filter holder assembly to keep out dust.
9. Wipe down 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 cooling air intake filter and clean or replace it if necessary.

---

### 7.3 Service and Replacement of O-rings and Tubing

There are 12 or more O-rings in the flow path of the BGI PQ200A sampler. O-rings are also part of the flow rate adapter and the Chinook Streamline™ Flow Transfer Standard. Plastic tubes connect sampler 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.

It is expected that some of the O-rings and tubing will need to be serviced and replaced as use and exposure to the elements degrade them. To detect problems and make repairs, follow these guidelines.

- ▶ Frequently inspect O-rings that hold the sampler inlet and the downtube in place. These O-rings are subject to wear each time the portable sampler is assembled and disassembled.
- ▶ To allow the inlet and downtube and the downtube and upper impactor housing to fit together easily, put a light coat of silicone vacuum grease on their O-rings and wipe off any excess with a laboratory tissue. Resist the temptation to apply too much grease. It is the O-ring that makes the seal, not the grease! Excessive grease may dissolve in the O-ring and cause it to wear out sooner.
- ▶ Inspect the O-rings in the assemblies that hold the WINS impactor and the filter/cassette. These O-rings must be free of dust or debris that could score or indent and create leakage channels. A flashlight and magnifying lens may be needed to get a good look to detect brittleness, cracks, or indentations. These O-rings are not subject to sliding friction and generally do not need to be coated with silicone grease.
- ▶ Suspect O-rings as the cause of leak check failures, but first determine that sealing pressure is adequate and look for loose tubing or connecting fittings.
- ▶ Remove O-rings carefully. Do not use tools that could score or nick the metal surfaces and channels where the O-rings are seated. Use of a plastic or wooden stick to dislodge a faulty O-ring is preferable to a knife blade! A small metal pin or a dental pick may be used to dig into the O-ring and pull it away from the channel so it 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. 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, mounting screws or bolts, etc. for signs of loosening due to use and vibration. Tighten or replace as needed. Unusual noises or excessive vibration may indicate something is loosening.

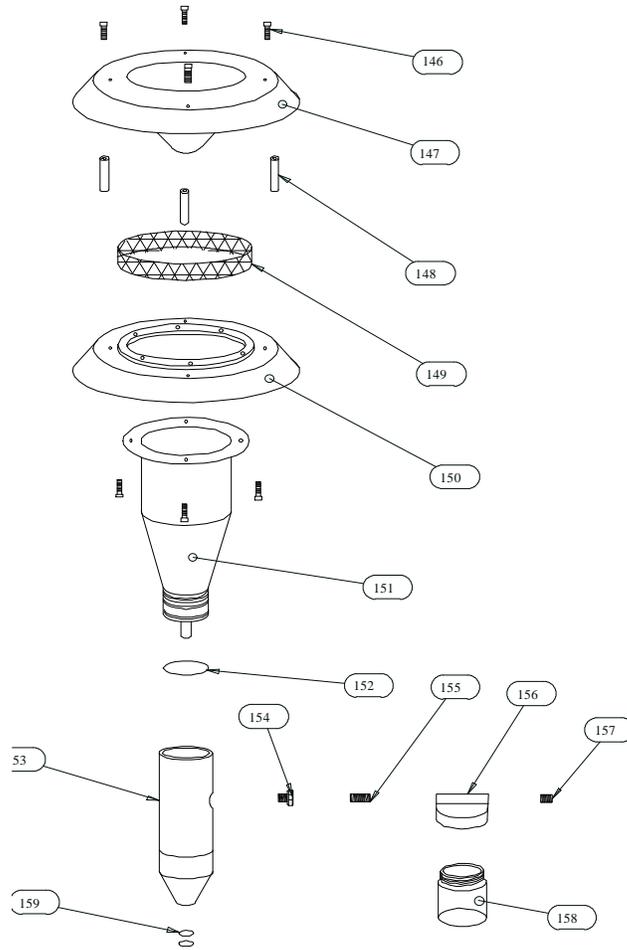


Figure 5.1. Exploded view inlet unit.

<u>Part Number</u>	<u>Description</u>	<u>Part Number</u>	<u>Description</u>
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

# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 6 Verifications**

- 6.01 Leak Check Procedures**
- 6.02 Barometric Pressure Verification**
- 6.03 Temperature Verification**
- 6.04 Flow Rate Verification**

## Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

### Operation: Leak Check Procedures for the BGI PQ200A Sampler

#### SOP: PEPF-6.01

Name: Printed	Signature	Date

#### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	2
7. Procedure	3
8. References	5

## 1.0 Scope and Applicability

This SOP applies to performing the mandatory external leak check procedure for the FRM PEP. Each portable FRM sampler will be checked for leaks before the flow rate verification. The leak check procedure verifies the integrity of the WINS and air handling tubes and fittings up to and including the FRM's flow rate measurement sensor. Each manufacturer's equipment is somewhat different, so consult the operations manual for specific instructions applicable to a particular FRM sampler. **NOTE:** This SOP applies only to the BGI PQ200A air sampler.

## 2.0 Summary of Method

The leak check procedure is used to verify that the air handling system in the sampler is adequately free from leakage that could cause either the flow rate to be measured incorrectly or filtration artifacts. The BGI PQ200A sampler automatically determines leakage by pulling a vacuum on the internal air volume of the totally assembled sampler, sealing the volume by closing valves, and monitoring the internal pressure change for a period of 10 minutes. If the internal pressure increases too rapidly, a leak is indicated, and troubleshooting procedures must be followed to stop the leak. The leak check must be successful before flow rate verification can be performed. An internal leak check procedure to assess leakage within the filter assembly is also described as a troubleshooting procedure.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ At the conclusion of the leak check, **it is very important to open the flow rate adapter valve slowly to avoid creation of rapidly moving air currents that could spread impactor oil and other contaminants throughout the system.**
- ▶ Ensure that the filter cassette is properly seated and the cam is properly closed to ensure a good seal.
- ▶ Do not connect any other device to the flow rate adapter when conducting this procedure.

## 6.0 Equipment and Supplies

- ▶ BGI PQ200A air sampler
- ▶ Clean filter in transport cassette, designated as a leak check or flow check filter. This filter is not to be used for sampling. This filter may be used repeatedly for leak checks and flow rate

verifications, and multipoint flow rate calibrations. When this filter becomes soiled, it should be discarded. However, the cassette is retained.

- ▶ Flow rate adapter with valve to close flow ( See Figure 6.1)
- ▶ Impermeable disk for internal leak check (stainless steel or plastic film)
- ▶ Field Data Sheet

## 7.0 Procedure

### 7.1 Conducting an External Leak Check

1. Insert a leak check filter/transport cassette into the filter holder. Label or mark the leak check filter/transport to ensure it will not be mistaken as a sample filter. Also be certain a WINS impactor well is present. Close the assembly by rotating the cam clockwise until an audible “click” is heard.
2. Remove the size-selective inlet from the downtube and place the flow rate adapter on the top of the downtube. Close the valve on the adapter to prevent air flow.
3. From the Main menu of the BGI PQ200A, use the arrow keys until \* **Test and Calibration Menu** flashes. Press **SELECT** to enter the Test menu.
4. From the Test menu, press the down arrow until \* **Leak Test** flashes. Press **SELECT**. The **PQ200 LEAK TEST: In Progress!** screen will be displayed. 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 WINS and filter assembly securely in place) and press **SELECT** to begin evacuating the system.
5. The PQ200A will automatically evaluate the performance of the system and report whether the system passed or failed the leak test. The pump will come on and begin to pull a vacuum on the system. When a vacuum in excess of 75 cm water is attained, the pump will cut off and a timer will begin to count for 10 minutes. The initial (locked) pressure is displayed on the left side of the screen. This pressure reading will be a number in excess of 75 cm of water column. Enter the initial pressure in the place provided on the Field Data Sheet (Appendix C).
6. In order to pass the test, the actively displayed differential system pressure (shown on the right side of the screen as “SP”) must not drop by more than 10 cm of water column during the 10-minute timing interval. At the end of a 10-minute period, the BGI PQ200A panel display will indicate whether the sampler passed or failed the leak test. Record the final pressure on the Field Data Sheet. Indicate whether the leak check was successful by circling "Yes" or "No."
7. If the leak test was passed, **slowly release the vacuum on the system by slowly opening the valve on the flow rate adapter**. Remove the flow rate adapter and put the inlet back on the downtube. Remove the filter. Discard the filter or retain it for future leak tests or flow rate verifications or calibrations. Proceed with the verification checks.

8. If the leak test was failed, investigate and correct any malfunctions as described in the following section. **Slowly release the vacuum on the system by slowly opening the valve on the flow rate adapter.**

NOTE: The leak test must be successful before performing the flow rate verification and before the sampler is used to acquire a PE sample.

### 7.1.1 Troubleshooting When the Leak Check Fails

The following troubleshooting procedures should be followed when a sampler does not pass the leak check after several tries:

1. **Slowly release the vacuum on the system by slowly opening the valve on the flow rate adapter.**
2. Make sure the flow rate adapter is securely seated on the downtube and that the valve is completely closed.
3. Make sure the WINS and filter cassette assembly is securely closed. If it is not, close it tightly. It may be necessary to make minor adjustments to the cam follower's position using the cam follower adjustment nut so the cam, when in the "closed" position, holds the WINS and filter assembly together more tightly.
4. Make sure the filter cassette was securely closed and placed in the filter housing during the leak test.
5. Visually inspect tubing for cracks or loose connections.
6. Visually examine the O-rings in the flow rate adapter, WINS, and filter holder for cracks, deformation, or improper seating.
7. If no reason for leakage is readily apparent, increase the compression between the upper and lower housings of the WINS assembly by slightly adjusting the length of the cam follower by turning the knurled ring. The knurled ring is located just above the cam follower.
8. If the problem was discovered and rectified, perform a second external leak check. If the problem was not discovered, proceed to an internal leak check.

It may be helpful to carry out the internal leak check procedure (described below) to isolate the location of the leak(s) to a point before or after the filter cassette.

## 7.2 Conducting an Internal Leak Check

Conduct the internal leak check as follows:

1. **Slowly release the vacuum on the system by slowly opening the valve on the flow rate adapter.** Keep this valve open.
2. Insert an impermeable disk for internal leak check (stainless steel or plastic film) the same size, shape, and rim thickness of the normally used Teflon™ filter. This disk effectively seals and isolates the air space from beneath the solid disk to the solenoid valve before the pump assembly.
3. Perform the internal leak check. For the BGI PQ200A, the check sequence is the same as described above for the external leak check except that the flow rate device valve is open to the atmosphere.
4. If no leakage is present, the internal leak check is passed and the external leak, if there was one, must be located somewhere above the filter. If leakage is present, confine the search for the leak to the area below the filter disk.
5. If the problem was discovered and rectified, perform the **external** leak check again (7.1).

If the problem cannot be located and the sampler continues to fail the leak checks, the sampler requires further troubleshooting and maintenance and must not be used for the PE.

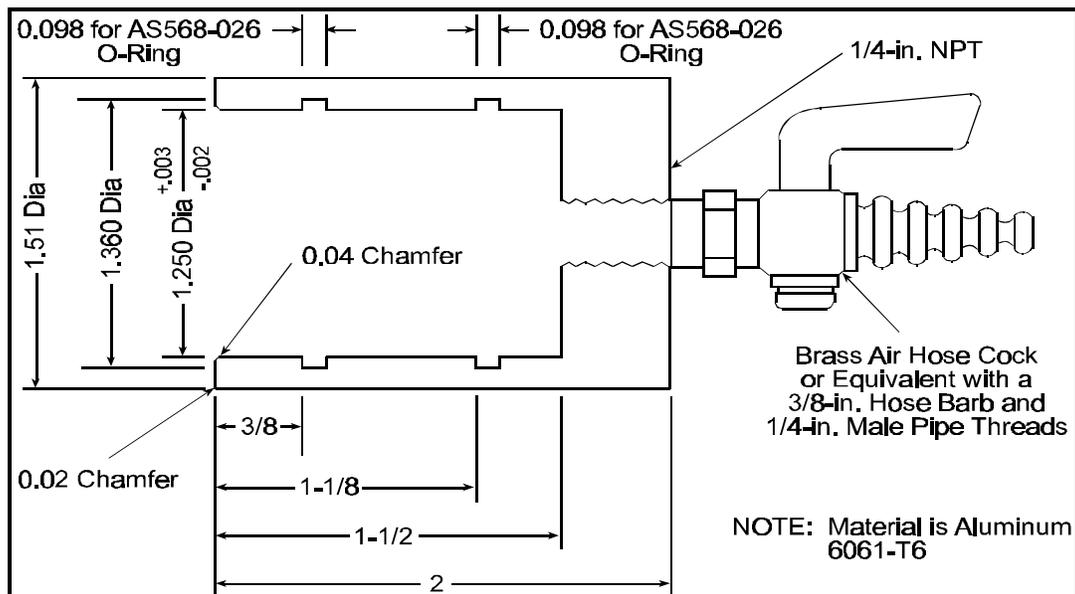


Figure 6.1. Flow rate adapter.

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual,
2. BGI Inc. August 1998. PQ200 Air Sampler Instruction Manual, "Appendix H - PQ200A Audit Sampler,"
3. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring PM<sub>2.5</sub> in Ambient Air Using Designated Reference or Class I Equivalent Methods.

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Barometric Pressure Verification Check

### SOP: PEPF-6.02

Name (printed)	Signature	Date

### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	3
7. Procedure	3
8. References	4

## 1.0 Scope and Applicability

**NOTE:** The following information applies only to the BGI Model PQ200A portable FRM sampler and specified calibration devices. Specific information herein may not be applicable to other makes or models of equipment.

This SOP applies to verifying the barometric pressure measurement system of the BGI PQ200A Portable PM<sub>2.5</sub> Sampler. Operations covered in this SOP include routine functional check procedures for the pressure measurement system.

## 2.0 Summary of Method

The BGI PM<sub>2.5</sub> sampler has a built-in atmospheric pressure sensor whose output is processed to allow control of the sampling flow rate to the design value of 16.7 L/min under actual ambient conditions of temperature and pressure.

To perform a routine verification, the barometric pressure sensor reading is verified at ambient pressure by comparison to the reading from an external standard of known accuracy. If a pressure difference of more than 10 mmHg is observed, a multipoint verification/calibration of the pressure-sensing and display system is required before the FRM sampler may be used to perform an evaluation.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ 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 standard) and either adjusting it or establishing an offset correction. Minimize the vertical and horizontal temperature gradients across the barometer and avoid direct sunlight, drafts, and vibrations.
- ▶ Barometers should be allowed some time to adjust to temperature and pressure differences. During transport and assembly of the instrument, also transport the barometer to the sampling platform so that it may equilibrate for an hour before use.

---

## 6.0 Equipment and Supplies

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

- ▶ Field Data Sheet
- ▶ Portable, NIST-traceable barometer for field barometric pressure verifications, Druck digital absolute pressure indicator, Model No. DPI 705

## 7.0 Procedure

### 7.1 Field Verification of Barometric Pressure System

The FRM sampler's barometric pressure sensing system is verified by comparing the sampler reading to that of the portable barometer at ambient conditions, as described in the following steps:

1. Unpack, install, and power the sampler at the site as described in SOPs PEPF-4.01 and PEPF-5.01.
2. Unpack the portable barometer transfer standard and place it near the sampler. Turn on the power and set the readout units and operating mode as follows:
  - a) Set the portable barometer to read in units of "mmHg" (also known as "Torr").
  - b) Set the portable barometer to operate in the "absolute" pressure mode, not "gauge" or "differential" pressure mode. [**NOTE:** On the "absolute" scale, the ambient atmospheric pressure should usually be between 600 and 760 mmHg, depending on altitude. If the barometer's reading is zero, or close to zero, it is likely that it is set to "gauge" or "differential" mode.]
3. Record the pressure readings from the sampler (Samp. Pressure) and the portable barometer (Std. Pressure) on the Field Data Sheet (App C).
4. If the two readings are within 10 mmHg of each other, the verification of the portable FRM monitor's pressure sensor is satisfactory. Carefully pack up the portable barometer transfer standard and continue with the remaining verification procedures.
5. If the deviation is greater than 10 mmHg, the sampler's pressure measurement system may be damaged and it should be serviced and a multipoint verification/calibration procedure performed (see PEPF-7.01). A spare portable sampler must be installed at the site

**NOTE:** There is also a possibility that the check standard, rather than the sampler's pressure system, is faulty. If possible, check the routine PM<sub>2.5</sub> sampler's barometric pressure and if this reading is within 10 mmHg of the portable samplers, record this on the Field Data Sheet and use the portable instrument that has been installed at the site. Inform the WAM of the problem to see if a spare portable barometric pressure check device can be sent to the field or be on hand for the next sampling visit. Take the faulty check device in for repairs as soon as possible.

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual,
2. BGI Incorporated. August 1998. PQ200 Air Sampler Instruction Manual, "Appendix H - PQ200A Audit Sampler," .
3. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring  $PM_{2.5}$  in Ambient Air Using Designated Reference or Class I Equivalent Methods.
4. SPK Druck User's Manual for the digital absolute pressure indicator, Model DPI 705.

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Temperature Verification

### SOP: PEPF-6.03

Name: Printed	Signature	Date

### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	2
7. Procedure	3
8..References	4

## 1.0 Scope and Applicability

This SOP applies to verifying the temperature measurement system for the FRM PE sampler. Operations covered in this SOP include verification checks for the two temperature sensors in the BGI PQ200A unit.

## 2.0 Summary of Method

Temperature sensors are verified at a single point using an external temperature standard of known, NIST-traceable accuracy. If an excessive difference is observed, a multipoint verification/calibration of the temperature sensor may have to be conducted (see PEPF-7.02).

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ Be sure that the temperature reference standard used to verify the instrument's sensors has been calibrated against a NIST-certified standard within the prescribed time period (annually).
- ▶ Due to continuous assembly and disassembly of the portable samplers, the ambient temperature probe's connecting pins may be damaged. Care must be taken at installation when connecting the pins to the main unit.
- ▶ Care must be observed when placing the thermometer's probe through the Gill screen to avoid any damage to the screen or probe.

## 6.0 Equipment and Supplies

- ▶ VWR digital thermometer, # 61220-601, NIST traceable, with probe
- ▶ Field Data Sheet
- ▶ Timepiece

## 7.0 Procedure

The response of two temperature sensors (ambient temperature and filter temperature) must be verified each time the BGI PQ200A portable sampler is set up at a new location.

### 7.1 Single-Point Field Verification in Ambient Air

To perform a single-point field verification of temperature for the BGI PQ200A. Conduct this temperature verification test after the sampler is assembled and in place on the site. Proceed as follows:

1. It is best if the sampler has been on the site for at least 1 hour to allow adequate time for the ambient and filter temperature sensors to reach temperature equilibrium with their surroundings.
2. Place the digital verification thermometer in the same general location as the portable sampler. Verify that the digital thermometer is influenced by the same environmental conditions as the portable sampler.
3. Turn on the sampler and display the Main screen. The current temperature and pressure should be displayed. It is not necessary for the sampler pump to be running.
4. Carefully insert the digital thermometer's sensor probe an inch or two into the space between the louvers of the Gill screen that encloses the ambient temperature sensor so that the probe tip is in close proximity to the ambient sensor.
5. Wait until the digital thermometer's reading is stable and compare it to the ambient temperature reading displayed on the Main screen. If the temperatures agree within  $\pm 2^{\circ}\text{C}$ , the ambient temperature sensor response is acceptable. If not, go to Step 10.
6. Remove the sensor probe from the Gill screen. Record information on the Field Data Sheet (App C)
7. Open the door of the main unit, open the filter holder assembly, and remove the cassette to a clean location.
8. Place the digital thermometer's sensor probe tip within  $\sim 1$  cm of the filter temperature sensor in the bottom portion of the filter assembly.
9. Allow the thermometer's reading to stabilize and compare the reading to that displayed on the Main screen for the filter temperature. If the temperatures agree within  $\pm 2^{\circ}\text{C}$ , the filter temperature sensor response is acceptable. Proceed to Step 11. If not go to step 10.
10. If the two readings are outside acceptance criteria, wait longer (10 to 15 minutes) for temperature equilibration to occur, and repeat the procedure. If the readings still do not agree, and the FS does not feel it can be rectified, and the problem is not with the digital verification thermometer, replace the portable sampler with a spare sampler and repeat the procedure.

**NOTE:** If the reporting organization operator is at the site, he/she may be able to check the routine monitor's temperature sensors. If they are in agreement with the portable samplers, this may indicate a problem with the digital verification thermometer. If there is agreement, the portable sampler can remain set up. However, indicate the verification problem on the data form and proceed with troubleshooting the verification thermometer.

11. Remove the thermometer probe from the sampler. Return the filter assembly to its normal configuration.
12. Record information on the verification form.

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual,
2. BGI Inc. August 1998. PQ200 Air Sampler Instruction Manual,, "Appendix H - PQ200A Audit Sampler"
3. Instruction leaflet. Traceable® Digital Thermometer. VWR, Inc.
4. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring PM<sub>2.5</sub> in Ambient Air Using Designated Reference or Class I Equivalent Methods. Draft.

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Flow Rate Verification

### SOP: PEPF-6.04

Name: Printed	Signature	Date

### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	3
6. Equipment and Supplies	3
7. Procedure	3
8. References	5

## 1.0 Scope and Applicability

**NOTE:** The following information is applicable to the BGI Model PQ200A portable FRM sampler, the Chinook Streamline™ FTM flow rate transfer standard. Specific information herein may not be applicable to other makes and models of equipment.

Each reference or Class I equivalent PM<sub>2.5</sub> sampler includes a specially designed sample air inlet, a size-fractionating impactor, and a sample flow rate control system. The particle size discrimination characteristics of both the inlet and the impactor are critically dependent on specific internal air velocities; a change in velocity will result in a change in the nominal particle size collected. These velocities are determined by the actual volumetric flow rate of the sampler.

In addition, the total volume of air sampled is determined from the measured volumetric flow rate and the sampling time. The mass concentration of PM<sub>2.5</sub> in the ambient air is computed as the total mass of collected particles in the PM<sub>2.5</sub> size range divided by the total volume of air sampled.

Therefore, in order to control the size-fractionating cutpoints and to measure the total volume correctly, the sampler's flow rate must be maintained at a constant value that is within  $\pm 4\%$  of the design flow rate of 16.67 Lpm. The flow rate of the portable FRM sampler must be verified at each site before the PE samples are taken.

This SOP should be used in conjunction with SOP PEPF-6.01 (Leak Checks), PEPF-6.02 (Barometric Pressure), and PEPF-6.03 (Temperature).

## 2.0 Summary of Method

A single-point verification of the sampler flow rate is performed prior to each use of the BGI sampler in a PE. If the verification check is outside the tolerance of  $\pm 4\%$ , and no reason can be found for the discrepancy, a multipoint verification/calibration of the sampler is performed (see PEPF-7.03). After the multipoint verification/calibration, the flow rate is verified again to confirm that the  $\pm 4\%$  tolerance has been achieved.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ Do not operate the sampler without the flow verification filter installed.
- ▶ Verification of the 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."
- ▶ The portable FRM sampler must pass the verification checks for temperature, pressure, and internal and external leaks before the flow verification is performed.
- ▶ Verify that the Chinook™ FTS is properly seated on the downtube. The O-rings on the Chinook™ FTS must face downward.
- ▶ Keep the glass orifice of the Chinook™ FTS clear of dust by gently scrubbing its surfaces with a lint-free swab, moistened with isopropyl alcohol. If the glass orifice is ever chipped or broken, the entire unit must be returned to the vendor for repair and verification/calibration.

## 6.0 Equipment and Supplies

- ▶ Chinook Engineering Streamline™ FTS and carrying case
- ▶ Dwyer Series 475-0 Mark III digital manometer
- ▶ Flexible, correctly sized, crimp-resistant interconnecting tubing for the above verification devices
- ▶ Isopropyl alcohol
- ▶ Lint-free swabs
- ▶ Hand calculator (scientific)
- ▶ Field data sheet
- ▶ Time piece

## 7.0 Procedure

The operating flow rate of 16.67 Lpm is verified before each PE. If the verification result is outside the required  $\pm 4\%$  tolerance, a multipoint verification/calibration at three different flow rates may be required. The one-point verification must be repeated after any three-point calibration as a double-check to ensure the sampler operates properly at the design flow rate of 16.67 Lpm.

### 7.1 Flow Rate Verification

Perform the sampler leak, temperature and barometric pressure verification procedures and take any corrective actions necessary to meet the acceptance criteria before performing this procedure.

1. Record the current ambient pressure (mmHg) and temperature ( $^{\circ}\text{C}$ ) indicated on the BGI PQ200A display screen on the Field Data Sheet.
2. Install a clean flow rate test filter/transport cassette in the filter holder. This filter should not be used for sampling or as a blank or QC sample. The flow rate test filter may be reused at other sites provided that it remains clean and is free from any defects such as tears, pinholes, or separation from the support ring.
3. Remove the size-selective inlet from the top of the downtube, leaving the downtube in place.

4. Turn on the manometer by pressing the I/O button. Press the **E/M** button until the display indicates **"IN WC"** (inches of water column)
5. Remove the protective caps from the manometer's air inlets. Adjust the needle valve on the top of the manometer until the water column reads **"0.00"**
6. Place the Chinook™ FTS orifice fitting (O-ring side down) on the downtube entrance. Ensure it fits smoothly and tightly and is fully pushed onto the downtube. Connect the outlet of the orifice device to the digital manometer with flexible rubber tubing on the negative "-" inlet.
7. From the Main menu of the sampler's control panel, use the arrow keys until \* **Test and Calibration Menu** flashes. Press **SELECT** to enter the Test menu.
8. From the Test menu, press the down arrow until \* **Verify Flow Calibration** flashes.
9. Press **SELECT**. The **Check Flow Now!** screen will be displayed and the sampler will then begin to pump air at the current selected flow rate. Watch the display screen as the flow rate increases and stabilizes. Allow at least 2 minutes for stabilization. The flow rate may fluctuate or oscillate. Once the reading is considered stable, observe the high and low values of the oscillation and record the mean value flow rate on the Field Data Sheet under "Sampler FR".
10. Use the Chinook™ FTS device to monitor the flow rate at the inlet. Read the inches of water displaced on the electronic manometer. The manometer reading may fluctuate. Once the reading is considered stable (1 to 2 minutes), observe the high and low values of the oscillations and record the mean value flow rate on the Field Data Sheet, and solve the following FTS equation to calculate  $Q_a$ , the actual flow rate. All flow rates must be expressed under actual or ambient conditions, **not** standard conditions. **NOTE:** the values of "m" and "b" are specific to each FTS.

$$Q_a = \left[ m \times \left( \sqrt{\frac{(\Delta P)(T_{amb})}{P_{amb}}} \right) + b \right]$$

Where:

- $Q_a$  = actual flow rate in liters/minute  
 $m$  = constant found on FTS certificate of calibration  
 $b$  = constant found on FTS certificate of calibration  
 $\Delta P$  = pressure reading from manometer inches H<sub>2</sub>O  
 $T_{amb}$  = ambient temperature in Kelvins<sup>1</sup>  
 $P_{amb}$  = ambient pressure in atmospheres<sup>2</sup>

<sup>1</sup> Kelvin = °C + 273.15

<sup>2</sup> 1 atmosphere = 760 mmHg

11. After the flow and pressure readings have been recorded, press the **ON/OFF** key to exit this function. Press the blank (**MENU**) button on the BGI to return to the Main menu.
12. Calculate the offset or error between the flow rate indicated by the sampler readout and the calculated flow rate from the Chinook™ FTS. The equation for relative percent difference (RPD) is as follows:

$$\text{RPD (\%)} = \frac{\text{Flow}_{\text{sampler}} - \text{Flow}_{\text{standard}}}{\text{Flow}_{\text{standard}}} \times 100$$

13. If the calculated flow rate is outside the  $\pm 4\%$  tolerance with the BGI, or the sample flow rate is outside  $\pm 5\%$  agreement with the design flow rate, the sampler must be verified/calibrated using the multipoint verification/calibration procedure. However, the operator should first check that the sampler and the flow rate measurement equipment are operating properly. Check for the following and repeat the verification procedure if problems are found:
  - a. Verify that all fittings and air hoses are tight and that there are no tubing kinks or obstructions.
  - b. Verify that the body of the FTS is properly seated on the downtube so that there is no leakage past the O-rings that seal it to the downtube.
  - c. Verify that the WINS impactor and filter holder assemblies are closed completely.
  - d. 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.
  - e. If any changes are made, including reseating O-rings, remeasure the indicated sampler flow and the flow rate standard pressure drop. If either has changed, recalculate the percent error. If the flow rate is still out of tolerance, proceed to verify/calibrate the sampler flow rate using SOP PEPF-7.03.

## 7.2 Completion of the Verification or Calibration

Following the verification, disconnect the flow rate standard from the sampler, remove the calibration adapter, and carefully reinstall the sampler's inlet. Remove the filter/cassette used during the verification and install a new filter/cassette if it is time to begin sampling.

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual.
2. BGI Inc. August 1998. PQ200 Air Sampler Instruction Manual, "Appendix H - PQ200A Audit Sampler,"

3. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring  $PM_{2.5}$  in Ambient Air Using Designated Reference or Class I Equivalent Methods. Draft.
4. 40 CFR Part 50, Appendix L, Section 9.2.
5. Chinook Engineering Chinook<sup>TM</sup> Flow Transfer Standard data sheet.

# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 7**

### **Multipoint Verification and Calibrations**

- 7.01 Pressure Multipoint Verification/Calibration**
- 7.02 Temperature Multipoint  
Verification/Calibration**
- 7.03 Flow Rate Multipoint Verification/Calibration**

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Barometric Pressure Multipoint Verification/Calibration

### SOP: PEPF-7.01

Name (printed)	Signature	Date

### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	3
7. Procedure	3
8. References	5

## 1.0 Scope and Applicability

**NOTE:** The following information applies only to the BGI Model PQ200A portable FRM sampler and specified calibration devices. Specific information herein may not be applicable to other makes or models of equipment.

This SOP applies to verifying/calibrating the barometric pressure measurement system of the BGI PQ200A Portable PM<sub>2.5</sub> Sampler. Recalibration of the PQ200A's pressure sensor should be required only in exceptional circumstances. Check first for a plugged pressure sensor tube, a malfunctioning pressure sensor, or defective circuitry before conducting a multipoint pressure calibration.

## 2.0 Summary of Method

Each reference or Class I equivalent PM<sub>2.5</sub> sampler has a built-in atmospheric pressure sensor whose output is processed to allow control of the sampling flow rate to the design value of 16.7 L/min under actual ambient conditions of temperature and pressure.

If a pressure difference of more than 10 mmHg between the sampler and the verification barometer is observed, a multipoint verification/calibration of the pressure-sensing and display system or equipment maintenance is required before the FRM sampler may be used to perform an evaluation.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ 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 either adjusting it to specifications or establishing an offset correction. Minimize the vertical and horizontal temperature gradients across any barometer and avoid direct sunlight, drafts, and vibrations.

---

## 6.0 Equipment and Supplies

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

- ▶ Barometric Pressure Multipoint Verification/Calibration Data Sheet (see Figure 7.1)
- ▶ a portable, NIST-traceable barometer having a  $\pm 1$  mmHg resolution and at least a  $\pm 5$  mmHg accuracy. For laboratory calibrations, EPA is supplying the Meriam Instrument digital manometer/calibrator kit; Model LP200I. For field or laboratory barometric pressure verifications, EPA is supplying the Druck digital absolute pressure indicator model # DPI 705.
- ▶ 3 sections of flexible hose approximately 1 foot in length, and of proper diameter to secure to connections and fittings
- ▶ Plastic "T" adapter for the hose
- ▶ 60 mL gas-tight plastic syringe
- ▶ Tubing clamps or a pair of hemostats
- ▶ Small flat-head screwdriver (for adjusting the sampler)

## 7.0 Procedure

This procedure must be done annually or after an unacceptable one-point verification check. Multipoint verification/calibration in the field should be required only rarely. Whenever possible, the multipoint verification/calibration and any necessary maintenance or repairs should be performed in a laboratory environment. If the FS has a backup FRM portable sampler at the site, the backup should be used and the faulty sampler should be recalibrated or repaired in the laboratory.

**CAUTION:** This procedure makes permanent calibration changes that can affect the FRM sampler's flow and volume measurements, which in turn affect the mass concentration results. Before proceeding, carefully check that the calibration equipment is operating properly and that the transfer standard has been calibrated within the past year.

1. Be sure that the two originally observed pressure readings made during the verification check have been recorded on the Barometric Pressure Verification/Calibration Data Sheet.
2. Examine the sampler for obvious physical damage that could be responsible for the discrepancy. Look for crimped or plugged tubing leading to the pressure sensor, evidence of shipping damage such as bent or loose components, a damaged pressure transducer, or electrical problems.
3. From the Main screen, take the PQ200A barometric pressure reading and compare it to that of the NIST-traceable portable barometer. (If the barometer reads in inches, multiply by 25.4 to obtain mmHg.) Adjust the "OFFSET" pot until the readings agree. The OFFSET pot is located on the board beneath the pressure transducer.

4. Remove the tubing attached to the P1 port of the PQ200A (barometric pressure transducer/sensor) and attach a piece of rubber or Tygon™ hose to this port. At the end of the hose, attach a plastic "T" adapter and attach pieces of hose to the other two ends of the "T" adapter.
5. Attach one of the hoses to the NIST-traceable portable barometer's pressure inlet fitting.
6. Attach a gas-tight syringe to the last hose and draw back on the plunger to apply a light suction until the NIST-traceable barometer reads approximately 100 mmHg below ambient pressure (i.e., 660 mmHg if ambient pressure was 760 mmHg). Clamp off the hose with a tubing clamp or the hemostats to prevent leakage and thus hold the pressure steady.
7. Observe the displayed value on the Main screen of the PQ200 sampler. It should agree with the value displayed by the NIST-traceable barometer within 10 mmHg. If not, adjust the "GAIN" control until they do agree within 10 mmHg or better. Record both readings on the Barometric Pressure Verification/Calibration Data Sheet (Figure 7.1) with appropriate comments. Consult the sampler instruction manual for diagrams of the printed circuit boards to locate the "GAIN" control.
8. Remove the tubing and syringe and read the NIST-traceable barometer and the PQ200 barometers at ambient pressure. The two readings should continue to agree within 10 mmHg. Record this value on the Barometric Pressure Verification/Calibration Data Sheet.
9. Repeat Steps 2 through 8 as necessary until the portable sampler agrees within 10 mmHg pressure with the NIST-traceable barometer at both points.
10. Reinstall the tubing and syringe as described above. Push the plunger of the syringe in to create a pressure approximately 30 to 100 mmHg higher than the ambient pressure. Record the values given by the NIST-traceable barometer and on the PQ200A Main screen on the Barometric Pressure Verification/Calibration Data Sheet. Do not make any adjustments to the sampler based on the above-ambient pressure verification check.
11. When the sampler and the standard agree within 10 mmHg for all readings, the pressure calibration is complete. Remove all tubing and return the sampler to its original condition. Record the final readings on the Barometric Pressure Verification/Calibration Data Sheet.
12. If the sampler cannot be brought into satisfactory agreement with the NIST-traceable barometer, troubleshooting and repairs may be required, the pressure sensor may have to be replaced, and/or a different portable sampler should be used for the PE.
13. Because barometric pressure calibration adjustments affect the sampler's flow rate, the flow rate must be verified/calibrated before returning the sampler to service.

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual.
2. BGI Inc. August 1998. PQ200 Air Sampler Instruction Manual, "Appendix H - PQ200A Audit Sampler,"
3. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring  $PM_{2.5}$  in Ambient Air Using Designated Reference or Class I Equivalent Methods. Draft.
4. User's Manual for the Meriam Instrument digital manometer/calibrator kit, Model No. LP200I.
5. User's Manual for the Druck digital pressure indicator, model DPI 705.

**Barometric Pressure Multipoint Verification/Recalibration Data Sheet**

*Use this form when a sampler is scheduled for multipoint verification or recalibration or because of an invalid single-point verification check. See Field SOP PEPF 7.01 for instructions.*

Sampler No.: \_\_\_\_\_ Sampler Make/Model: \_\_\_\_\_

Reason for multipoint procedure:  failed verification check  scheduled calibration

**Original Verification Results:** *Fill out this section only if this multipoint procedure is being done because an on-site single-point verification failed. Verification is done at ambient pressure.*

Verif. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (mmHg)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient P			

**Initial Readings:** *Use this section to record multipoint verification readings and/or readings taken before the sampler is recalibrated.*

Calib. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (mmHg)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient P			
2. Reduced P			
3. Elevated P			

**Final Readings:** *Record readings after the sampler's calibration response has been adjusted. Fill out this section only when performing the multipoint recalibration procedure.*

Calib. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (mmHg)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient P			
2. Reduced P			
3. Elevated P			

**Reverification Results:** *Fill out this section only if a sampler has been recalibrated.*

Verif. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (mmHg)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient P			

**Reverification Result:**  Pass  Fail

**Notes:**

## Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

**Operation: Temperature Multipoint Verification/Calibration**

### **SOP: PEPF-7.02**

<b>Name: Printed</b>	<b>Signature</b>	<b>Date</b>

*Contents*  
(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	3
7. Procedure	3
8. References	4

## 1.0 Scope and Applicability

This SOP applies to calibrating the temperature measurement system for the FRM PE sampler.

## 2.0 Summary of Method

Temperature sensors are calibrated by moving them from their mountings in the sampler and placing them in a constant temperature environment such as a liquid bath or a block of metal of substantial mass. The sensor port is adjusted so that the sampler read-out value matches that of a NIST-traceable thermometer, which is collocated with the sampler's temperature sensor. It is recommended that multipoint calibrations be conducted indoors in a temperature-controlled environment, away from the effects of drafts and sunlight.

Before proceeding with a multipoint temperature calibration, check to be sure that the sensor is not broken or corroded and that there is no electrical malfunction.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2,5</sub> FRM PEP.

## 5.0 Cautions

- ▶ Exercise care when using mercury-in-glass thermometers, which can be broken easily. Verify there are no gaps in the mercury column. If a thermometer is broken, avoid contact with mercury and/or breathing mercury vapors, and clean up the mercury and dispose of it properly. A NIST-traceable digital thermometer with probe is an alternative measurement method that avoids mercury.
- ▶ When using water baths, avoid wetting thermocouple or thermistor cables and connectors.
- ▶ When using water or other liquid as a constant-temperature bath, stir the liquid well prior to the measurement; however, do not stir while actually taking the measurement.
- ▶ Be sure that the temperature reference standard used to verify the instrument's sensors has been calibrated annually against a NIST-certified standard.

## 6.0 Equipment and Supplies

- ▶ VWR brand Digital Thermometer Model No. 61220-601
- ▶ 4&1/2 digit, precision, calibrated, volt meter
- ▶ Total immersion, precision, NIST traceable mercury-in-glass thermometer
- ▶ Partial immersion, precision, NIST traceable mercury-in-glass thermometer
- ▶ Small slotted screwdriver (required only for verification/calibration to adjust potentiometers)
- ▶ Temperature Sensor Multipoint Verification/Calibration Data Sheet
- ▶ Thermos™ bottle and water.

## 7.0 Procedure

### 7.1 Set-up and Multipoint Verification

The multipoint temperature verification/calibration procedure is to be used whenever the single-point verification of either the ambient or filter temperature sensor was out of the 2 °C tolerance, when compared to an NIST-traceable temperature standard. The procedure for performing the multipoint temperature verification is as follows:

1. Select a minimum of three target temperatures that will be used for the calibration. It is not necessary to achieve the target temperatures precisely, as long as a NIST-traceable temperature standard is available to indicate the exact temperature. The temperatures selected should be representative of the temperature range expected at the site during the PE.
2. A styrofoam thermos or other small container such as a Thermos™ bottle can be used. Cool water can be made by dissolving ice in ordinary tap water. Be sure to remove all ice before doing the temperature verification, however. Other methods may be necessary to achieve sub-freezing temperatures. Additional temperatures can be checked by adjusting the water bath temperature. Room temperature (approximately 23 °C) an elevated temperature (40°C) are suggested. Remove the temperature sensor from the sampler and immerse it in the liquid. Also immerse a NIST-traceable mercury-in-glass thermometer or the probe of a digital thermometer in the liquid bath and position its tip near the sampler's sensor.
3. Record the temperatures indicated by the sampler readout and by the temperature standard at a minimum of three points within the expected range of temperatures. The multipoint response is satisfactory if agreement is within 1 °C. If satisfactory, record the results on the Temperature Sensor Multipoint Verification/Calibration Data Sheet.
4. If the multipoint calibration check was not satisfactory, it is necessary to make adjustments as described in the next section.

## 7.2 Calibration Adjustment Procedures

**NOTE:** A temperature sensor should not be recalibrated if the single-point or multipoint temperature verification above was satisfactory.

There are two temperature sensor boards in the BGI PQ200 sampler. The filter temperature sensor board is located on the front panel and the ambient sensor board is located on a bracket attached to the ambient sensor gauge connector. This adjustment procedure applies to both TEMP SENSOR boards. Consult the BGI PQ200 instruction manual for details on this procedure. Record results on the Temperature Sensor Multipoint Verification/Calibration Data Sheet.

1. Adjustments are made while the sensors are immersed in the room temperature water bath. Refer to Step 2 of the multipoint calibration procedure given above.
2. When confident that the devices are equilibrated and stable, and while the unit is still running, carefully open the front panel of the PQ200 and locate JP4 on the main printed circuit board.
3. Set up the digital voltmeter for a range that will allow a reading of +2.389 VDC.
4. Attach the negative (black) lead of the meter to the black wire connection of JP4.
5. Touch the positive (red) lead to the test point labeled TP1 on the TEMP SENSOR board to be calibrated. If the voltage reads somewhere between +2.388 and +2.390, the span will not have to be set. A higher or lower reading will require adjustment of the span pot. Use a small slotted screwdriver to adjust the "SPN" trimmer pot on the sensor board.
6. Compare the displayed readings to that of the total immersion thermometer. Adjust the "OFST" trimmer pot until the readings agree within 0.1 °C
7. Repeat this procedure for the other temperature sensor if it was also out of specification.

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual,
2. BGI Inc. August 1998. PQ200 Air Sampler Instruction Manual,, "Appendix H - PQ200A Audit Sampler,"
3. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring PM<sub>2.5</sub> in Ambient Air Using Designated Reference or Class I Equivalent Methods.

**Temperature Sensor Multipoint Verification/Recalibration Data Sheet**

Use this form when a sampler is scheduled for multipoint verification or recalibration or because of an invalid single-point verification check. See Field SOP PEPF 7.02 for instructions. Use one form for each T sensor.

Sampler No.: \_\_\_\_\_ Sampler Make/Model: \_\_\_\_\_

Reason for multipoint procedure:  failed verification check  scheduled calibration

Sensor Type:  Ambient  Filter  DGM

**Original Verification Results:** Fill out this section only if this multipoint procedure is being done because an on-site single-point verification failed. Verification is done at ambient temperature.

Verif. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (deg. C)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient T			

**Initial Readings:** Use this section to record multipoint verification readings and/or readings taken before the sensor is recalibrated.

Calib. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Date: \_\_\_\_\_

Reading (deg. C)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient T			
2. Reduced T			
3. Elevated T			

**Final Readings:** Record readings after the sensor's calibration response has been adjusted. Fill out this section only when performing the multipoint recalibration procedure.

Calib. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (deg. C)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient T			
2. Reduced T			
3. Elevated T			

**Reverification Results:** Fill out this section only if the sensor has been recalibrated.

Calib. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (deg. C)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient T			

**Reverification Result:**  Pass  Fail

**Notes:**

## Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

### Operation: Flow Rate Multipoint Verification/Calibration

#### SOP: PEPF-7.03

Name: Printed	Signature	Date

#### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	3
7. Procedure	3
8. References	5

## 1.0 Scope and Applicability

**NOTE:** The following information is applicable to the BGI Model PQ200A portable FRM sampler when used with the BIOS DryCal primary flow rate standard. Specific information herein may not be applicable to other makes and models of equipment.

Each reference or Class I equivalent PM<sub>2.5</sub> sampler includes a specially designed sample air inlet, a size-fractionating impactor, and a sample flow rate control system. The particle size discrimination characteristics of both the inlet and the impactor are critically dependent on specific internal air velocities; a change in velocity will result in a change in the distribution of the nominal particle sizes collected. These velocities are determined by the actual volumetric flow rate of the sampler.

In addition, the total volume of air sampled is determined from the measured volumetric flow rate and the sampling time. The mass concentration of PM<sub>2.5</sub> in the ambient air is computed as the total mass of collected particles in the PM<sub>2.5</sub> size range divided by the total volume of air sampled.

Therefore, in order to control the size-fractionating cutpoints and to measure the total volume correctly, the sampler's flow rate must be maintained at a constant value that is within  $\pm 5\%$  of the design flow rate of 16.67 Lpm. The flow rate of the portable FRM sampler must be verified at each site before the PE sample is taken.

This SOP should be employed only if adjustments were made to barometric pressure (PEPF 7.01) and/or temperature (PEPF 7.02) or if the flow rate verification (PEPF 6.04) showed out-of-tolerance flow rate. .

## 2.0 Summary of Method

A multipoint flow rate verification/calibration of the sampler is performed once a year. After the multipoint calibration, the flow rate is verified with the Chinook Streamline™ FTS again to confirm that the  $\pm 4\%$  tolerance has been achieved.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ Do not operate the sampler without a flow verification filter installed.
- ▶ Calibration of the sampler's flow rate measurement system must be in the units of the actual ambient volumetric flow rate. Do not use "mass flow rate" or "flow rate at standard conditions."

- ▶ The portable FRM sampler must pass the verification check for external leaks before the flow verification/calibration is performed.
- ▶ Do not calibrate the flow rate measurement system if there is any doubt that the temperature and pressure measurement systems also are not in calibration. If there is doubt, verify/calibrate the temperature and pressure sensors.
- ▶ Verify tight connections exist between the BIOS™ flow rate standard and the sampler. This includes all o-ring seals and hose connections.
- ▶ When the equipment is not in use, cap all entrance points to the BIOS™ primary flow calibrator and store in a protective case or container.

## 6.0 Equipment

- ▶ A flow rate calibration adapter and tubing to connect the primary flow rate standard outlet to the PM<sub>2.5</sub> sampler downtube.
- ▶ The BIOS™ Model DryCal DC-Lite piston flowmeter will be supplied for use in the FRM PEP.
- ▶ Chinook™ Engineering Streamline FTS
- ▶ Dwyer Series 475-0 Digital Manometer
- ▶ Flow Rate Multipoint Verification/Calibration Data Sheet.

## 7.0 Procedure

### 7.1 Overview

The operating flow rate of 16.67 Lpm is verified before each PE. If the verification result is outside the required  $\pm 5\%$  tolerance for agreement with the design flow rate of 16.67 Lpm, a multipoint calibration at three different flow rates may be required. The one-point verification must be repeated after any three-point calibration as a double-check to ensure the sampler operates properly at the design flow rate of 16.67 Lpm.

Calibration of the sampler's flow rate measurement system consists of three separate flow rate measurements (a multipoint calibration) approximately evenly spaced over the range of -10 % to +10 % of the sampler's operational flow rate. Adjustments to the sampler's pump speed are made through entries to the calibration screen keyboard so that the sampler's indicated flow rates are brought into agreement with the flow rate as measured by the BIOS™ flow standard device.

### 7.2 Multipoint Flow Rate Verification/Calibration

**CAUTION:** This procedure makes changes to the internal calibration of the FRM sampler. Do not proceed unless you are certain that verification/calibration is necessary. This calibration is best performed at an indoor location.

The sampler's flow rate measurement system is recalibrated using three separate flow rate measurements evenly spaced within the range of -10 % to +10 % of the sampler's operational flow rate. Given that the operational flow rate is 16.67 Lpm, the two other calibration points will be 15.00 Lpm and 18.33 Lpm. Results are recorded on the Flow Rate Multipoint Verification/Calibration Data Sheet.

1. Remove the size-selective inlet from the BGI PQ200A sampler.
2. Firmly attach the flow rate calibration adapter to the top of the downtube.
3. Using rubber tubing, attach the vacuum side of the BIOS dry-cal primary flow rate standard to the barbed inlet of the calibration adapter.
4. From the Main menu, use the arrow buttons until \* **Test and Calibration Menu** flashes. Press **SELECT** to enter the Test and Calibration menu.
5. From the test and calibration menu, use the arrow buttons until \* **Select and calibrate a Flow Rate** flashes. Press **SELECT**. The **Volume or Mass Control?** message will be displayed. The current selection will be flashing on the second line.
6. Press the arrow button to select **(VOLUME)**.
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, and the ambient temperature and barometric pressure for the current calibration. The “current” calibration is the one residing in memory from the most recent calibration.)
8. Press **SELECT (NEXT)**. The value preceding the decimal place will stop flashing, indicating it can be edited.
9. Repeat the following for the three flow rates: 15.0 Lpm, 16.7 Lpm, and 18.3 Lpm:
  - a. Use the arrow **(EDIT)** buttons to increase or decrease the selected value. When done press **SELECT (NEXT)**. The value following the decimal will then stop flashing.
  - b. Again use the arrow keys to select the decimal value. Press the blank **(EXIT)** button to return to the second Set-Ups menu.
  - c. Press the **ON/OFF (PUMP)** button to turn on the pump. The **Corrected Q:** message will then display. (The corrected Q value shown is for reference only.)
  - d. Use the arrow keys to adjust the pump speed to obtain the desired flow rate as indicated by the value displayed by the BIOS dry-cal flow calibrator. The arrow keys are used for fine adjustments of the pump speed. To make coarse adjustments, hold the **SELECT** key and the up or down arrow key simultaneously.
  - e. When satisfied that the flow rate is correct, press the blank **(OK)** button to lock the calibration into memory.

f. Repeat for all three flow rates: 15.0, 16.7, and 18.3 Lpm. Repeat the 16.67 Lpm calibration to return the system to the flow rate set point.

10. After successful calibration, repeat the verification test using the Chinook™ FTS to ensure the sampler is operating within  $\pm 4\%$  of 16.67 Lpm, the designated flow rate set point.

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual,
2. BGI Inc. August 1998. PQ200 Air Sampler Instruction Manual, "Appendix H - PQ200A Audit Sampler,"
3. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring PM<sub>2.5</sub> in Ambient Air Using Designated Reference or Class I Equivalent Methods. Draft.
4. 40CFR Part 50, Appendix L, Section 9.2
5. BIOS™ Model DryCal DC-Lite Operating Instructions.
6. Chinook Engineering, Chinook™ Flow Transfer Standard data sheet.

**Flow Rate Multipoint Verification/Recalibration Data Sheet**

Use this form when a sampler is scheduled for multipoint verification or recalibration or because of an invalid single-point verification check. See Field SOP PEPF 7.03 for instructions.

Sampler No.: \_\_\_\_\_ Sampler Make/Model: \_\_\_\_\_  
 Reason for multipoint procedure:  failed verification check  scheduled calibration

**Original Verification Results:** Fill out this section only if this multipoint procedure is being done because an on-site single-point verification failed. Verification is done at ambient pressure and temperature.

Verif. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (Lpm)	Sampler (a)	Transfer Standard (b)	Pct. Difference (a-b)/b
1. Design FR			

**Initial Readings:** Use this section to record multipoint verification readings and/or readings taken before the sampler is recalibrated.

Calib. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (Lpm)	Sampler (a)	Transfer Standard (b)	Pct. Difference (a-b)/b
1. Design FR			
2. Design FR - 10%			
3. Design FR + 10%			

**Final Readings:** Record readings after the sampler's calibration response has been adjusted. Fill out this section only when performing the multipoint recalibration procedure.

Calib. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (Lpm)	Sampler (a)	Transfer Standard (b)	Pct. Difference (a-b)/b
1. Design FR			
2. Design FR - 10%			
3. Design FR + 10%			

**Reverification Results:** Fill out this section only if a sampler has been recalibrated.

Verif. Std. Make/Model.: \_\_\_\_\_ Serial No.: \_\_\_\_\_ Date: \_\_\_\_\_

Location (Field Site ID or Laboratory): \_\_\_\_\_ Operator or FS: \_\_\_\_\_

Reading (Lpm)	Sampler (a)	Transfer Standard (b)	Pct. Difference (a-b)/b
1. Design FR			

**Reverification Result:**  Pass  Fail

**Notes:**

# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 8**

### **Sample Filter Handling**

- 8.01 Conducting the Filter Exposure**
- 8.02 Filter Sample and Data Retrieval**
- 8.03 Filter Packing and Shipment**

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Conducting the Filter Exposure

### SOP: PEPF-8.01

Name: Printed	Signature	Date

### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	3
7. Procedure	3
8. References	8

## 1.0 Scope and Applicability

**NOTE:** The following information is applicable to the BGI Model PQ200A portable FRM sampler. Specific information herein may not be applicable to other makes and models of samplers.

This SOP describes how to set up the BGI PQ200A sampler to start and end sampling for a 24-hour period, midnight-to-midnight.

Before collecting the PE Sample, the sampler must have successfully passed the leak, barometric pressure, temperature, flow rate verification and time checks. Activities concerning sampling filter receipt, examination, installation, use, retrieval, packaging, and shipment must be documented in accordance with instructions given in the COC SOP, PEPF-9.01.

## 2.0 Summary of Method

The PE sample must be taken over a 24-hour period from midnight to midnight. Other topics covered in this SOP include interpreting controller screens during programming and sample collection, and downloading of data from the PQ200A. PM<sub>2.5</sub> filter/cassettes should be removed within 8 to 48 hours after sampling has ended and shipped within 8 hours of filter removal.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ Exercise care in handling unexposed and exposed filters.
- ▶ Strictly follow all procedures concerning labeling, documenting, and transporting filters (in their cassettes) to reduce the chance for measurement errors.
- ▶ Ensure that the portable computer or other data storage device used for downloading data is in good condition and that the battery is sufficiently charged.

## 6.0 Equipment and Supplies

- ▶ BGI PQ200A Air Sampler
- ▶ COC Form
- ▶ Field Data Sheet
- ▶ Impactor well loaded with 37mm glass fiber filter and diffusion oil
- ▶ Preweighed Teflon™ filter in cassette, with metal filter caps, in plastic resealable antistatic cassette bag
- ▶ 9x12" sealable plastic shipping bags
- ▶ Marker (indelible ink )

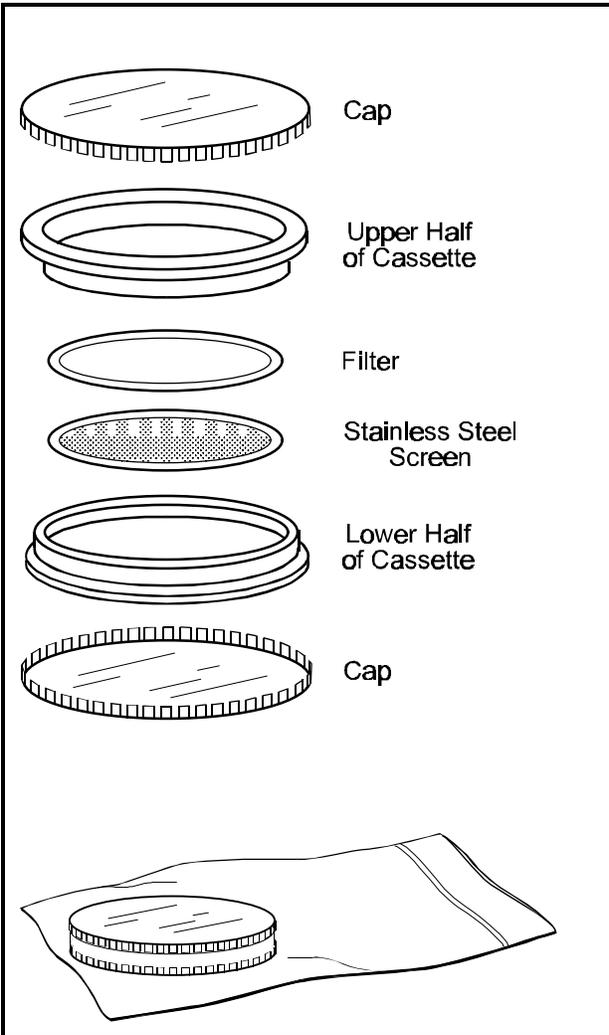
## 7.0 Procedure

### 7.1 Cassette Inspection

Handle the cassette as indicated in PEPF-3.01. Prior to working with cassettes, clean your hands with alcohol wipes or clean water.

1. Filter cassettes will remain with filter caps on, in the antistatic filter cassette bags, and be double bagged into 9 x 12" self-sealing shipping bags until they are to be ready to be put into the portable sampler (see Figure 8.1)
2. Remove one cassette, still in its antistatic self sealing cassette bag, from the 9 x 12" shipping bag.
3. Remove the cassette from the antistatic self-sealing cassette bag. **Save this bag for post sample transport!** Place this bag in the interior of the portable sampler.
4. Carefully remove the filter caps and place them on top of the antistatic self-sealing plastic cassette bag interior side down.
5. Hold the cassette in a manner that will avoid touching any part of the filter.
6. Visually inspect the filter and cassette for defects before use. Look for the following types of defects:
  - loose or improperly fitting cassette
  - filter offset or wrinkled
  - cassette number does not match COC information
  - pinhole —A small hole
  - loose material—Any extra loose material or dirt particles on the filter.
  - discoloration—Any obvious discoloration that might be evidence of contamination.
  - filter nonuniformity—Any obvious visible nonuniformity in the appearance of the filter when viewed over a light table or black surface that might indicate gradations in porosity or density across the face of the filter.

- other—Any imperfections not described above that could affect the filter's weight or cause sampled air to bypass the filter medium.



**Figure 8.1. Filter cassette equipment and filter cassette in antistatic sample bag.**

7. Return any filter/cassettes with visible damage or imperfections to the weighing laboratory along with the voided COC Form. Use a spare filter in place of the defective filter.
8. If the filter is acceptable, install the cassette per instructions in 7.2. Fill in the "Transport of Filter and Field Site Information" on the COC Form that associated with this cassette.
9. Indicate the filter type (RO-Routine, FB-Field Blank, CO-Collocated) on the antistatic self-sealing cassette bag as well as the "Filter Type" area on the COC Form.
10. Place filter caps together (exterior side out) and place in the same antistatic self-sealing plastic cassette bag from which the came, seal the bag, and store in the portable sampler until sample collection is complete.

## 7.2 Impactor and Cassette Installation

This procedure includes temporarily inserting a field blank into the sampler, if a field blank will be implemented at the sampling site.

Prior to working with cassettes, clean your hands with alcohol wipes or clean water.

**NOTE:** The portable sampler is transported to the site with a transport cassette and a WINS impactor assembly without diffusion oil installed inside the main unit. See SOP PEPF 5.01 for steps to properly check the filter cassette and the WINS impactor, and for adding the 37-mm glass fiber filter and diffusion oil to the WINS impactor before starting a sample.

1. Install a WINS impactor loaded with a 37-mm glass fiber filter and diffusion oil per SOP PEPF-5.01.
2. Select a filter per Section 7.1 above.

3. Open the main unit door and carefully rotate the handle counterclockwise using both hands to expose the transport cassette and WINS assemblies. (**CAUTION:** Once the assembly has started to open, the weight of the two plates will tend to force the whole assembly open even further.)
4. The transport filter cassette and the WINS impactor should now be visible. If not, gently separate the filter cassette or WINS impactor from its respective upper housing.
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 to distinguish it from a sample cassette. If performing a field blank, go to Step 6; if not, go to Step 10.

### **Field Blank**

6. If performing a field blank, install the field blank filter. The Teflon™ filter medium needs to be facing up toward the WINS impactor.
7. Close the assembly by slowly rotating the handle clockwise 3/4 of a turn. Watch the filter cassette and WINS impactor to ensure that they are seated properly and that the assemblies close securely.
8. Open the assembly and remove the field blank.
9. Cap the blank filter/cassette assembly with the same filter cap and place it in the same antistatic self-sealing cassette bag from which it was removed. Seal the bag and place it into the main unit compartment. The blank will stay in the main unit the same length of time as the routine filter. Make sure you have indicated the field blank on the cassette bag and on the COC Form.

### **Routine PE Filter**

10. Install the sampling filter cassette in the filter cassette housing. The Teflon™ filter medium must face up toward the WINS impactor.
11. Close the assembly by slowly rotating the handle clockwise 3/4 of a turn. Watch the filter cassette and WINS impactor to ensure that they are seated properly and that the assemblies close securely.

### **7.3 Acquiring a 24-hour PE Sample**

To comply with EPA regulation the 24-hour filter sampling begins at midnight (00:00) and concludes at midnight of the next day. The total sampling period is programmed for 24 hours (1440 minutes). However, if sampling during some other time period is required by the WAM, consult Addendum 1 to this SOP for instructions on resetting the sampling times in the BGI PQ200A air sampler. Addendum 2 describes the procedure to use if it is necessary to briefly stop and restart the sampler during a sampling period. Addendum 3 describes the controller screen outputs available for status monitoring during an exposure.

This procedure refers to use of the PQ200A control panel shown in Figure 8.2. Proceed as follows:

1. Install the PE filter cassette per Section 7.2 above. Ensure all data have been recorded on the Field Data Sheet and COC Form.
2. Verify that the reporting organization site operator has installed a filter in the routine sampler that is scheduled to be evaluated.
3. Enter the 4-digit cassette ID and the 9-digit AIRS site ID into the PQ200A as described in 7.3.1
4. Program the FRM sampler's software to perform the evaluation (section 7.3.1 below)
5. Close the samplers' doors, pack up loose supplies, pick up trash, and secure the site for the 24-hour exposure period. It is not necessary for the FS or site operator to be present at midnight, when the samplers start or end the sampling exposure.
6. It is recommended, but not required, that the FS or site operator visit the site at a convenient time during the exposure to verify that there are no problems with either sampler (see Addendum 3). Such a visit allows a defective run to be terminated so that a replacement exposure can be scheduled as soon as possible.

### 7.3.1 Setting up the BGI PQ200A Air Sampler for the 24-hour PE Exposure

Data from the previous run should already have been downloaded from the PQ200A prior to acquisition of the sample. However, the instrument will alert the FS if the data have not been downloaded. Set up the BGI PQ200A's controller as follows:

1. Go to the main screen and confirm that the date and time are correctly set.
2. Scroll to "Set-ups and Download", hit **Select** key. At "More Selections" hit **Select** key.
3. Scroll to "Enter Site and Filter Information", hit **Select** key.
4. Scroll thru (use  key) characters to program in the cassette ID (4 digit number).
5. Go back to the Main menu
6. From the Main menu of the PQ200A's controller screen, use the arrow keys until **\* Run Sampler from Midnight to Midnight** flashes
7. Press **SELECT**. If the unit has been previously downloaded the following message will be displayed;

**Clearing Memory. Please Wait!**

If the unit has not been downloaded the following message will be displayed:

**Current Data Not Yet Downloaded!  
EXIT now or loose the current run data!**

and then;

**Alarm Triggered Run, Saving Data!**

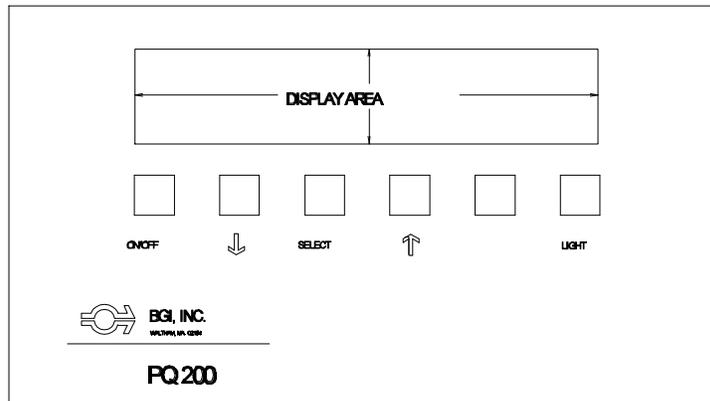
and then;

**PQ200A Powering Down.**

The PQ200A is then programmed to power itself on and begin sampling at midnight.

### 7.3.2 Data Displayed While the PQ200A is Running

During the exposure run, the PQ200A display will provide certain status information that may be useful in verifying that an exposure session is proceeding properly (see addendum 3).



NOTE: ALTERNATE FUNCTIONS OF BUTTONS WILL  
APPEAR ON DISPLAY/RECEIPT ONLY.

**Figure 8.2. Sampler control panel.**

## 8.0 References

1. BGI Inc. May 1998. PQ200 Air Sampler Instruction Manual.
2. BGI Inc. August 1998. PQ200 Air Sampler Instruction Manual, "Appendix H - Audit Version - PQ200A."
3. U.S. Environmental Protection Agency. April 1998. Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Part II, Section 2.12. Monitoring PM<sub>2.5</sub> in Ambient Air Using Designated Reference or Class I Equivalent Methods. Draft.

### Addendum 1 - Running the Sampler with User-Defined Start/Stop Times

NOTE: FRM PEs are ordinarily conducted midnight-to-midnight. This addendum is included for completeness, or in case the FS, directed by the WAM, to adjust the start and end times to account for exceptional conditions such as daylight savings time changes or crossing time zones.

Be sure to note the exceptional exposure time on the Field Data Sheet.

Data from a previous run should be downloaded prior to use of this function. However, the instrument will alert the operator if any previously acquired data has not been downloaded.

- From the Main menu, use the arrow keys until \* **Setups and Download** flashes. Press **SELECT**.
- From the Set-Ups and Download menu, use the arrow keys until \* **Run w/ User Defined Start/Stop** flashes. Press **SELECT**.
- The **Set the sample Start Date and Time** message will be displayed. The current selection will be flashing on the second line.
- Press **SELECT (NEXT)**. The first value (Day of the Month) will stop flashing, indicating it can be edited.
- Use the arrow (**EDIT**) buttons to increase or decrease the selected value. When done press **SELECT (NEXT)**.
- Continue to press the **SELECT (NEXT)** and arrow (**EDIT**) buttons in this fashion to enter the desired date and time.
- When done setting the start date and time, press the blank (**EXIT**) button to continue. If the unit has been previously downloaded, the following message will be displayed;

**Clearing Memory. Please Wait!**

- The **Set the sample STOP DATE and TIME** message will be displayed. The current selection will be flashing on the second line.
- Use the same procedure to set the stop date and time. When done, press the blank (**EXIT**) button to return to the Set-Ups and Download screen. Select **\* More Selections**, then **\* Return to Main Screen**.

**Addendum 2 - Temporary Halt then Continue Sampling**

During a PE sampling period, it is not desirable to halt sampling operations during a run for either the portable FRM PE sampler or the fixed site sampler. However, in an emergency it may be necessary to suspend sampling for a brief period. *Be sure to note any interruption of sampling on the Field Data Sheet. Specify the time and duration of the interruption and the reason. Interruptions of both the portable sampler and the fixed site sampler should be noted.*

A 24-hour sample may be suspended for up to 10 minutes and still remain a legitimate sample according to EPA rules. Therefore, a means to temporarily halt and then resume sampling has been incorporated into the BGI PQ200A. To halt the sampler, simply press the **ON/OFF** button. The unit will jump to the Main menu and will display the message;

**Halted by Operator!**

To continue with the current sample run;

- From the Main menu, use the arrow keys until **\* Setups and Download** flashes. Press **SELECT**.
- From the Set-Ups and Download menu, use the arrow keys until **\* Continue with Current Run** flashes. Press **SELECT**.

The sampler will then resume the run. However, observe that the elapsed time did not change while the unit was halted.

### Addendum 3 - Monitoring Status while the BGI PQ200A is Running

While the PQ200A air sampler is running, the display should appear similar to this:

```

ET000:05 TV:000.08M3 [DC In]      □□□□□
Start:04jul15:00 Stop:05jul15:00   1997
Q(Vlpm):16.70 AVG:16.71 CV 0.16    04jul
749mmHg A28.6°C F27.8°C SP025cm    15:05
  
```

Pressing the select button will display a second screen:

```

Tmax:28.5 Tmin:28.2 Tavg:28.4     □□□□□
BPmax:750 BPmin:749 BPavg:749     1997
Q(Vlpm):16.70 AVG:16.71 CV 0.16   04jul
749mmHg A28.6°C F27.8°C SP025cm   15:05
  
```

Where:

- ET:** elapsed time since the current run started
- TV:** total volume sampled during the current run
- [DC In]:** current power source from which the sampler is operating
- Start:** the time and date (in military notation) the current sample started
- Stop:** the time and date the current sample stopped (or is set to stop)
- Q(Vlpm):** the instantaneous flow rate (V for volumetric, M for mass)  
in liters per minute
- AVG:** average flow rate, liters per minute
- CV:** coefficient of variation of flow rate
- mmHg:** instantaneous ambient barometric pressure, millimeters of mercury
- A °C:** instantaneous ambient temperature in degrees Celsius
- F °C:** instantaneous filter temperature in degrees Celsius
- SP cm:** pressure drop across the filter, in cm H<sub>2</sub>O
- Tmax:** the maximum ambient temperature measured during the run
- Tmin:** the minimum ambient temperature measured during the run
- Tavg:** the average ambient temperature
- BPmax:** the maximum barometric pressure measured during the run
- BPmin:** the minimum barometric pressure measured during the run
- BPavg:** the average barometric pressure
- :** flag area -- flags which may appear are:
  - P** indicates that a power failure has occurred
  - Q** indicates that flow has varied more than +/- 5 percent
  - F** indicates that a 5 degree filter overheat lasting  
more than 30 minutes has occurred

**M** indicates memory overflow (max run time with 5 minute logger interval)

During operation, the **SELECT (NEXT)** button provides alternate displays of minimum, maximum, and average ambient temperatures and barometric pressures or other run time data while the **ON/OFF** button will temporarily suspend the run. The run is not considered complete until the Sample Stop Date and Time have been attained.

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Filter Sample and Data Retrieval

### SOP: PEPF-8.02

Name: Printed	Signature	Date

### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	3
7. Procedure	3

## 1.0 Scope and Applicability

**NOTE:** The following information is applicable to the BGI Model PQ200A portable FRM sampler. Specific information herein may not be applicable to other makes and models of samplers.

This SOP describes how to set up the BGI PQ200A sampler to start and end sampling for a 24-hour period, from midnight to midnight.

Before collecting the PE Sample, the sampler must have successfully passed the leak, temperature, barometric pressure, flow rate, and time verification checks. Activities concerning sampling filter receipt, examination, installation, use, retrieval, packaging, and shipment must be documented in accordance with instructions given in the COC SOP, PEPF-9.01.

## 2.0 Summary of Method

The PE sample must be taken over a 24-hour period, from midnight to midnight. Other topics covered in this SOP include interpreting controller screens during programming and sample collection and downloading of data from the PQ200A. PM<sub>2.5</sub> filter/cassettes should be removed within 8 to 48 hours after the collection period ends and shipped within 8 hours after an exposure.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

Exercise care in handling unexposed and exposed filters.

Strictly follow all procedures concerning labeling, documenting, and transporting filters (in their cassettes) to reduce the chance for measurement errors.

Ensure that the portable computer or other data storage device used for downloading data is in good condition and that the battery is sufficiently charged.

## 6.0 Equipment and Supplies

- ▶ BGI PQ200A air sampler
- ▶ COC Form
- ▶ Field Data Sheet
- ▶ Impactor well loaded with 37-mm glass fiber filter and diffusion oil
- ▶ Preweighed Teflon™ filter in cassette, with filter caps, in plastic antistatic cassette bag
- ▶ Protective filter/cassette containers
- ▶ 9x12" plastic shipping bags
- ▶ Marker, (indelible ink )
- ▶ Portable computer with the PQ200A Job Controller software loaded
- ▶ 9-pin, female-female, RS-232 serial cable
- ▶ Data Trans

## 7.0 Procedure:

### 7.1 Ending a Run

The FS and the site operator will retrieve their filters after the exposure has terminated, typically the next day. PM<sub>2.5</sub> filters should be removed within 8 to 48 hours after the collection period ends. The following steps describe shutdown procedures for the sampler:

1. A properly programmed PQ200A will automatically stop sampling at the end of 24 hours. Ensure that the sampler pump has stopped running. When the PQ200A has completed its run, the display screen will appear similar to this:

<b>SAMPLE RUN COMPLETED!</b>	<b>1998</b>
	<b>28OCT</b>
<b>750mmHg A28.1 °C F27.4 °C</b>	<b>15:55</b>

2. From the above display, push the blank menu button to reach the main menu screen. Select "Review last run data and conditions". Scroll through the display screens and record summary information for the portable sampler during the 24-hour sampling period.
3. Review the recorded data for start and end times, sample elapsed time, flow rate, filter quality, and temperature to start the process of determining if the sample is valid, questionable, or invalid. Record observations and reasoning for questioning a run on the Field Data Sheet. Scan through the sampling summary on the sampler display and note flags. The BGI PQ200A displays the following flags
  - P - Power failure
  - Q flow variation of more than  $\pm 5\%$
  - M - Memory overflow
  - F- 5°C filter overheating for > 30 min.
  - T - 24 hour sample time < 23 hours 50 minutes

4. If the exposure was not valid for any reason, the FS will contact the WAM to begin scheduling a second evaluation to replace the invalid evaluation. This may require scheduling considerations that are beyond the scope of this SOP.
5. Clean hands with an alcohol wipe or clean water.
6. Open the antistatic cassette bag which was stored in the main unit, remove the filter caps from the bag and set them on top of the bag, exterior side down.
7. Carefully rotate the handle counterclockwise using both hands to expose the sample cassette and WINS assemblies. (**CAUTION:** Once the assembly has started to open, the weight of the two plates will tend to force the whole assembly open even further.)
8. The sample filter cassette and the WINS impactor should now be visible. If not, gently separate the filter cassette or WINS impactor from its respective upper housing.
9. Remove the sample filter cassette. Inspect it for integrity and contamination (tears, bugs, etc) Enter comments or flags on Field Data Sheet.
10. Cap the filter/cassette assembly with the same filter caps and place it in the same antistatic self-sealing bag from which it was removed. Seal the bag. See SOP PEPF-8.03 for packing and shipping.
11. Follow procedure in Section 7.2 below to download run data.
12. See SOP PEPF-5.01 for disassembly of the sampler.

## **7.2 Downloading Data from the PQ200A Air Sampler**

It is recommended that the laptop be used as the device for downloading data from the portable sampler since there are fields in the BGI software that need to be entered manually which can't be accomplished with the Datatrans data logger above. However, the Datatrans can be used in situations such as inclement weather or where safety concerns dictate not using a lap top. As a last resort, if there are problems with both the laptop computer and the Datatrans, the FS must record the information manually on the Field Data Sheet.

**NOTE:** This section describes downloading process using a portable PC-compatible computer with the PQ200 job controller software for Windows™. Other means of data downloading may be used and are described in the BGI PQ200 Manual.

---

### 7.2.1 Downloading to the Laptop PC

When the sampler has completed its run, the data may be downloaded from the memory of the PQ200A.

**Be sure to download the most recent run before setting the sampler to start another run.**

1. Using a serial (9-pin) cable (female-female), connect the PQ200A sampler to a computer equipped with the PQ200 job controller program.
2. Open the PQ200 job controller program. The program has four folders: **J**ob **C**ontrol, **S**ummary, **L**ogs and **P**rint **S**heets, and **G**raphs.
3. In the **J**ob **C**ontrol folder, select **B**egin **J**ob. The **N**ew **J**ob window will appear.
4. Enter a job name into the first line item. The file should be coded with the first 4 characters being the month and day of the sample run (use leading zeros if necessary). For examples January 30<sup>th</sup> would be 0130. The next 4 characters will be the cassette ID number. This will make an 8- digit file name. The job file will automatically be given the suffix **.job**.
5. Tab to “Job Code” enter any field flags as identified in Appendix B. For multiple flags separate by commas”,”.
6. Tab to “Site Name” and enter the site description (e.g., name of town, city location etc)
7. Tab to “Station Code” enter the 9 digit AIRS Site ID code that is also on the Site Data Sheet.
8. Tab to “Operator” enter your initials. No other fields need to be entered.
9. Press **S**ave when done, select the appropriate subdirectory on the computer, then press **O**K to save the file and return to the **J**ob **C**ontrol folder.
10. Select **D**ownload. The Download Summary and Logger Data window will appear. Under “Options”, Choose **S**ummary and **L**ogger
11. Click on **B**egin. After a short delay, the computer will begin receiving data from the PQ200A.
12. When the computer has finished receiving data from the PQ200A, click on **R**eturn. The serial cable may now be removed from the PQ200A sampler and from the computer.
13. To view information about the data collected from the PQ200A, select the other folders: **S**ummary, **L**ogs and **P**rint **S**heets, and **G**raphs.
14. To save the downloaded data to a disk, press **S**ave **C**hanges in the **J**ob **C**ontrol folder. The job file has been created and saved to disk.

15. The electronic data should be backed up to two floppy disk. One floppy disk should be send along with the filter, the COC Form and the Field Data Sheet to the weighing laboratory. The other disk and copies of the forms and Data Sheet are brought back to the field office.

### **7.2.2 Downloading Data using the Datatrans**

The BGI Datatrans downloader can be used to capture up to 20 "Runs" from either the PQ100 or PQ200 Air Samplers and transport the "Run Data" (along with the filter) back from the field to the lab for analysis and storage. Its compact size, extended temperature ranges (-30 to +60 Degrees Celsius), and ease of operation make it ideal for field data retrieval.

#### ***To use the Datatrans***

1. Turn the unit on with the power switch on the front panel.
2. The following light sequence should be observed: red, yellow then green.
3. The green light will remain on. (This indicates a ready condition.)

#### ***Downloading the PQ200***

1. Place the connection switch, located on the front panel, in the "Samp" (sampler) position.
2. Insure the PQ200 Sampler is powered on.
3. Plug the Datatrans into the RS232 port on the front panel of the PQ200.
4. Press and release the pushbutton on the front of the Datatrans.
5. The red light will turn on, the green light will turn off and if communication is successful the yellow light will flash for each line of data received.
6. When the download is complete, the yellow light will remain on, the red light will stop flashing and turn off and the green light will turn on.
7. Repeat the above steps for each sample run that is to be collected (multiple samplers) realizing that the "Runs" are stacked up using **First In, Last Out methodology**.
8. It is now safe to turn the unit off.

NOTE: The data will be retained in the Datatrans, even if the 9 volt battery fails, until it has been uploaded into a computer and the unit is erased using the data deletion procedure described below.

***To Upload to the Computer***

1. Plug the Datatrans into the RS232 serial port of the computer.
2. Observe the following light sequence: red, yellow then green. (Green light indicates unit is ready and yellow on indicates Runs are stored.) Red light turns off.
3. Place the connection switch, located on the front panel, in the (**Comp**) computer position.
4. Insure the computer is running PQ200 BGI Software and is ready to receive data as if it were attached directly to the sampler.
5. Point and click on BEGIN JOB and follow the instructions given on the screen by the software. Enter any applicable data to the "Run" such as initial filter weight, user data etc.
6. Point and click on DOWNLOAD.
7. Point and click on BEGIN.
8. Green light will turn off, Red light will turn on and "Run Data" will be stored in the Datatrans.
9. When "END" or "MEM END" is detected on the computer screen and the Green light is lighted on the Datatrans, the "Run" has been transferred.
10. If multiple runs have been stored in the Datatrans, the last run captured is the current resident run. While a run is resident, the Datatrans retains the characteristics of the sampler type it was captured from. To step the Datatrans to the next run, you must first download the current run and then press the pushbutton. Repeat for multiple runs pushing the Datatrans button after each sample is uploaded. You must "Begin" a new run for each sample run to be uploaded to the computer. When all runs have been uploaded, the yellow light will remain off.

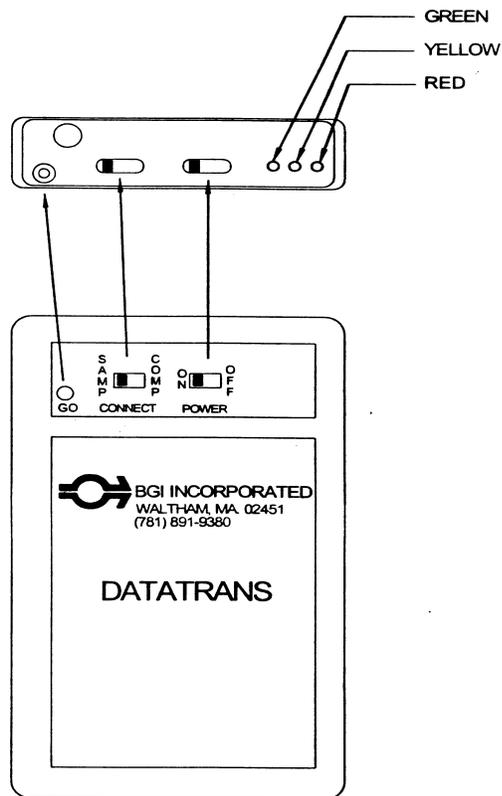
**NOTE: TO RECYCLE SAMPLE RUNS:**

After green light goes off, indicating all runs have been downloaded, pressing button will retrieve the series of runs and remain until deleted. This is helpful if you are unsure of an uploaded run.

***Data Deletion Procedure*****To erase the Datatrans after all runs have been transferred**

1. Turn the power switch off.
2. Hold down the pushbutton.
3. While holding the pushbutton down, turn the power switch ON.

4. The red light will turn on, now release the button.
5. When erased, all three lights will flash 2 times in unison and 1 time in series.
6. Unit is now cleared and ready for new downloads.



**Figure 8.1 Datatrans**

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Filter Packing and Shipment

### SOP: PEPF-8.03

Name: Printed	Signature	Date

### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	2
7. Procedure	3

## 1.0 Scope and Applicability

This procedure will describe packaging the sampled filters into shipping containers and transporting them to the national laboratories.

## 2.0 Summary of Method

PM<sub>2.5</sub> filter/cassettes should be removed within 48 hours after the collection period ends, and shipped with 8 hours of sample exposure. The sampled cassettes, along with Field Data Sheets, COC Forms, data diskettes, will be packed with ice substitutes and sent to the national laboratory by Federal Express™ next day air.

## 3.0 Definitions

Appendix A contains a glossary of terms used in the PEP.

## 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## 5.0 Cautions

- ▶ Exercise care in handling unexposed and exposed filters.
- ▶ Strictly follow all procedures concerning labeling, documentation, and transporting filters (in their cassettes) to reduce the chance for measurement errors.

## 6.0 Equipment and Supplies

- ▶ Prew weighed/Sampled Teflon™ filters (routine, field blanks, collocated samples), in cassettes, in filter caps, and antistaticcassette bags
- ▶ COC Form
- ▶ Field Data Sheet
- ▶ Filter shipping container
- ▶ Ice substitutes (4/shipping container)
- ▶ Digital max/min thermometer
- ▶ Roll of bubble wrap
- ▶ Heavy duty rubber bands
- ▶ Masking tape
- ▶ Packing tape
- ▶ Knife or scissors
- ▶ 9 x 12" plastic self-sealing shipping bags (1 for cassettes, 1 for forms and diskette)
- ▶ 3.5" high density data diskettes

---

## 7.0 Procedure:

This procedure describe the method of packing and shipping the sampled cassettes that have been capped and are placed in their antistatic self-sealing cassette bags. The procedure creates a group of filters that are “sandwiched” between ice substitutes and wrapped in bubble wrap held together by either heavy- duty rubber bands or tape.

1. Group all sampled cassettes into one 9 x 12" plastic shipping bag and seal the bag. Ensure that there is a one-to-one match of COC Forms. There must also be a one-to-one match with Field Data Sheets for routine and collocated samples. Field blanks do not require a Field Data Sheet. Also ensure that the data diskettes contain routine and collocated data.
2. Select the next preprinted Federal Express label and complete the “Shipping from Field to Weighing Lab” portion of each COC Form for the shipment of cassettes so that the air bill number is recorded.
3. Find a working surface. Lay out a section of bubble wrap from the roll and place two ice substitutes on the wrap.
4. Place the 9 x 12" plastic shipping bag containing the sampled cassettes on top of these ice substitutes. Unplug the digital max/min thermometer probe from the readout device and tape the probe onto the shipping bag over sampled cassettes. Fold the empty portion of the bag over the probe 1 or 2 times.
5. Place two ice substitutes on top of the plastic shipping bag and probe.
6. Roll the bubble wrap around this ice substitute/cassette assembly (i.e., like packing a Subway™ sandwich) and secure this assemblage using masking tape or heavy rubber bands.
7. Connect the digital max/min thermometer probe to the readout device and tape the readout device to the top of the ice substitute/cassette assembly.
8. Place the ice substitute/cassette assembly in the insulated shipping container. Allow the probe to equilibrate with the ice substitutes. This may take 5 minutes. If the ice substitutes are hard (frozen), the max/min thermometer’s current reading should be at least 0 °C
9. Place the **laboratory portions** of the COC Forms, the Field Data Sheets and the data diskettes for all the samples in a second 9 x 12" plastic shipping bag, and retain the field copies.
10. Just before sealing the shipping container, reset the digital max/min thermometer by hitting the reset button until there is a click. This resetting will be confirmed by initial readings of “88”.
11. Immediately place the 9 x 12" plastic shipping bag containing the COC Forms, Field Data Sheets and the data diskettes into the shipping container. Place additional bubble wrap in the container to inhibit as much movement as possible of the ice substitute/cassette assembly and close the container.

12. Seal the container with packing tape.
13. Affix a preprinted Federal Express™ shipping label to the shipping container and transport the container to the nearest Federal Express™ office.
14. Call or e-mail the LA to report a sample shipment on the day of the shipment. Include in the call, your name, the date, the airbill number, and the number of containers in the shipment.

**NOTE:** If for some reason the sampled cassettes cannot be shipped on the day of sampling, complete Steps 1 through 12 above and go to SOP PEPF-3.01 (Section 7.2.4).

# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 9**

### **Chain of Custody and Field Data Sheet**

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Chain of Custody and Field Data Sheet

### SOP: PEPF-9.01

Name: Printed	Signature	Date

### *Contents*

(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	2
4. Personnel Qualifications	2
5. Cautions	2
6. Equipment and Supplies	2
7. Procedure	4

## **1.0 Scope and Applicability**

This SOP applies to the COC procedures used in the field for the FRM PEP.

## **2.0 Summary of Method**

The COC procedure for the PM<sub>2.5</sub> PEP is used to track individual weighed filters. COC begins after a filter is weighed, when the filter is placed in a cassette. A separate COC Form accompanies each filter/cassette. The form stays with the filter as it is sent to the field, is exposed (or used as a blank), and returned to the original weighing laboratory.

## **3.0 Definitions**

Appendix A contains a glossary of the terms that will be used in the PEP.

## **4.0 Personnel Qualifications**

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

## **5.0 Cautions**

This section is not applicable to this SOP.

## **6.0 Equipment and Supplies**

- ▶ FRM PEP COC Form, COC-2
- ▶ Field Data Sheet, FDS

**PM<sub>2.5</sub> Federal Reference Method Performance Evaluation Program  
Chain of Custody Form**

**PART I - WEIGHING LABORATORY**

Filter Weighing and Shipping Information			
Filter ID Number		Filter Cassette No	
Weighing Lab		Cassette Type	
Analyst/Custodian Name		Weighing Date	
Shipment Date		Airbill No.	
Sent to (PE Org)		Shipped via	Fed. Express
This Filter Must be Used by:		Return to:	

*On completion of Part I, the weighing laboratory keeps one copy and sends 2 copies to the field office with the filter.*

**PART II - FIELD OFFICE**

Date Received:		PE Organization:	
Shipment Integrity OK?	<input type="checkbox"/> Yes <input type="checkbox"/> No (describe)	Field Scientist:	

**PART III FIELD SITE**

Filter Type				
<input type="checkbox"/> RO	<input type="checkbox"/> CO	<input type="checkbox"/> FB	<input type="checkbox"/> Void (describe)	<input type="checkbox"/> Other (describe)
Associated Filter Samples - enter cassette numbers for other filters used for this exposure				
PE Sample	Colloc. PE	Field Blank	Other (describe)	Other (describe)
Transport of Filter and Field Site Information				
Arrival Date at Site:		Site Name:		
AIRS Site ID:		Primary Site Sampler:	Make/Model:	Ser. No:
Site Operator and Other Observers:				
Filter Integrity OK	<input type="checkbox"/> Yes <input type="checkbox"/> No (describe)			

**PART IV FIELD FILTER SHIPPING**

Shipping from Field to Weighing Lab					
Shipped by:		Shipment Date:		Shipped via:	Fed. Express
Airbill No.		Destination:			

*On completion of Part II-IV, the field scientist keeps one copy and sends the other to the laboratory with the filter.*

**PART V - WEIGHING LABORATORY**

Received by:		Date Received:		Integrity Flag:	
Received Condition OK?	<input type="checkbox"/> Yes <input type="checkbox"/> No (describe)	Max Temperature:	°C	Cold Pack Condition:	<input type="checkbox"/> frozen <input type="checkbox"/> cold <input type="checkbox"/> ambient

**Notes:**

---

## 7.0 Procedure

### 7.1 COC Form

The COC Form is printed on 3-part carbonless paper. The form itself is divided into five parts, which are filled out at different locations, as described below. Parts II - IV given below indicate where additional instructions on filling out the COC Form can be found.

#### **PART I - WEIGHING LABORATORY**

Part I is filled out at the laboratory. It contains the filter ID number and cassette number, some supporting information, and shipping information from the laboratory to the field office. A very important section in this part is the last day that the filter may be used. This is calculated as 30 days after the weighing date. The filter exposure must begin no more than 30 days after weighing. Another important item in this Part is the return address. All filters must be returned to the laboratory from which they originated.

**NOTE:** copy of the multi part form is retained by the laboratory after Part I has been completely filled out. The remaining two copies are sent to the field office.

#### **PART II - FIELD OFFICE (PEPF-3.01)**

Part II is filled out by the field office and by the FS when the cassettes are received. See SOP PEPF-3.01 (section 7.1) for instructions. This part contains identifying information about the field organization, the FS, and the integrity of the received shipment.

#### **PART III- FIELD SITE (PEPF-8.01)**

Part III is filled out at the site. A critical item in this part is the "Filter Type" section which identifies how the filter is used at the site. The five options are:

**RO - routine** FRM PE sample.

**CO - collocated** FRM sample that is taken simultaneously with the regular FRM sample by the FS. Whenever the FS takes two simultaneous samples, the primary and collocated PE samplers should be designated before the exposure begins.

**FB - field blank** filter that is used by the FS as a blank.

**For the first three filter types mentioned above, the two letter suffix will also be placed on the antistatic cassette bag, which is described in SOP PEPF-8.01 (Section 7.1).** The two other options include the following:

**Void** - filter that the FS considers to be invalid. Describe the reason for voiding a filter in the Notes section. Some possible reasons for voiding a filter include visible contamination on the filter, sampler malfunction, a discrepancy in the COC documentation, etc.

---

Other - A filter that is in some other category (for example, a special type of QA or QC sample). This type must be described in the Notes section.

The "Associated Filter Samples" section lists other filter/cassettes that are used during the same FRM PE exposure. These include blanks and collocated samples, as well as "other" types of filters that may be associated with the exposure. List the cassette numbers of those filters that are directly associated with a single 24-hour exposure.

The "Transport of Filter and Field Site Information" section documents information about the sampling site and is usually filled out before filter exposure. The following items are included in this section:

- ▶ Transport Date to Site - date that the FS arrives at the monitoring site. This need not be the date that the sample was taken.
- ▶ Site Name and AIRS Site ID - these should have been determined prior to coming to the site.
- ▶ Site Operator and Other Observers - list the name and affiliations of the site operator and any other official observers such as representatives of EPA or the local air monitoring authority.
- ▶ Primary Site Sampler - This refers to the fixed PM<sub>2.5</sub> sampler operated at the site for compliance purposes.

The "Filter Integrity OK?" section refers to a visual inspection of the filter prior to installation, which is described in SOP PEPF-8.01 (Section 7.1). If any defects are noted, the FS should describe the imperfection. If the imperfection is judged to be significant, the filter should be voided. Mark "Void" in the "Filter Type" section.

#### **PART IV FIELD FILTER SHIPPING (PEPF-8.03)**

Part IV should be filled out completely. The FS should normally package and mail the exposed and blank filters within 8 hours of conclusion of the exposure. This section is used to record shipping information.

- ▶ Shipped by usually refers to the FS, unless shipping is delegated to some other person.
- ▶ Destination should always be the same Weighing Laboratory as indicated in Part I.

**NOTE:** A copy of the multi-part form is retained by the FS after Part IV has been completely filled out. The remaining parts of the form are returned to the lab along with the filter(s), the completed Field Data Sheet(s), data diskettes, and any additional written notes.

#### **PART V - WEIGHING LABORATORY**

The final part of the COC Form documents the condition of the container upon receipt at the laboratory. Data are then entered from the form, and the form is filed at the laboratory.

NOTES - Record all relevant notes here. Use extra pages if necessary.

The weighing laboratory archives the form after Part V is completed and data are entered into the data system.

---

## 7.2 Field Data Sheet

The Field Data Form is printed on 2-part carbonless paper. The FS originates a new Field Data Sheet in the field, as verification checks begin. After all the sampler verifications have been successfully completed and documented, an unexposed filter is selected and its cassette number is entered on the Sheet. A summary of exposure data is also included on the Sheet. These data are sufficient to calculate the  $PM_{2.5}$  concentration in the event that the data downloaded electronically from the sampler are lost.

**NOTE:** Only filters that are actually exposed in an FRM sampler require a Field Data Form. Thus, only filters that are designated as "PE Sample" or "Colloc. PE" on the COC Form will have Field Data Sheets filled out. Filters designated as "Blank" and "Void" do not require Field Data Sheets.

Identification numbers for all transfer standards used to verify the FRM sampler are entered in the "Transfer Standards" section. If additional standards are used, enter them in the Notes section.

The "Site Checks" section describes the results of synchronization of the FRM sampler's clock with an external standard (must agree within 1 minute). This section also records whether the siting criteria were met by the FRM sampler. Describe any violations of these criteria below.

The "FRM Sampler Verification Checks" section must be filled out using the associated verification SOPs. The acceptance criteria are listed on the Sheet for reference, but necessary equations are not provided. In particular, the "Flow Rate Verification" section requires a relatively complex equation for calculating the flow rate based on the pressure drop across an orifice. The documentation accompanying each orifice device provides the necessary equations and the constants applicable to the orifice.

The "Exposure Information" contains the number of the filter/cassette used for this exposure. This number should be entered before the filter is loaded into the FRM sampler. The remainder of this section is filled out after the FRM PE has concluded. The "Filter Integrity OK?" section indicates that the filter appeared to be free of gross imperfections when it was removed from the sampler. The remaining information is taken directly from the sampler's screen. The final section, "Data Download OK?" reports whether or not the electronic download of data was successful.

NOTES - Record all relevant notes here. Use extra pages if necessary.

<p><b>NOTE:</b> The FS sends one copy of the Field Data Form to the weighing laboratory along with the COC Form and the filter. In the laboratory, data on the Form are entered into the data base and the Form is archived. The field office retains the other copy of the Sheet.</p>
--

## PM<sub>2.5</sub> Federal Reference Method Performance Evaluation Program Field Data Sheet for BGI PO200A

Identification			
Field Scientist:		FRM Serial No:	
Date:		AIRS Site ID:	
Transfer Standards - enter manufacturer's serial number:			
Temp. Trans. Std:		Flow Rate Orifice:	
BP Trans. Std:		FR press. gauge:	
Site Checks			
Time checks OK?	Q Yes Q No (describe)	Siting criteria OK?	Q Yes Q No (describe)

**FRM Sampler Verification Checks:** Indicate only the final result of the check after all troubleshooting has been done. Document troubleshooting in the Notes section below and/or in field notebook.

Leak Checks	Criteria	Beginning P	Ending P	Verification OK?
External Leak	change < 10 cmH <sub>2</sub> O			Q Yes Q No (describe)
Bar. Pressure	Criteria	Std. Pressure	Samp. Pressure	Verification OK?
Ambient Pressure	±10 mmHg			Q Yes Q No (describe)
Temperature	Criteria	Std. Temp.	Sampler Temp.	Verification OK?
Ambient Sensor	±2°C			Q Yes Q No (describe)
Filter Sensor	±2°C			Q Yes Q No (describe)
Flow Rate Verification				
Data for calculating standard orifice FR	Ambient T	Orifice delta-P	Ambient BP	Orifice Constants
	°C	cmH <sub>2</sub> O	mmHg	m=      b=
Audit standard FR check:	Criteria	Std FR (calc.)	Sampler FR	Verification OK?
	< 4% difference	Lpm	Lpm	Q Yes Q No (describe)
Design flow rate check:	Criteria	Design FR	Sampler FR	Verification OK?
	≥ 15.84 ≤ 17.51	16.67 Lpm	Lpm	Q Yes Q No (describe)

**Exposure Data**

Filter Cassette No:		Filter Integrity OK?	Q Yes Q No (describe)
Start Date/Time:		Total Volume:	m <sup>3</sup>
End Date/Time:		Average Flow Rate:	Lpm
Total Time:		CV of FlowRate:	Lpm
Average Ambient T:	°C	Sampler Flags: Field Flags:	
Average Bar. Press:	mmHg		
Data Download OK?	Q Yes Q No (describe)		

**Notes:**

# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 10**

### **Quality Assurance /Quality Control**

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Quality Assurance / Quality Control

### SOP: PEPF-10.01

Name: Printed	Signature	Date

*Contents*  
(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Summary of Method	2
3. Definitions	3
4. Personnel Qualifications	3
5. Cautions	3
6. Equipment and Supplies	3
7. Procedure	3

## 1.0 Scope and Applicability

This procedure describes the QA procedures that will be implemented at prescribed frequencies during routine PEP activities.

## 2.0 Summary of Method

This procedure summarizes the important quality assurance and quality control procedures that must be accomplished and also provides procedures for those activities that have not been covered in other SOPs. QA/QC procedures covered in other SOPs are not discussed in this section. Table 10-1 summarizes the field QC procedures.

**Table 10-1 Field Quality Control Checks.**

Requirement	Frequency	Acceptance Criteria	SOP Reference
<b>Filter Holding Times</b> Presampling Filter collection Filter Shipment	all filters “ “	< 30 days before sampling 8-48 hours 8 hours after retrieval	PEPF-2.03 PEPF-2.03 PEPF-2.03
<b>Data Completeness</b>	quarterly	75%	PEPF-10.01
<b>Filter</b> Visual defect check	all filters	See reference	PEPF-8.01
<b>Field QC Checks</b> Field filter blank	1/week/instrument	$\pm 30 \mu\text{g}$ change between weighings	PEPF-10.01
<b>Calibration/Verification of Sampler</b> Flow Rate (FR) calibration FR multipoint verification One-point FR verification External leak check Internal leak check Temperature calibration Temp multipoint verification One-point temp verification Pressure calibration Pressure verification Clock/timer verification	if multipoint failure 1/yr every sampling event every sampling event upon failure of external if multipoint failure on installation, then 1/yr every sampling event 1/yr every sampling event every sampling event	$\pm 2\%$ of transfer standard $\pm 2\%$ of transfer standard $\pm 4\%$ of transfer standard 80 mL/min 80 mL/min $\pm 2\%$ of standard $\pm 2^\circ\text{C}$ of standard $\pm 4^\circ\text{C}$ of standard $\pm 10 \text{ mmHg}$ $\pm 10 \text{ mmHg}$ 1 min/mo	PEPF-7.03 PEPF-7.03 PEPF-6.04 PEPF-6.01 PEPF-6.01 PEPF-7.02 PEPF-7.02 PEPF-6.03 PEPF-7.01 PEPF-6.02 ?
<b>Accuracy</b> Flow rate audit External leak check Internal leak check Temperature audit Pressure audit	4/yr (manual) 4/yr 4/yr 4/yr 4/yr	$\pm 4\%$ of audit standard < 80 mL/min < 80 mL/min $\pm 2^\circ\text{C}$ $\pm 10 \text{ mmHg}$	PEPF-10.01 “ “ “ “

Requirement	Frequency	Acceptance Criteria	SOP Reference
<b>Precision</b> Collocated samples Paired All samplers in Region-	1/month 1/year	CV ≤ 10% CV ≤ 10%	PEPF-10.01 “
<b>Standards Recertifications</b> Flow rate transfer std. Field thermometer  Field barometer  Working mass Stds. Primary mass Stds.	1/yr 1/yr  1/yr  3-6 mo. 1/yr	±2% of NIST-traceable Std. ± 0.1° C resolution ± 0.5° C accuracy ± 1 mmHg resolution ± 5 mmHg accuracy 0.025 mg 0.025 mg	PEPF-10.01 “ “ “ “ “ “

### 3.0 Definitions

Appendix A contains a glossary of the terms be used in the PEP.

### 4.0 Personnel Qualifications

Personnel who conduct the FRM PEs must have passed the written and the hands-on practical training examinations for the field component in the PM<sub>2.5</sub> FRM PEP.

### 5.0 Cautions

The activities described in the procedure below refer to other SOPs where the procedure is described. The referenced SOPs provide the appropriate cautions.

### 6.0 Equipment and Supplies

The activities described in the procedure below refer to SOPs where the activity is described. The referenced SOPs provide the appropriate equipment and supply list.

### 7.0 Procedure

#### 7.1 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained. Each Region has the expected number of sites that need a PE. The PEP is expected to obtain valid data for 75% of these sites each quarter.

## .2 Field Blanks

Field blanks are used to capture any contamination that occurs in the transportation stage and the field implementation stage of the PEP. A field blank is temporarily installed in **each** instrument during a field week. For example, if the same portable sampler was used at two sites in one week, one field blank would be implemented at one of the sites. However, each instrument used in that week must have at least one field blank associated with it.

SOP PEPF-8.01, Section 7.2 describes how to install field blanks.

## 7.3 Accuracy

Once every 3 months, on all actively used samplers, the FS will perform the following tasks :

- ▶ External leak check PEPF-6.01
- ▶ Internal leak check PEPF-6.01
- ▶ Temperature Audit PEPF-6.02
- ▶ Pressure Audit PEPF-6.03
- ▶ Flow rate audit PEPF-6.04

These audits will be performed using the same procedures as the verification checks, as indicated by the SOPs listed above. The difference is that **these audits will be performed with a verification device that is not the verification device used for everyday verifications**. They must be accomplished with either the standard used for multipoint verification/calibration or a spare verification device that is not used in normal operations.

## 7.4 Collocated Sampling

Collocated sampling provides an estimate of the precision or repeatability of the portable sampler and the measurement system.

### 7.4.1 Once-A-Year Collocation --

At the beginning of this program (1/1/99) and every year thereafter, all portable samplers being used by any one FS must be set up and run based on these field SOPs within the same 24-hour period. The samplers will be within 1-4 m of each other and their inlets will be within 1m vertical height. It is suggested that these samplers run for 3-4 days to provide enough data to ensure that the results are repeatable over several sampling days. The filters will be sent to the national laboratory for weighing by normal procedures.

#### 7.4.2 Once-a-Month Collocation–

Once a month, any instrument that is regularly used in the normal FRM PEP must be collocated within 1-4 m of another portable sampler and collect samples as indicated in the field SOPs. The COC and Field Data Sheets provide spaces for recording this sample information. The collocation can occur during a normal field visit (preferred) or at the field office.

#### **7.4 Standards Recertifications**

All primary and transfer standards will be recertified as NIST-traceable and will have 1-year warranties. . During EPA purchase of this equipment, agreements were set up to provide this recertification service. EPA will inform the FS of where and when to send standards for this recertification.

# **Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program**

## **Section 11**

### **Information Retention**

# Field Standard Operating Procedures for the PM<sub>2.5</sub> FRM Performance Evaluation Program

## Operation: Information Retention

### SOP: PEPF-11.01

Name: Printed	Signature	Date

*Contents*  
(applicable to this SOP)

<u>Section</u>	<u>Page</u>
1. Scope and Applicability	2
2. Procedure	2

## 1.0 Scope and Applicability

This SOP defines which records are critical to the project and what information needs to be included in reports, as well as the data reporting format and the document control procedures to be used.

The following information describes the document and records procedures for the PEP field activities. In EPA's QAPP regulation and guidance, EPA uses the term "reporting package". This term is defined here as all the information required to support the concentration data reported to EPA, which includes all data required to be collected as well as data deemed important by the PEP. Table 11-1 identifies these documents and records.

## 2.0 Procedures

### 2.1 Information Included in the Reporting Package

#### 2.1.1 Data Reporting Package Format and Document Control

The PEP has structured its records management in a similar manner to EPA's records management system (EPA-220-B-97-003) and follows the same coding scheme in order to facilitate easy retrieval of information during EPA technical systems audits (TSAs) and reviews. Table 10-1 includes the documents and records that will be filed according to the statute of limitations discussed in Section 2.3. Table 11-1 also includes a reference to more detailed instruction on the kind and type of data to be included in each record. In order to archive the information as a cohesive unit, all the PEP PM<sub>2.5</sub> information will be filed under the major code "PEP", followed by the codes in Table 11-1

**Table 11-1 PM<sub>2.5</sub> Reporting Package Information.**

Categories	Record/Document Types	File Codes	Reference
Management and Organization	Organizational structure Personnel qualifications and training Training certification Quality management plan EPA directives Support contracts	ADMI/106 PERS/123 AIRP/482 AIRP/216 DIRE/007 CONT/003	PEP IMP Sec 9 PEP IMP Sec 9
Site Information	Site characterization file (Site Data Sheets) Site maps Site Pictures	AIRP/237 AIRP/237 AUDV/708	
Field and Laboratory Environmental Data Operations	QA project plans Standard operating procedures (SOPs) Field notebooks and communications Sample handling/custody records Inspection/Maintenance records	PROG/185 SAMP/223 SAMP/502/COM TRAN/643 AIRP/486	PEP QAPP PEPF-1-10 PEPF-9.01 PEPF-5.01
Raw Data	Any original data (routine and QC data) including data entry forms	SAMP/223	PEPF-8.01, 02, 03

Categories	Record/Document Types	File Codes	Reference
Data Reporting	Data/summary/progress reports Journal articles/papers/presentations	AIRP/484 PUBL/250	PEPF-2.01
Data Management	Data algorithms Data management plans/flowcharts PM <sub>2.5</sub> data Data management systems	INFO/304 INFO/304 INFO/160 INFO/304	
Quality Assurance	Data quality assessments QA reports Response/Corrective action reports Site audits	SAMP/223 OVER/203 PROG/082 OVER/203	

### 2.1.2 Field Notebooks

The PEP will issue notebooks to each FS. This notebook will be uniquely numbered and associated with the individual and the PM<sub>2.5</sub> Program. Although data entry forms are associated with all routine environmental data operations, the notebooks can be used to record additional information about these operations.

#### Sample Receipt

One notebook will be issued to each field receiving facility. This notebook will be uniquely numbered and associated with the PM<sub>2.5</sub> program. For use in logging in sample receipt.

### 2.1.3 Field Binders

Field binders will also be issued to each FS. These notebooks will be 3-ring binders that will contain the appropriate data forms for routine operations as well as the inspection and maintenance forms and SOPs.

### 2.1.4 Electronic Data Collection

All raw data required for the calculation of a PM<sub>2.5</sub> concentration, the submission to the AIRS database, and QA/QC data will be collected electronically or on data forms that are included in the field SOP sections. Data listed in Table 11-2 will be collected electronically, as well as the laboratory pre and postsampling weights. Therefore, both primary field and laboratory data will be collected electronically and the calculation of the primary data into a final concentration will also be electronically calculated.

It is anticipated that other data may eventually be electronically collected. In order to reduce the potential for data entry errors, automated systems will be used where appropriate to record the same information found on the data entry forms. In order to provide a back-up, a hardcopy of automated data collection information will be stored for the appropriate time frame in project files.

**Table 11-2. Field Measurements.**

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

### 2.1.5 Hand Entered Data

A number of data forms will be entered by hand. These can be found at the end of each field SOP. All hardcopy information will be filled out in indelible ink. Corrections will be made by inserting one line through the incorrect entry, initialing this correction, and placing the correct entry alongside the incorrect entry, if this can be accomplished legibly, or by providing the correct information on a new line.

## **2.2 Reports to Management**

In addition to the reporting package, various reports will be required.

### **2.2.1 Field Monthly Report**

See SOP PEPF-1.01.

## **2.3 Data Retention/Archive**

The information listed in Table 11-1 will be retained by the ESAT contractor for 3 years based on a calendar year (i.e., all data from calendar year 1999 will be archived until 12/31/2002). Upon reaching the 3-year archival date, the ESAT contractor will inform OAQPS that the material has met the archive limit and will ask for a decision on further archiving or disposal.

## *Appendix A*

### *Glossary*

The following glossary is taken from two documents: 1) and 2) *EPA Guidance For Quality Assurance Project Plans* EPA QA/G-5

## *Glossary*

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

**Accuracy** — A measure of the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; the EPA recommends using the terms “*precision*” and “*bias*”, rather than “accuracy,” to convey the information usually associated with accuracy. Refer to *Appendix D, Data Quality Indicators* for a more detailed definition.

**Activity** — An all-inclusive term describing 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.

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

**American National Standards Institute (ANSI)**- Administrator and coordinator of the U.S. private sector voluntary standardization system.

**American Society for Testing and Materials (ASTM)** -A professional organization that develops and distributes protocols for testing and provides reference standards.

Analyst - A staff member who weighs the new and used filters and computes the concentration of PM<sub>2.5</sub> in µg/m<sup>3</sup>.

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

**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). Refer to *Appendix D, Data Quality Indicators*, for a more detailed definition.

**Blank** — A sample subjected to the usual analytical or measurement process to establish a zero baseline or background value. Sometimes used to adjust or correct routine analytical results. A sample that is

intended to contain none of the analytes of interest. A blank is used to detect contamination during sample handling preparation and/or analysis.

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

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

**Cassette** - A device supplied with PM<sub>2.5</sub> samplers to allow a weighed Teflon® 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 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. Refer to *Appendix D, Data Quality Indicators*, for a more detailed definition.

**Computer program** — A sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, a compiler, an interpreter, or a translator to prepare the program for execution. A computer program may be stored on magnetic media and referred to as “software,” or it may be stored permanently on computer chips, referred to as “firmware.” Computer programs covered in a QAPP are those used for 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 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, they will include the unknown population parameter with the same specified probability.

**Confidentiality procedure** — A procedure 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, a measure of the degree of linear relationship between two variables.

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

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

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

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

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

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

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

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

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

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

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

**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 sample*.

**Electrostatic charge buildup**- A buildup of static electrical charge on an item, such as the PM<sub>2.5</sub> filter, which makes it difficult to handle, attracts or repels particles, and can influence its proper weighing

**Environmental technology** — An all-inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be utilized to remove pollutants or contaminants from, or to prevent them from entering, the environment. Examples include wet scrubbers (air), soil washing (soil), granulated activated carbon unit (water), and filtration (air, water). Usually, this term applies to hardware-based systems; however, it can also apply to methods or techniques used for pollution prevention, pollutant reduction, or containment of contamination to prevent further movement of the contaminants, such as capping, solidification or vitrification, and biological treatment.

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

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

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

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

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

**Equilibration chamber-** A clean chamber usually constructed of plastic or glass, held at near constant temperature and humidity, used to store and condition PM<sub>2.5</sub> 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 filter-** New filters, selected at random, that are weighed at the same time that presampling weights are determined for a set of PM<sub>2.5</sub> filters and used for QA purposes. These field blank filters are transported to the sampling site in the same manner as filter 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 it is 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 interlaboratory precision.

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

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

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

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

**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, intended as an aid or example in complying with a standard or requirement.

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

**Hazardous waste** — Any waste material that satisfies the definition of hazardous waste given in 40 CFR 261, "Identification and Listing of Hazardous Waste."

**HEPA filter** - A high efficiency particulate air filter is an extended-media dry-type filter with a minimum collection efficiency of 99.97% when tested with an aerosol of essentially monodisperse 0.3  $\mu\text{m}$  particles.

**Holding time** — The period of time a sample may be stored prior to its required analysis. While 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** - Instrument resulting from the combination of a thermograph and a hygrograph and furnishing, on the same chart, simultaneous time recording of ambient temperature and humidity  
Laboratory blank filter New filters that are weighed at the time of determination of the presampling (tare) weight of each set of PM<sub>2.5</sub> 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.

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

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

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

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

**Item** — An all-inclusive term 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 ESAT contractor(s) responsible for the activities described in the standard operating procedures.

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

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

**Management 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.

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

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

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

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

**Mean 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 in order to control or acquire data to verify conformance to specified requirements.

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

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

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

**Microbalance** - A type of analytical balance that can weigh to the nearest 0.001 mg (that is, 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 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, a term denoting a requirement that has to be met.

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

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

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

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

**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.

**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<sub>2.5</sub> sampler** - A sampler used for monitoring PM<sub>2.5</sub> 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<sub>2.5</sub> mass concentration is calculated as the weight of the filter catch divided by the sampled volume. A sampler cannot calculate PM<sub>2.5</sub> concentration directly

**PM<sub>2.5</sub>**- 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.

**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 (<sup>210</sup>Po) antistatic strip** - A device containing a small amount of <sup>210</sup>Po that emits α particles (He<sup>2+</sup>) that neutralize the static charge on filters, making them easier to handle and their weights more accurate.

**Polytetrafluoroethylene (PTFE)**- The polymer that is used to manufacture the 46.2-mm diameter filters for PM<sub>2.5</sub> Federal Reference Method (FRM) and Federal Equivalent Method (FEM) samplers. Also known as Teflon®.

**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.

**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. Refer to *Appendix D, Data Quality Indicators*, for a more detailed definition.

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

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

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

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

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

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

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

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

**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.

**Radioactive waste** — Waste material containing, or contaminated by, radionuclides, 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 start-up or continued use of a facility, process, or activity. Readiness reviews are typically conducted before proceeding beyond project milestones and prior to initiation of a major phase of work.

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

**Recovery** — The act of determining whether or not the methodology measures all of the analyte contained in a sample. Refer to *Appendix D, Data Quality Indicators*, for a more detailed definition.

**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** - 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** — 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. See also *Appendix D, Data Quality Indicators*.

**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 interlaboratory precision and method bias or recovery efficiency.

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

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

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

**Sensitivity** — the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. Refer to *Appendix D, Data Quality Indicators*, for a more detailed definition.

**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 denoting a requirement that is mandatory whenever the criterion for conformance with the specification permits no deviation. This term does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled.

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

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

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

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

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

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

**Standard 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 has 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 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** — 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.

**Traceability** - 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 quality assurance 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 concerns the process of examining a product or result to determine conformance to user needs. See also *Appendix G, Data Management*.

**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 concerns 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 which is 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 to 10.0 meters per second.

## ***Appendix B***

### ***Data Qualifiers/ Flags***

A sample qualifier or a result qualifier consists of 3 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 produced a numeric result but for administrative reasons is not to be reported outside the laboratory.

**Field Qualifiers**

Code	Definition	Description
CON	Contamination	Contamination including observations of insects or other debris
DAM	Filter damage	Filter appeared damaged
EST <sup>1/</sup>	Elapsed sample time	Elapsed sample time out of specification
EVT	Event	Exceptional event expected to have affected sample (dust, fire, spraying)
FAC	Field accident	There was an accident in the field that either destroyed the sample or rendered it not suitable for analysis.
FAT	Failed temperature check - ambient	Ambient temperature check out of specification
FIT	Failed temperature check- Internal	Internal temperature check out of specification
FLR <sup>1/</sup>	Flow rate	Flow rate 5 min avg out of specification
FLT <sup>1/</sup>	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
LEK	Leak suspected	Internal/external leak suspected
SDM	Sampler damaged	Sampler appears to be damaged, which may have affected the filter

<sup>1/</sup>- Flag generated by sampling equipment.

**Laboratory Qualifiers**

Code	Definition	Explanation
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	Average value - 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	The 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.

<b>Code</b>	<b>Definition</b>	<b>Explanation</b>
FBK	Found in blank	The subject parameter had a measurable value above the established QC limit when a blank was analyzed using the same equipment and analytical method. Therefore, the reported value may be erroneous.
FCS	Failed collocated sample	Collocated sample exceeded acceptance criteria limits.
FFB	Failed field blank	Field blank samples exceeded acceptance criteria limits.
FIS	Failed internal standard	Internal standards exceeded acceptance criteria limits.
FLB	Failed laboratory blank	Laboratory blank samples exceeded acceptance criteria limits.
FLD	Failed laboratory duplicate	Laboratory duplicate samples exceeded acceptance criteria limits.
FLH	Failed laboratory humidity	Laboratory 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.
FRW	Failed replicate weight	The sample was reweighed and was not repeatable with acceptance criteria.
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.
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.
PSD	Possible shipping damage	Upon receipt of filter from the field, the filter appears to have been damaged during shipping.
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	Reque 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
SIS	Sample integrity suspect	Based upon other flags or free-form notes the data quality from this sample is suspect.
STD	Internal standard	The subject parameter is being utilized 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.
VOD	Void sample	The sample had flags indicating that the sample integrity was suspect and, after examination, further processing was halted.

*Appendix C*  
*Field Data Forms*





<b>Phone Communication Form</b>		
<b>Date:</b>	<b>Time:</b>	<b>Recorder:</b>
<b>Personnel on call:</b>		
<b>Issue(s):</b>		
<b>Decisions(s):</b>		
<b>Follow-up Action(s):</b>		
<b>Follow-up Responsibilities:</b>		
<b>Completion Dates for Follow-up Actions:</b>		

Form COM-01

<b>Monthly Progress Report</b>		
<b>Reporting Date: Start:</b>	<b>End:</b>	<b>Reporter:</b>
<b>Progress</b>		
<b>Sites Scheduled for Month:</b>	<b>Sites Evaluated during Month:</b>	
<b>Issues</b>		
<b>Old:</b>	<b>New:</b>	
<b>Actions:</b>	<b>Actions:</b>	
<b>Free Form Notes:</b>		
Form COM-2		

<b>Site Data Sheet</b>	
AIRS Monitor Site ID	Monitor ID
Site Name	Monitoring Freq. (1/6, 1/3, daily)
AIRS Method Designation	Monitor Make/Model
Site Coordinates Lat: Long:	Site Type (SLAMS/NAMS)
Reporting Org. Address	Reporting Org Contact Name Phone Number E-Mail
Directions to Site from Field Office:    Directions From major thoroughfare:	
Safety Concerns	Additional Equipment Needed
Closest Hospital Address and directions from site:	Closest Federal Express Facility
Closest Hardware Store:-	Recommended Hotel (Address/Phone #)
Closest Monitoring Site:	2 <sup>nd</sup> Closest Monitoring Site :
Free Form Notes	
Form SD-01	

**PM<sub>2.5</sub> Federal Reference Method Performance Evaluation Program  
 Chain of Custody Form**

**PART I - WEIGHING LABORATORY**

Filter Weighing and Shipping Information			
Filter ID Number		Filter Cassette No	
Weighing Lab		Cassette Type	
Analyst/Custodian Name		Weighing Date	
Shipment Date		Airbill No.	
Sent to (PE Org)		Shipped via	Fed. Express
This Filter Must be Used by:		Return to:	

*On completion of Part I, the weighing laboratory keeps one copy and sends 2 copies to the field office with the filter.*

**PART II - FIELD OFFICE**

Date Received:		PE Organization:	
Shipment	<input checked="" type="checkbox"/> Yes (describe)	Field Scientist:	

**PART III FIELD SITE**

Filter Type				
<input type="checkbox"/> RO	<input type="checkbox"/> CO	<input type="checkbox"/> FB	<input type="checkbox"/> Void (describe)	<input type="checkbox"/> Other (describe)
Associated Filter Samples - enter cassette numbers for other filters used for this				
PE	Colloc. PE	Field Blank	Other (describe)	Other (describe)
Transport of Filter and Field Site Information				
Arrival Date at Site:		Site Name:		
AIRS Site ID:		Primary Site	Make/Model:	Ser.
Site Operator and Other Observers:				
Filter Integrity OK	<input type="checkbox"/> Yes	<input type="checkbox"/> No (describe)		

**PART IV FIELD FILTER SHIPPING**

Shipping from Field to Weighing Lab				
Shipped by:		Shipment	Shipped	Fed. Express
Airbill No.		Destination:		

*On completion of Part II-IV, the field scientist keeps one copy and sends the other to the laboratory with the filter.*

**PART V - WEIGHING LABORATORY**

**PM<sub>2.5</sub> Federal Reference Method Performance Evaluation Program  
 Field Data Sheet for BGI PO200A**

Identification			
Field Scientist:		FRM Serial No:	
Date:		AIRS Site ID:	
Transfer Standards - enter manufacturer's serial number:			
Temp. Trans. Std:		Flow Rate Orifice:	
BP Trans. Std:		FR press. gauge:	
Site Checks			
Time checks OK?	Q Yes Q No (describe)	Siting criteria OK?	Q Yes Q No (describe)

**FRM Sampler Verification Checks:** Indicate only the final result of the check after all troubleshooting has been done. Document troubleshooting in the Notes section below and/or in field notebook.

Leak Checks	Criteria	Beginning P	Ending P	Verification OK?
External Leak	change < 10 cmH <sub>2</sub> O			Q Yes Q No (describe)
Bar. Pressure	Criteria	Std. Pressure	Samp. Pressure	Verification OK?
Ambient Pressure	±10 mmHg			Q Yes Q No (describe)
Temperature	Criteria	Std. Temp.	Sampler Temp.	Verification OK?
Ambient Sensor	±2°C			Q Yes Q No (describe)
Filter Sensor	±2°C			Q Yes Q No (describe)

Flow Rate Verification				
Data for calculating standard orifice FR	Ambient T	Orifice delta-P	Ambient BP	Orifice Constants
	°C	cmH <sub>2</sub> O	mmHg	m=      b=
Audit standard FR check:	Criteria	Std FR (calc.)	Sampler FR	Verification OK?
	< 4% difference	Lpm	Lpm	Q Yes Q No (describe)
Design flow rate check:	Criteria	Design FR	Sampler FR	Verification OK?
	≥ 15.84 ≤ 17.51	16.67 Lpm	Lpm	Q Yes Q No (describe)

**Exposure Data**

Filter Cassette No:		Filter Integrity OK?	Q Yes Q No (describe)
Start Date/Time:		Total Volume:	m <sup>3</sup>
End Date/Time:		Average Flow Rate:	Lpm
Total Time:		CV of FlowRate:	Lpm
Average Ambient T:	°C	Sampler Flags: Field Flags:	
Average Bar. Press:	mmHg		
Data Download OK?	Q Yes Q No (describe)		

**Notes:**

<b>Barometric Pressure Multipoint Verification/Recalibration Data Sheet</b>			
<i>Use this form when a sampler is scheduled for multipoint verification or recalibration or because of an invalid single-point verification check. See Field SOP PEPF 7.01 for instructions.</i>			
Sampler No.: _____		Sampler Make/Model: _____	
Reason for multipoint procedure: <input type="checkbox"/> failed verification check <input type="checkbox"/> scheduled calibration			
<b>Original Verification Results:</b> <i>Fill out this section only if this multipoint procedure is being done because an on-site single-point verification failed. Verification is done at ambient pressure.</i>			
Verif. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (mmHg)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient P			
<b>Initial Readings:</b> <i>Use this section to record multipoint verification readings and/or readings taken before the sampler is recalibrated.</i>			
Calib. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (mmHg)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient P			
2. Reduced P			
3. Elevated P			
<b>Final Readings:</b> <i>Record readings after the sampler's calibration response has been adjusted. Fill out this section only when performing the multipoint recalibration procedure.</i>			
Calib. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (mmHg)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient P			
2. Reduced P			
3. Elevated P			
<b>Reverification Results:</b> <i>Fill out this section only if a sampler has been recalibrated.</i>			
Verif. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (mmHg)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient P			
<b>Reverification Result:</b> <input type="checkbox"/> Pass <input type="checkbox"/> Fail			
<b>Notes:</b>			

<b>Temperature Sensor Multipoint Verification/Recalibration Data Sheet</b>			
<i>Use this form when a sampler is scheduled for multipoint verification or recalibration or because of an invalid single-point verification check. See Field SOP PEPF 7.02 for instructions. Use one form for each T sensor.</i>			
Sampler No.: _____		Sampler Make/Model: _____	
Reason for multipoint procedure: <input type="checkbox"/> failed verification check <input type="checkbox"/> scheduled calibration			
Sensor Type: <input type="checkbox"/> Ambient <input type="checkbox"/> Filter <input type="checkbox"/> DGM			
<b>Original Verification Results:</b> <i>Fill out this section only if this multipoint procedure is being done because an on-site single-point verification failed. Verification is done at ambient temperature.</i>			
Verif. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (deg. C)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient T			
<b>Initial Readings:</b> <i>Use this section to record multipoint verification readings and/or readings taken before the sensor is recalibrated.</i>			
Calib. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Date:	
Reading (deg. C)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient T			
2. Reduced T			
3. Elevated T			
<b>Final Readings:</b> <i>Record readings after the sensor's calibration response has been adjusted. Fill out this section only when performing the multipoint recalibration procedure.</i>			
Calib. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (deg. C)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient T			
2. Reduced T			
3. Elevated T			
<b>Reverification Results:</b> <i>Fill out this section only if the sensor has been recalibrated.</i>			
Calib. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (deg. C)	Sampler (a)	Transfer Standard (b)	Difference (a-b)
1. Ambient T			
<b>Reverification Result:</b> <input type="checkbox"/> Pass <input type="checkbox"/> Fail			
<b>Notes:</b>			

<b>Flow Rate Multipoint Verification/Recalibration Data Sheet</b>			
<i>Use this form when a sampler is scheduled for multipoint verification or recalibration <u>or</u> because of an invalid single-point verification check. See Field SOP PEPF 7.03 for instructions.</i>			
Sampler No.: _____		Sampler Make/Model: _____	
Reason for multipoint procedure: <input type="checkbox"/> failed verification check <input type="checkbox"/> scheduled calibration			
<b>Original Verification Results:</b> <i>Fill out this section only if this multipoint procedure is being done because an on-site single-point verification failed. Verification is done at ambient pressure and temperature.</i>			
Verif. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (Lpm)	Sampler (a)	Transfer Standard (b)	Pct. Difference (a-b)/b x
1. Design FR			
<b>Initial Readings:</b> <i>Use this section to record multipoint verification readings and/or readings taken before the sampler is recalibrated.</i>			
Calib. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (Lpm)	Sampler (a)	Transfer Standard (b)	Pct. Difference (a-b)/b x
1. Design FR			
2. Design FR - 10%			
3. Design FR + 10%			
<b>Final Readings:</b> <i>Record readings after the sampler's calibration response has been adjusted. Fill out this section only when performing the multipoint recalibration procedure.</i>			
Calib. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (Lpm)	Sampler (a)	Transfer Standard (b)	Pct. Difference (a-b)/b x
1. Design FR			
2. Design FR - 10%			
3. Design FR + 10%			
<b>Reverification Results:</b> <i>Fill out this section only if a sampler has been recalibrated.</i>			
Verif. Std. Make/Model.:		Serial No.:	Date:
Location (Field Site ID or Laboratory):		Operator or FS:	
Reading (Lpm)	Sampler (a)	Transfer Standard (b)	Pct. Difference (a-b)/b x
1. Design FR			
<b>Reverification Result:</b> <input type="checkbox"/> Pass <input type="checkbox"/> Fail			
<b>Notes:</b>			