

**STANDARD OPERATING PROCEDURE
FOR
MEASUREMENT OF PM10 METALS USING THE
BGI PQ167R LOW VOLUME SAMPLER**



**U.S. Environmental Protection Agency
Region 4, Science and Ecosystem Support Division
Athens, Georgia, 30605**

Acknowledgement

This Standard Operating Procedure (SOP) was developed by EPA Region 4, Science and Ecosystem Support Division. This SOP is based on the Commonwealth of Kentucky's ambient monitoring SOP template. Special thanks to BGI Inc. for operational content and illustrations.

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I. INTRODUCTION

This procedure is designed to provide instruction on collecting suspended airborne particulates with a size diameter of 10 microns or smaller (PM10) using the BGI PQ167R air sampler for metals analysis.

The BGI PQ100 is an "Intelligent Air Pump" that can monitor its own airflow rate and thereby adjust the pump speed to compensate for changes in load pressure and/or other forces which would otherwise hamper the flow of air through a filter (or sample collector). The PQ100 can be programmed to begin its sampling job at a specific date, time, and stop sampling after the user defined run time is depleted. However, the sampling time should always be 24 hours for the Toxics in Schools Study.

The PQ100 was designed to operate from 1 standard liter per minute (1000 cc per minute) to 25.0 standard liters per minute and is unaffected by changes in ambient temperature and barometric pressure. The flow rate precision is guaranteed to 2% of the calibration set point.

This SOP is designed to be a step by step method for operating the sampler to be used in conjunction with the manufacturer's operators manual. Laboratory Analysis Methodology may be referenced by contacting the Eastern Research Group (ERG) directly at 919-468-7800 or by email Julie.Swift@erg.com. Maintenance and troubleshooting should be conducted using the BGI167R operator's manual.

FIGURE 1. Schematic of PQ167 Sampling System

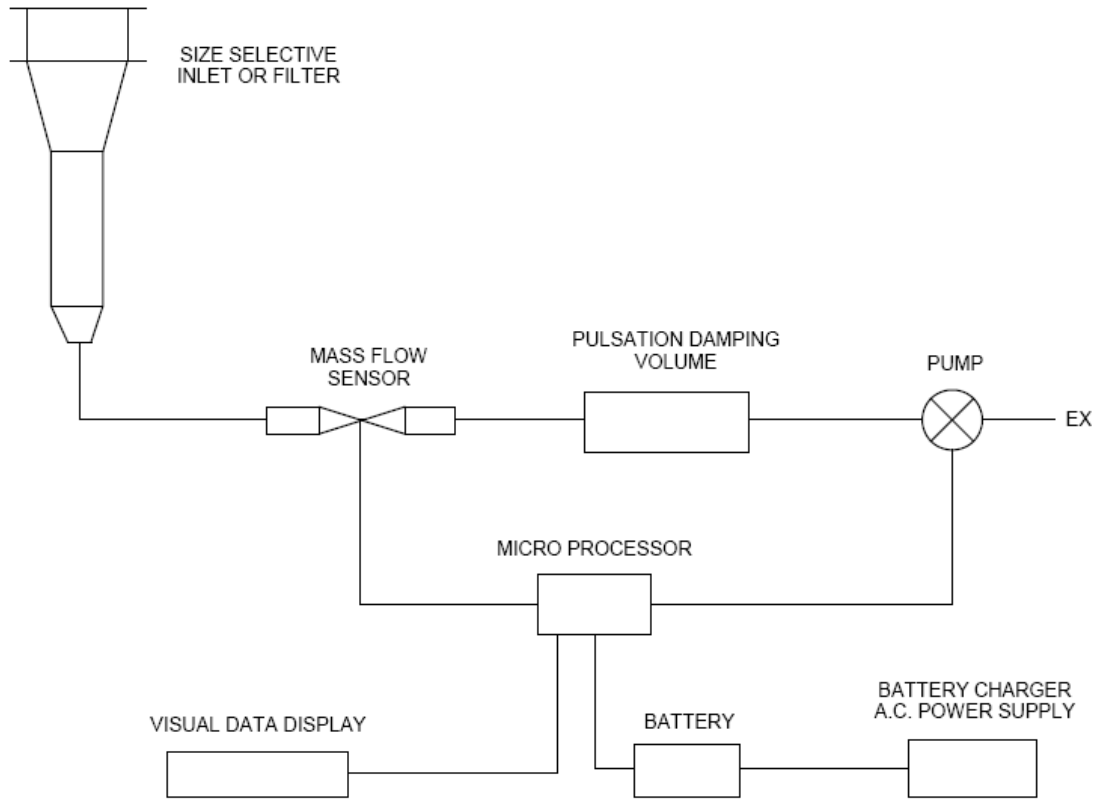
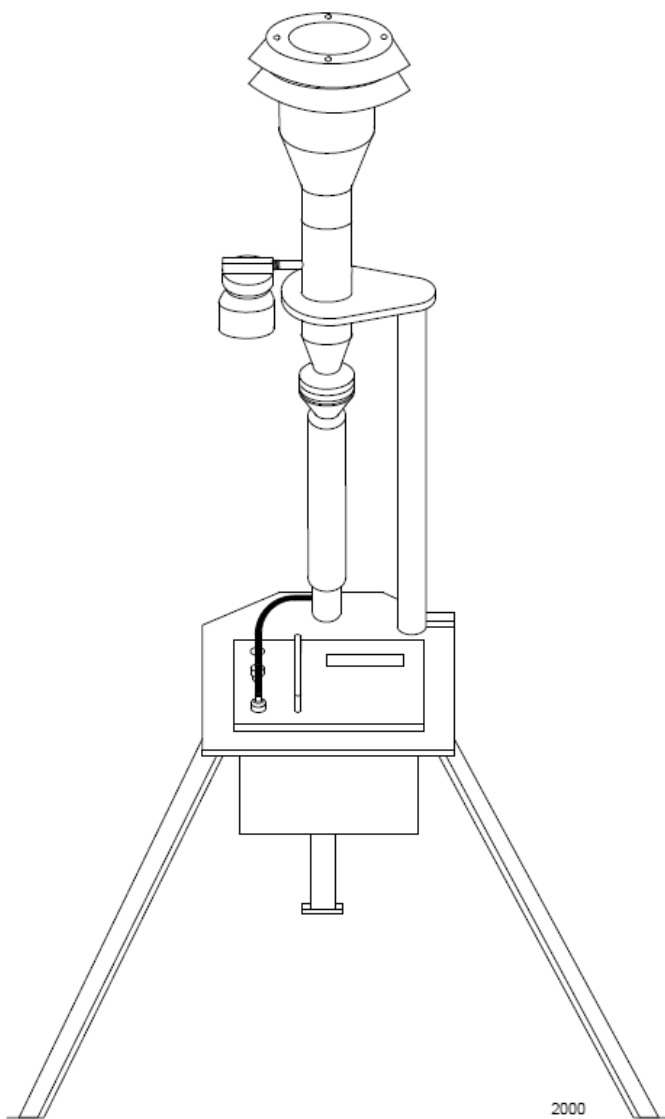


FIGURE 2. PQ167R with Mounting Stand



II. INSTALLATION

A. Sampler Siting

Check the areas for safety. Ensure there will be enough room for the operator to move freely while working, and ensure physical conditions of the location will allow the operator to work safely.

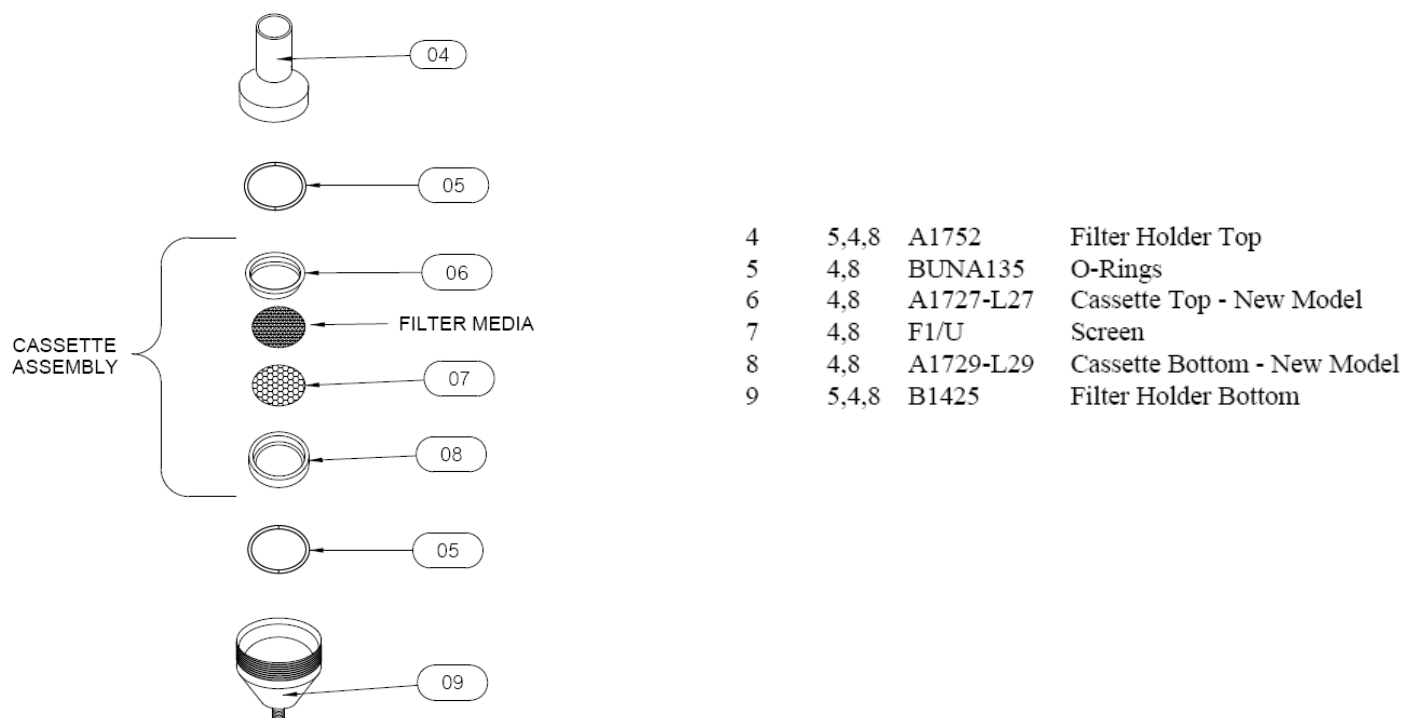
The sampler should be set in a location unobstructed from any side. No tree limbs or other hanging obstructions should be above the sampler. It is suggested that the horizontal distance from the sampler to the closest vertical obstruction higher than the sampler be at least twice the height of the vertical obstruction.

Locate the sampler on a reasonably level structure at a height between two (2) and fifteen (15) meters above the ground.

B. Sampler Installation

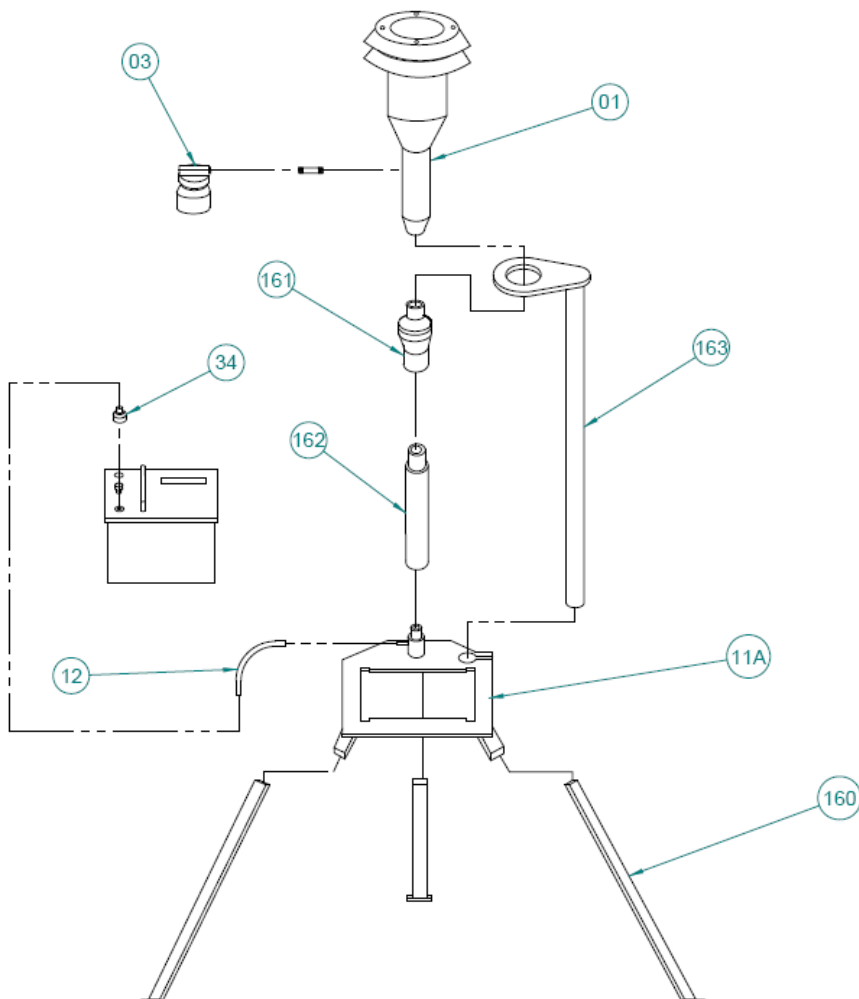
Assemble the filter cassette holder according to Figure 3. For detail and illustration, refer to the BGI PQ167 Quick Start document, pages 2 through 8.

FIGURE 3. Cassette and Cassette Holder Assembly



Assemble the sampler according to Figure 4. For detail and illustration, refer to the BGI PQ167 Quick Start document, pages 2 through 8.

Figure 4. Sampler Assembly Diagram



- 01 PM10 Inlet head
- 03 Water collection bottle
- 11A Tripod frame
- 12 Rubber hose
- 34 Hose adapter
- 160 Sampler leg
- 161 Filter cassette holder assembly
- 162 Downtube
- 163 Downtube assembly brace

Place and level the sampler on site. To secure the sampler and protect

membrane roofs, 2 x 4 wooden studs may be cut into one foot sections and fastened to the feet of the legs using lag bolts. Place sand bags on these skids to prevent tipping of the sampler.

Connect the sampler to a grounded electrical outlet with 115 volts, and at least 5 amp service. Protect the connector from precipitation by fastening beneath the sampler or wrapping it with plastic tape.

If collocated samplers will be located at the site, the two samplers must be within four (4) meters of each other, but outside of two (2) meters. The inlet heights must be within one (1) meter vertically.

III. OPERATING PROCEDURE

A. Equipment and Supplies

BGI PQ167R
Flow Calibrator
Logbook
Pre-weighed 47mm filter cassette(s) in antistatic bag
Powderfree gloves
ERG sample paperwork

B. Initial Receipt Activities

1. Plug sampler into AC power and charge the internal battery for at least 24 hours.
2. Check parts and components against the packing list.
3. After charging, ensure sampler will power up and that the main screen is operational.

C. Verification

NOTE: THE PQ100 DOES NOT REQUIRE A LEAK TEST. CUTTING OFF THE FLOW OF AIR BY COVERING OR RESTRICTING THE AIR FLOW TO THE INLET WILL CAUSE DAMAGE TO THE INTERNAL PUMP AND WILL VOID THE WARRANTY.

To VERIFY flow:

1. Remove the PM10 inlet head and downtube. Unscrew filter cassette holder assembly and place a test filter cassette, with filter facing up, in the bottom holder assembly. Replace top holder assembly and reinstall the entire filter cassette assembly on the sampler.

NOTE: The filter cassette should not be the same one used for the actual run event.

2. Take off the PM10 inlet head and replace with a NIST traceable flow standard. Ensure the flow standard is on and has equilibrated to ambient conditions.
3. Turn on the PQ167R by pushing the "ON/OFF" button. If a message is blinking on the display, press "ENTER" to proceed to the "MAIN IDLE DISPLAY".

The screen display should read:

ET0000Min TS00.00M (Date)
Q(Flow)Lpm T(Time) Bty(Capacity)%

(Date) – today's date in military notation; e.g., 01JAN= January 1st
(Flow) - the current flow rate selected to be regulated.
(Time) - military time; e.g., 13:08= 13 Hours 8 Minutes or 1:08 PM
(Capacity) - remaining charge in the internal battery.

4. Press SETUP three times until the Set START DATE and TIME screen appears: The screen should appear as below:

Set START DATE and TIME
(Date) (Time) Off
5. The word, "Off", should be displayed in the lower right corner of the screen. The bottom line of the display should be flashing. If "On" is displayed, press the "ENTER" button until "On" stops flashing. Then toggle to "Off" by pressing the + or – buttons.
6. Press the "SETUP" button twice to get to the "MAIN IDLE DISPLAY"
7. Press the "RUN/STOP" button to activate the pump.
8. Allow the pump to stabilize for at least 2 minutes.

9. If the measured flow and the flow indicated on the flow standard are within 4%, the sampler's calibration is acceptable. If the flow is outside 4%, the unit must be recalibrated.
10. Press the "RUN/STOP" button to turn off the pump.

D. Calibration

NOTE: THE PQ100 DOES NOT REQUIRE A LEAK TEST. CUTTING OFF THE FLOW OF AIR BY COVERING OR RESTRICTING THE AIR FLOW TO THE INLET WILL CAUSE DAMAGE TO THE INTERNAL PUMP AND WILL VOID THE WARRANTY.

To CALIBRATE flow:

1. Insert test filter cassette in filter cassette holder as described in C. Verifications Step 1.
2. Press "SETUP". The screen will read; "Select FLOW RATE"
3. From the "MAIN IDLE DISPLAY" press the "Setup" key once until the message below appears;

Select FLOW RATE

Target Q should read 16.7 (See Sect. 6.4 of the operator's manual to select a new target Flow Rate.)

4. From the "Select FLOW RATE" message screen, press both the "Reset" key and the "Run/Stop" key simultaneously to enter the calibration mode and the message below will appear;

CALIBRATE Target=16.7 Lpm

5. Press the "RUN/STOP" button to activate the pump and the message below will appear:

CALIBRATE Target = 16.7 Lpm
Reference Q.. XX.X

The Reference Q is an approximate flow rate used only as a visual aid in finding the corrected flow on the calibration device. This value may indicate 5 to 15% error. This is for reference only!

6. Use the "+/-" keys to move the pump speed up or down until the calibration device indicates the desired flow rate.

7. When a stable reading has been achieved, press the "ENTER" key to store the flow rate.
8. Exit the Setup menu and return to the "MAIN IDLE DISPLAY". CALIBRATIONS ARE NOT AFFECTED UNTIL THE ENTER KEY IS PRESSED AND THE PUMP IS RUNNING.
9. Record pre- and post- flow measurements and adjustments in the logbook.

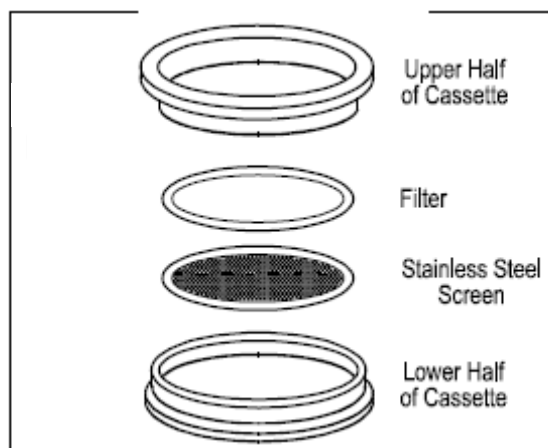
E. Conducting the Sampling Event

Prior to going to the monitoring site, a filter must be loaded into a clean cassette. The following describes procedures for cleaning the filter cassette and loading the filter into the cassette.

Cleaning the filter cassette

1. Disassemble the "sandwiched" three parts of the cassette (top, bottom, and stainless steel screen). The easiest way to remove the top from the bottom is to firmly grasp the top and bottom and firmly twist. The parts are diagrammed below in Figure 5.

Figure 5. Cassette Assembly Diagram



2. The components of the cassette should be cleaned using a detergent or solvent that will not leave a residue that may contaminate the sample. A 1% solution of Liquinox© and deionized water has been used successfully for cleaning, but Staticide©, or another alcohol based cleaner may be used without dilution.

3. Wearing gloves, wipe down the surfaces of the disassembled cassette parts with a low-lint wipe such Kim-wipes©. Set the parts aside to dry for approximately 30 minutes.

Loading the filter into the cassette

4. Filters should be loaded into the cassettes in clean laboratory or office environment. Do not load filters in the field.
5. Clean the area where loading will occur and put on powder-free latex gloves.
6. Identify the lower half of the cassette (i.e., the portion with the wider “inner ring”); place this item on a clean surface with the flat wide surface down.
7. Using Teflon forceps, pick up the stainless steel screen and place it in the lower half of the cassette. There is no “up side” to the screen.
8. Using Teflon forceps (do not use metal), carefully pick up a filter **touching only the plastic ring** on the filter from the shipping holder (i.e., Petri dish in which it was shipped and received). Hold the filter against a light to inspect for pinholes, discoloration, wrinkles, tears, or contamination. If any of these defects are discovered, discard the filter and select another.
9. Using Teflon forceps, place the filter in the lower half of the assembly on top of the screen. The side of the filter displaying a number should be visible when looking down at the filter. The filter must be discarded if the filter itself is touched by anything other than the forceps.
10. Place the upper half of the cassette on top of the lower half and firmly press down until the top and bottom halves are seated. Use equal pressure across the top half; do not twist.
11. The filter should be flat in the cassette without wrinkles, contamination, or holes. If any of these issues are observed; repeat the loading procedure.
12. Place the filter cassette assembly in the transport container provided by the laboratory to protect it during transit to the monitoring site.
13. Note: if a PM2.5 FRM or low volume PM10 weighing laboratory operates locally within the agency, the cassettes can be cleaned and loaded using their facility and procedure.

Site arrival activities

1. Visually inspect the filter holder and confirm the O-rings are in place and secure. Inspect all visible O-rings and replace if necessary.
2. Confirm all cables (electrical connections) are secure, and that exterior connections are protected from the elements.
3. Inspect the water collection jar. As needed, drain and clean, inspect the seal and replace the glassware on the holder.
4. Record activities and/or maintenance activities in logbook.

Preparing Sampler for a Sampling Event

1. Prepare sample paperwork. On the ERG PM10 Metals Sample Data Sheet, complete the "Lab Pre-Samp." and "Field Setup" sections. In the top part of the TSP/PM10 Metals table, record the filter number under "Filter #" and sampler ID under "System #" for the run. Record any pertinent observations in the notes section at the bottom of the form.
2. Turn on the PQ167R by pushing the "ON/OFF" button. If a message is blinking on the display, press "ENTER" to proceed to the "MAIN IDLE DISPLAY". Then press "RESET" to clear prior run data.
3. The screen display should read:

ET0000Min TS00.00M (Date)
Q(Flow)Lpm T(Time) Bty(Capacity)%

(Date) – today's date in military notation; e.g., 01JAN= January 1st
(Flow) - the current flow rate selected to be regulated.
(Time) - military time; e.g., 13:08= 13 Hours 8 Minutes or 1:08 PM
(Capacity) - remaining charge in the internal battery.
4. Press "SETUP". The screen will read; "Select FLOW RATE"
The flow rate value will be blinking.
5. The flow rate should read 16.7 Lpm. If it does not read 16.7 Lpm, set TARGET FLOW RATE to 16.7 Lpm by pressing ENTER. The whole number value will remain on constant while the tenths still blink); use "+" or "-" to increase or decrease until 16 is displayed. Press ENTER (Tenths value will now remain constant while whole number blinks); use "+" or "-" to increase or decrease until .7 is displayed.

6. Press "SETUP". This is the date and time screen.

The screen should read;

Set DATE and TIME
(dd) (mmm) (yyyy) (time)

To change the Date and Time;

TIP: Only the field not blinking can be adjusted. Push enter to move to the next field.

- a. DAY: Press ENTER and change by pressing the + or - key. When the day is correct, press ENTER.
 - b. MONTH: To change, press + or - key. When correct, press ENTER.
 - c. YEAR: To change, press + or - key. When correct, press ENTER.

 - d. TIME (hrs): To change, press + or - key. When correct, press ENTER.
 - e. TIME (min): To change, press + or - key. When correct, press ENTER.
7. When date and time are correct press "SETUP"
 8. This is the sample start screen which reads;

Set START DATE and TIME
(dd) (mmm) 00:00 Off

This screen allows you to set a start date and time for a sampling run. The default is set to midnight the next day. To designate your own start date and time:

- a. DAY: Press ENTER and change by pressing the + or - key. When the day is correct, press ENTER.
- b. MONTH: To change, press + or - key. When correct, press ENTER.
- c. YEAR: To change, press + or - key. When correct, press ENTER.

- d. TIME (hrs): To change, press + or - key. When correct, press ENTER.
- e. TIME (min): To change, press + or - key. When correct, press ENTER.
- f. Enable the run by setting the "On/Off" function on the screen to "On".

WARNING: The sampler will not automatically activate if this option is set to "Off".

9. Press "SETUP"

The screen will read;

Set RUN TIME
Hours: 24 Min: 00 On

Set to 24 hours 0 minutes. The default is always 24 hrs 0 min, the required sample duration. If the sample time needs to be modified, adjust as instructed in step 6 and 8.

10. Press "SETUP". The screen will return to the "MAIN IDLE DISPLAY"

WARNING: DO NOT PRESS THE RESET BUTTON AT THIS TIME AS THE START TIME AND RUN TIME WILL DEFAULT.

11. Press "RUN/STOP"

If the START TIME ENABLE is set to "On" then the message "Alarm Triggered Run..." followed by "PQ100 Powering Down.." will appear briefly. The PQ100 is now waiting for the internal real time clock to achieve the designated start time and will then power itself on and begin the sampling run. If the START TIME ENABLE is set to "Off" then the pump will begin to run immediately. If this occurs, press RUN/STOP and begin back at step 2 ensuring START TIME ENABLE is set to "On".

Retrieving Filter Cassette from Filter Cassette Holder

Prior to loading a new filter cassette into the sampler, the sample cassette must be removed

1. Remove the PM10 inlet head and downtube and set aside.

2. Remove filter cassette holder.
3. Put on a clean pair of powder free gloves
4. Open a cassette transport container and set aside.
5. Unscrew filter holder top from filter holder bottom.

NOTE: Gloves must be changed for each sample, i.e. between retrieving a sample and preparing a new run, gloves MUST be changed to prevent cross contamination.

6. Remove filter cassette and place it back into the cassette transport container.

Loading Filter Cassette into Filter Cassette Holder Assembly

1. Remove gloves and put on new pair of powder free gloves.
2. Open the cassette transport carrier containing the clean filter and cassette; set the cap to the side and remove the clean cassette.
3. Place the filter cassette filter side up onto the filter holder bottom. Carefully screw the filter holder top onto the filter holder bottom. Remember to annotate the filter number on the ERG PM10 Metals Sample Data Sheet.
4. **If running a field blank, repeat steps 1 through 3, count to 10, and then remove the field blank filter cassette placing it back into its transport container. Ensure the transport container carrying the blank is clearly labeled / distinguishable from the other transport containers. Log the filter ID as field blank in the comments section of the ERG PM10 Metals Sample Data Sheet. The field blank must be run before the sample filter cassette is loaded into the sampler.**
5. Replace the filter cassette holder assembly on the sampler.
6. Replace the downtube and the PM10 head.

Field Data Recovery

On the ERG PM10 Metals Sample Data Sheet, fill in the "Field Recovery" section. In the TSP/PM10 Metals table, fill in the "End Time", "Total Time" (ETXXXXMin), and "Avg Flow (L)" (QXX.XLpm). Record the total sample volume (TSXX.XM) in the comments section. "Start MFC" and "Stop MFC" are not used; in their place record start

and end flow rates in LPM.

Filter Retrieval from Cassette

Filters should be retrieved from the cassettes in clean laboratory or office environment. Do not retrieve filters in the field.

1. Clean the area where loading will occur and put on powder-free latex gloves.
2. Open the filter cassette transport container and remove the sample cassette.
3. Open the cassette ensuring the bottom portion of the cassette (i.e., where filter is seated) is down. Place upper / top portion of the cassette to the side.
4. Using Teflon forceps (do not use metal), carefully pick up the filter **touching only the plastic ring** on the filter and place in the shipping holder (i.e., Petri dish in which it was shipped and received).
5. Place the shipping holder in the bubble wrap mailer provided by ERG. Place mailer in with canister or cooler, if applicable, or simply mail on its own.

Sample Shipping

1. Place the filter shipping holder and appropriate paperwork (sample data sheet / COC form) in the bubble wrap mailer provided by ERG.
2. Use the pre-filled out FedEx label provided by ERG, and fill out the "Sender" section with the sampling agency's address and phone number. Send priority overnight to ERG.
3. If the shipping form is lost, use the address below for shipping to ERG, and contact them directly for the FedEx accounting.


ERG
601 Keystone Park Drive
Suite 700
Morrisville, NC 27560
919-468-7924

IV. DATA FORMS

All sample related data forms will be supplied by ERG; the ERG PM₁₀ / TSP Sample Data Sheet is attached. ERG will complete all Lab Pre-Sampling and Lab Recovery info. The site operator is responsible for completing the info in the Field Setup and Field Recovery sections, as well as the following in the PM₁₀ / TSP METALS section:

Sample Date	
Start Time	
End Time	
Total Time	
Start MFC	} <i>Simply report Start Flow and End Flow in LPM</i>
End MFC	
Avg Flow (L)	
System #	<i>If already established continue with same; if not yet established recommend Sampler ID (3 digits)</i>
Filter #	<i>Printed on the filter</i>
Comments	<i>Record the total sample volume (TSXX.XM) plus any additional noteworthy info especially re: operational deviations</i>

ERG PM10 Metals Sample Data Sheet

		ERG Lab ID # _____
PM₁₀ / TSP METALS DATA SHEET		
Lab Pre-Samp.	Site Code: _____ City/State: _____ AQS Code: _____	Collection Date: _____ Duplicate Event (Y/N): _____
Field Setup	Set-Up Date: _____ Operator: _____	
Field Recovery	Recovery Date: _____ Sample Duration (i.e. 24 hr): _____ Status: Valid Void (Circle one)	
Lab Recovery	Received by: _____ Date: _____ Status: Valid Void (Circle one) If void, why: _____	

PM₁₀ / TSP METALS	Sample Date	Start Time	End Time	Total Time	System #	Filter #	Lab ID
		Start MFC	End MFC	Avg Flow (L)			
	Sample Date	Start Time	End Time	Total Time	System #	Filter #	Lab ID
		Start MFC	End MFC	Avg Flow (L)			
	Sample Date	Start Time	End Time	Total Time	System #	Filter #	Lab ID
		Start MFC	End MFC	Avg Flow (L)			

Comments: _____

White: Sample Traveler

Canary: Lab Copy

Pink: Field Copy