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NORTH CAROLINA  
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DAQ-11-001.2 Standard Operating Procedure (SOP)  
Thermo Scientific 2025i Standard Procedures for Operators  
Revision 1.0



Approval Sign Off-Sheet

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I certify that I have read and approve of the contents of the DAQ -11-001.2 Standard Operating Procedure (SOP) Thermo Scientific 2025i Standard Procedures for Operators with an effective date of June 1, 2022

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Disclaimer: This document, and any revision hereto, is intended solely as a reference guide to assist individuals in the operation of the instrument, related to the North Carolina Division of Air Quality's Ambient Monitoring Program.

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## 1.0 SCOPE AND PURPOSE

The U.S. Environmental Protection Agency (EPA) began regulating fine particles in July 1997. The regulation established the gravimetric based federal reference method (FRM) in the Code of Federal Regulations (CFR) at 40 CFR Part 50, Appendix L. This document has been prepared to assist the field operators with the North Carolina Division of Air Quality (DAQ) to use the EPA reference method to monitor the ambient atmosphere for particles with an aerodynamic diameter of 2.5 micrometers ( $\mu\text{m}$ ) or less ( $\text{PM}_{2.5}$ ), known as fine particles. Fine particles are formed in the atmosphere from gases such as sulfur dioxide, reactive oxides of nitrogen, and volatile organic compounds. Sources include power plants, diesel trucks, wood stoves, and industrial processes.

The objective of this standard operating procedure (SOP) is to familiarize the station operator with the activities used in the collection of air monitoring data. The accuracy of data obtained from any instrument depends upon the instrument's performance and the operator's skill. It is important that the station operator become familiar with both this SOP as well as the manufacturer's operation manual to achieve a high level of data quality. This SOP is to be used as an outline and is not intended to replace the equipment manufacturer's manual or procedures.

The following document describes the operation and field technician or operator's responsibilities for the Thermo Scientific Inc. Partisol 2025i Sequential Air Sampler. The sampler will be referred as the 2025i from this point forward.

## 2.0 SAMPLER DESCRIPTION AND ASSEMBLY

### 2.1 Description of the 2025i Sequential Air Sampler

The 2025i is designed to meet the EPA requirements for  $\text{PM}_{2.5}$  sampling (40 CFR Part 50, Appendix L). The 2025i can operate using a variety of inlet systems. By utilizing an automated filter exchange system and having the capability to hold up to 16 filters, the 2025i can run unattended for up to 2 weeks on a daily sampling schedule.

For  $\text{PM}_{2.5}$  sampling, a 2025i sampler draws a known volume of ambient air at a constant flow rate through a  $\text{PM}_{10}$  (particulate matter with aerodynamic diameters of 10  $\mu\text{m}$  or smaller) size-selective inlet (Figure 1) followed by a very sharp cut cyclone (VSCC, Figure 3) particle size separator. The VSCC which removes particles in the 2.5 to 10  $\mu\text{m}$  range. Particles in the  $\text{PM}_{2.5}$  size range are then collected on a Teflon™ filter during a specified 24-hour sampling period. Each sample filter is weighed before and after sampling to determine the net weight (mass) gain of the collected  $\text{PM}_{2.5}$  sample. This mass concentration is reported as micrograms per cubic meter at local conditions.

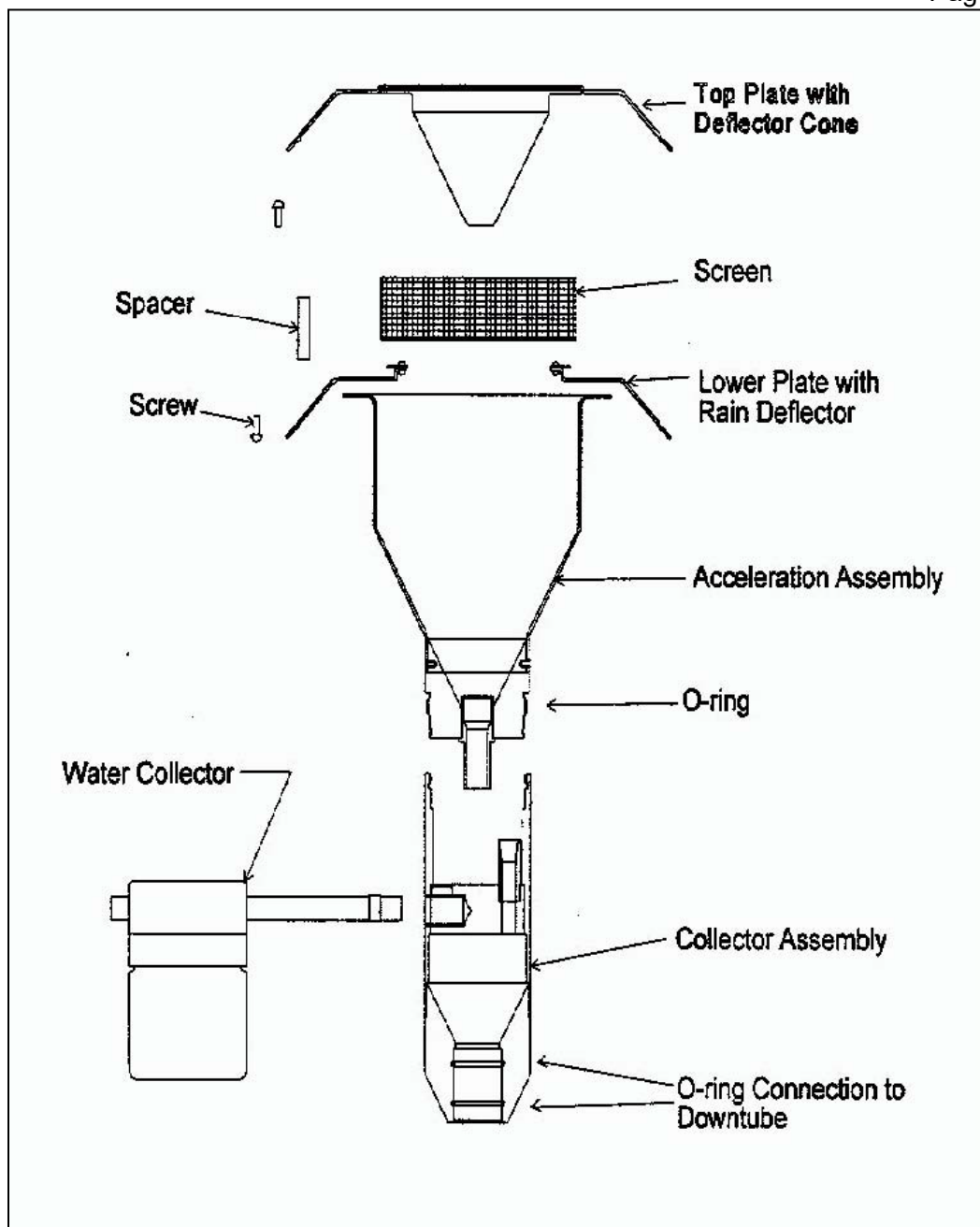
For  $\text{PM}_{10}$  sampling, a 2025i sampler can also be used. The VSCC is removed and replaced with a pass-through adapter tube. Particles in the  $\text{PM}_{10}$  size range are then collected on a Teflon filter during a specified 24-hour sampling period. Each sample filter is weighed before and after sampling to determine the net weight (mass) gain of the collected  $\text{PM}_{10}$  sample. This mass concentration is reported as micrograms per cubic meter at standard conditions (25 degrees Celsius [ $^{\circ}\text{C}$ ] and 760 millimeters mercury [mmHg]). The two different configurations of Set Temp/Flow Screens are shown later in this SOP to

reflect the difference between reporting  $PM_{2.5}$  at local conditions and  $PM_{10}$  at EPA standard conditions (Section 4.5.3.4). The reference method for  $PM_{10}$  sampling is given in the Code of Federal Regulations (40 CFR 50, Appendix J).

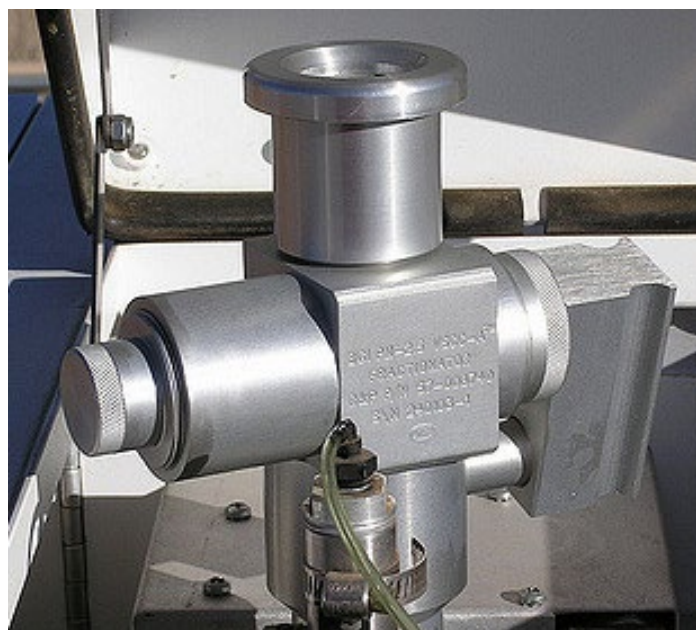


**Figure 1.**  $PM_{10}$  Inlet.

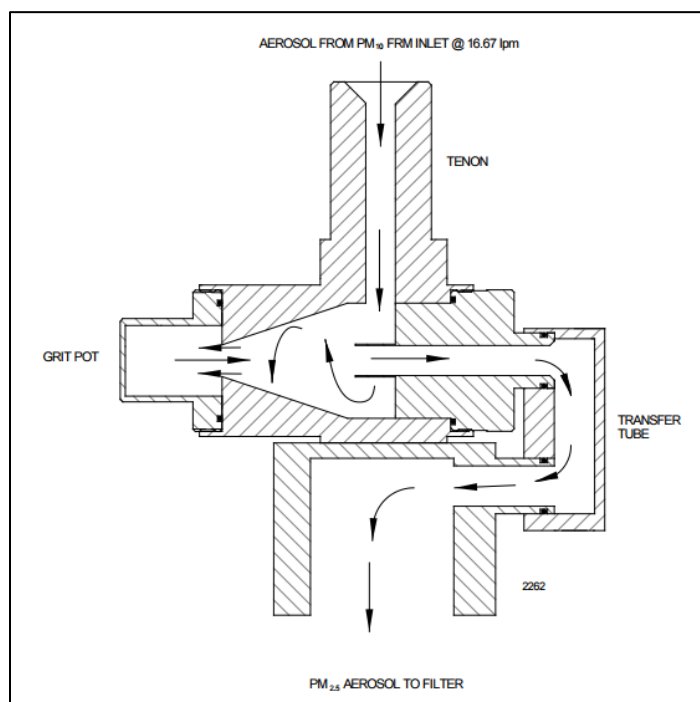




**Figure 2.** Exploded Cross-Sectional View of PM<sub>10</sub> Inlet.



**Figure 3.** Very Sharp Cut Cyclone (VSCC).



**Figure 4.** Operation of the VSCC.

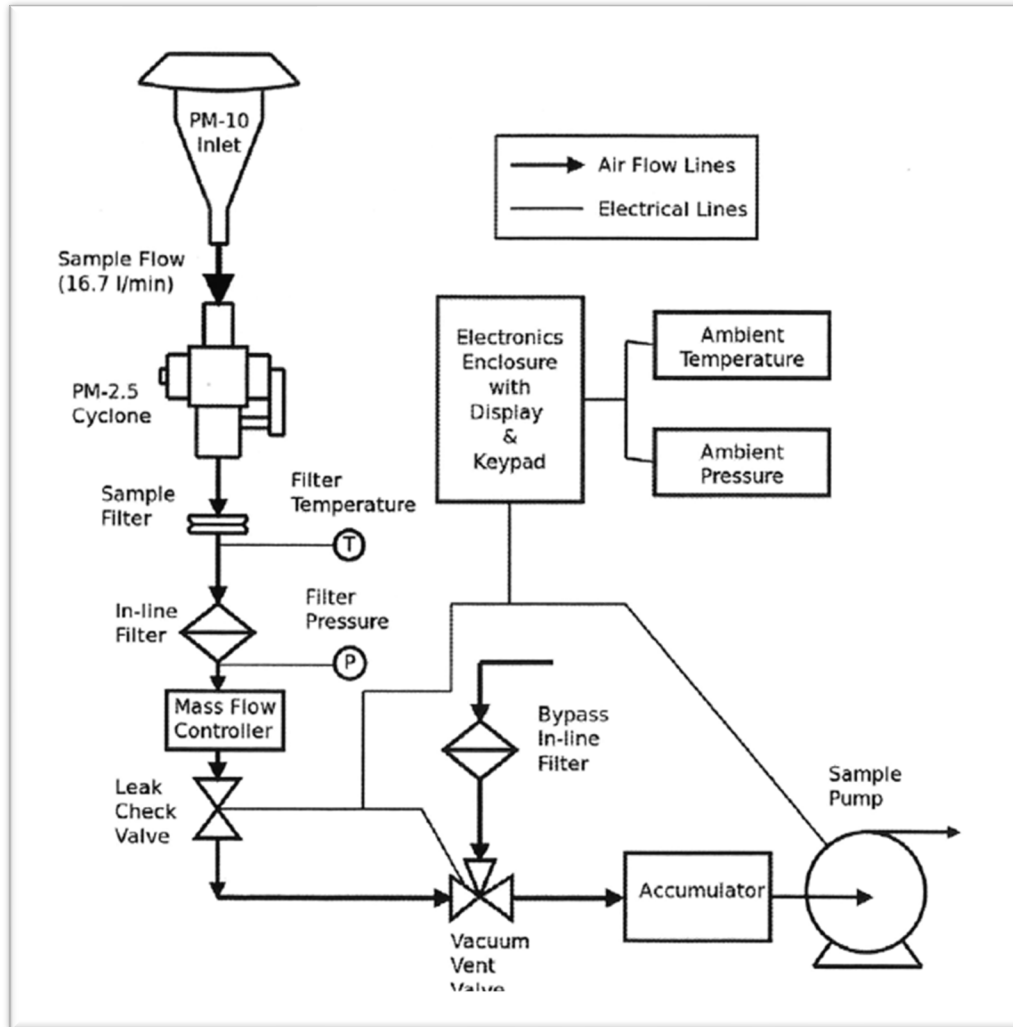


Figure 5. 2025i Flow Schematic.

## 2.2 Principles of Operation

Ambient air is sampled starting at the top of the instrument at the PM<sub>10</sub> inlet and through the PM<sub>2.5</sub> VSCC. The inlet and VSCC rely heavily on flow rate to cyclone out the correct particles. The sampler can maintain a constant volumetric flow rate of 16.67 liters per minute (LPM) by utilizing a mass flow controller to vary flow based on ambient temperature and pressure.

The microprocessor calculates the mass flow set point using the following formula:

$$\text{Flow Rate (Set Point)} = \text{Flow Rate (Vol.)} \times (273.15 / \text{Current Temp. } ^\circ\text{K (degrees Kelvin)}) \times (\text{Current Pres. mmHg} / 760)$$

where  $^\circ\text{K} = ^\circ\text{C} + 273.15$ .

The sample is collected on a 47 millimeter (mm) filter housed in a Delrin cassette. The 2025i sequential samplers has an automated filter exchange mechanism that allows for uninterrupted sampling on up to 16 filters at user selectable intervals. Please refer to Figure 5 for a flow schematic of the 2025i.

## 2.3 Assembly

### 2.3.1 Physical Inspection

Each 2025i should be supplied with the following supplies:

1 Partisol enclosure with	1 ambient temperature sensor and cable
1 PM2.5 VSCC	1 i-Port Instruction Manual with software CD
1 PM10 Inlet	1 9-to-9 pin computer cable
1 sample tube	1 Operating Manual
1 pass-through adaptor tube	1 Quick Start Guide
3 rain hoods and associated hardware	1 leak check plate
1 flow audit adapter	1 stand assembly
2 filter cassette canisters	1 Quick Start Guide
1 canister transport container	1 10-key keypad

Upon installation of the 2025i at the site by ECB, visually inspect it to ensure that all components are accounted for. Inspect the instrument for external physical damage due to transport, such as scratched or dented panel surfaces and broken knobs or connectors. Open the instrument cover and inspect the interior of the instrument for damage, such as broken components or loose circuit boards. If no damage is evident, the monitor is ready for installation, calibration, and operation. Notify ECB immediately if any equipment is missing or damaged.

## 3.0 SUMMARY INFORMATION SPECIFIC TO THE INSTRUMENT

### 3.1 Safety Precautions

Installation, operation, maintenance, and calibration of the sampler should only be performed by properly trained personnel. High voltages are used to power the unit. Due to typical rooftop installations, the risks of working outdoors at elevation should also be considered. To prevent injury from the sampler falling over, the sampler should be securely mounted to the stand using the included hex head bolt hardware and washers. The stand should be properly secured or anchored to the floor/platform.

### 3.2 Interferences

Special precaution must be taken when handling the PM<sub>2.5</sub> filter cassettes. It is strongly recommended that the instrument operator take extreme care when handling the filters to prevent contamination. The Teflon filter is extremely delicate. Any foreign object touching the surface may result in pinholes and, subsequently, the invalidation of the sampling run.

### 3.3 Siting Criteria






The installation of the 2025i should follow the siting criteria requirements in 40 CFR Part 58, Appendix E for the sampled filters to be considered valid. General siting criteria include:

1. Being greater than 20 meters from a tree drip line, and at least 10 meters from a tree drip line,
2. Being greater than 1 meter horizontally away from another probe,
3. Having the probe inlet located 2-15 meters above ground; and
4. Being twice the distance from a structure or tree that acts as an obstruction, as the structure or tree protrudes above the inlet.

### 3.4 Resetting 2025i Memory

**WARNING: RESETTING THE MEMORY ERASES ALL CALIBRATION AND SAMPLER SETTINGS AND RESTORES ALL SETTINGS TO DEFAULT FACTORY VALUES. USE THIS OPTION ONLY WHEN NECESSARY. RECORD ALL CALIBRATION OFFSETS BEFORE RESETTING TO AVOID RE-CALIBRATING THE SAMPLER AFTER RESET.**

The Restore Defaults screen is used to reset the user calibration and configuration values to defaults. To view and record the calibration values prior to reset, the monitor must be in Service Mode. To view the values:

1. Select the  key to return to the Main Menu. Scroll down and select Service Mode and press .
2. Use the  key to toggle the value to On.
3. Select the  key to return to the Main Menu again. Select Audit and Calibration and press .
4. The flow calibration values will be listed under "Flow". The meteorological calibration values will be listed under "Cal. Intercepts".
5. To reset the memory, select "Restore User Defaults" under Instrument Setup.

## 4.0 LOGBOOK SETUP, SITE VISIT PROCEDURES AND CHECKS

### 4.1 Logbook Setup

An electronic logbook (e-log) must be created for each site at the beginning of the calendar year or upon setup. The 2025i FRM e-log consists of the spreadsheets listed in Table 1. The most current e-log version can be obtained from the Internet Based Enterprise Application Management (IBEAM) documents module, the Ambient/Documents/PM Monitoring SharePoint folder or by contacting the Raleigh Central Office (RCO) particulate matter lead.

**Table 1. Description of E-Log Spreadsheets.**

<b>E-Log Spreadsheet</b>	<b>Description</b>
Instructions	Setup of site information (Site Name, AQS [Air Quality System] ID, SiteID2). Provides a summary of operational evaluations and sampler maintenance for users.
File Naming Convention	Table for naming conventions for e-log and data downloads
Event Summary	Table for users to track dates of verifications, audits, and maintenance.
Calibration	Table for documenting sampler calibrations.
Verification Audit	Table for documenting all verifications and audits.
FTS Calculator	Table for calculating the flow using a manometer and flow orifice.
Maintenance Log	Table for documenting monthly, quarterly, and annual maintenance activities, as well as tape changes, leak checks, clock verifications, etc.
Sample Log	Table for recording important dates and times associated with each individual filter used.
AQS Upload	This spreadsheet is for RCO use. Formulas on this page generate the AQS upload files for all verifications and audits.

Initial setup of the e-log requires selecting the site name from a pull-down menu on the “Instructions” tab of the e-log. The AQS ID, pollutant, and BAM type field will automatically populate based on the site name.

#### **4.1.1 Guidance for Useful Logbook Documentation**

EPA has been providing guidance on record keeping requirements for Quality Assurance/Quality Control (QA/QC) programs. EPA has discussed the role that logbooks play in providing proof that Quality Assurance Project Plans (QAPPs) and SOPs are being followed. According to EPA, logbooks should, at a minimum, provide the following to be a useful tool for documenting the operations conducted at a monitoring site:

1. Purpose – Define the purpose of this site visit. Tell why you are there. Is it to replace a filter? Did you note something in the previous data download that is indicating a problem? Are you experiencing data drops and want to see if anything is wrong? In a couple of sentences, tell what you intend to do. Don’t say routine maintenance, say instead: “noted fluctuations in flow while reviewing the 5-minute average data”. Be specific.
2. Appearance – Tell how you found the site. If the site was secure, say so. If you noted a problem, or a changed condition, then document it in a couple of sentences: “construction has taken place in the vacant lot next to the site since my last visit”.

3. Action – Tell what you did. In a few short sentences describe the actions you took at the site: “cleaned the PM<sub>10</sub> head and replaced one of the two gaskets”. You might want to document any site computer updates that were run. Just things like that.
4. Results – Were you successful? Did you accomplish your goals? If so, then say so: “completed the monthly and quarterly maintenance and returned the monitor to “Wait” mode”. If not, then say so: “failed as-left leak check, contacted ECB”.
5. Response – Is the equipment operating within specifications set in the SOP? If so, then great, note that fact in the logbook and you are done. If not, then what did you do? If something is wrong then reach out for help and document it: “contacted Scott at ECB, he will be here presently with a new FRM.”
6. Reviewers should add their comments: “reviewed above, approved operator action.” Or: “upon review noted deviation from SOP”.

## 4.2 RTI Chain of Custody Forms and Sample Log

The chain of custody (COC) is an integral component of the PM<sub>2.5</sub> FRM program. The Quality Assurance Guidance Document 2.12 defines COC as an unbroken trail of accountability that verifies the physical security of environmental samples and documented information. The RTI Lab initiates the COCs, which are shipped with the filters to the regions and local programs. The complete COC includes the Master List and the Field List. Both pages of the forms need to be completed and returned to RTI as a complete COC. If filters in a partial batch are shipped to the lab, make a copy of the signed Master List and include it with the Field List that is shipped to RTI. If shipping filters to RTI, in two different batches make a copy of both Master lists from each batch and include the copies with the Field Lists that are shipped to the lab (See Appendix B).

### 4.2.1 Field Sample Log

Prior to using the RTI lab, DAQ printed filter data sheets and used them as the COC forms. Currently, there is no need for printing filter data sheets. RTI creates the COC forms needed for field operations. The field information that was previously entered on the filter data sheets can be found in the e-log (Field Sample Log). An example of the sample log can be found in the appendix of this SOP. Data reviewers will use the Field Sample Log in their review process in place of the filter data sheets used in the past.

## 4.3 Site Visit Procedures and Checks

### 4.3.1 Site Inspection

Before entering the station, the perimeter should be inspected for damage. Extreme weather conditions, neglect of station maintenance or vandalism that may have resulted in damage to the site since the operator's last visit. Once the operator has approached the site, she or he should first:

1. Check for any obvious sampler malfunctions. For example, check to see that the equipment is running, the pumps are operating, and the instrument is cycling properly.
2. Note any unusual odors or noise. An unusual odor may indicate a point source of a pollutant, or a strange new noise can indicate a malfunction in the equipment.

These observations should be recorded in the station logbook and may prove to be invaluable if the data are challenged. The station operator is responsible for making several observations during the station inspection. Any of the above-described observations must be thoroughly detailed in the site logbook.

It is the operator's responsibility to maintain the monitoring site. Routine maintenance includes keeping site clean and being observant of potential problems. Examples of potential problems include:

1. Accumulation of dirt and debris.
2. Infestation by rodents or insects.
3. Overgrowth of vegetation around the site.

#### **4.3.2 Site Logbook**

A station logbook must be maintained at each monitoring site and should accurately reflect site operations. The logbook will be identified with the station name, station number, date, time, operator, instrument identification, parameter, scale and units. All entries shall include the date, time, maintenance on equipment, and equipment changes. Additional information should include: maintenance performed on the station, abnormal traffic patterns or nearby construction. If the data is challenged, the information recorded in the logbook is invaluable. A written record of observations concerning abnormal operations or localized occurrences is critical if a violation of ambient air standards were recorded during this period.

#### **4.3.3 Equipment Inspection**

There are several routine duties that must be performed each time an air monitoring station is inspected. These duties include equipment inspection, performing calibrations, assisting during audits, documentation, and making necessary adjustments or repairs to the instruments.

It is suggested that each station operator consult the [Partisol 2025i Sequential Air Sampler Instruction Manual](#) and compile personal notes on troubleshooting as they gain experience with the instruments. The operator is encouraged to contact the ECB prior to attempting any repairs.

**The Operator's manual is the best resource the operator has for the information on the operation and maintenance of the PM<sub>2.5</sub> and PM<sub>10</sub> samplers.**



## 5.0 SAMPLER SETUP

### 5.1 Keypad Button Definitions

The 2025i uses a liquid crystal display (LCD) with menu driven soft keys to control the features and functionality of the monitor.

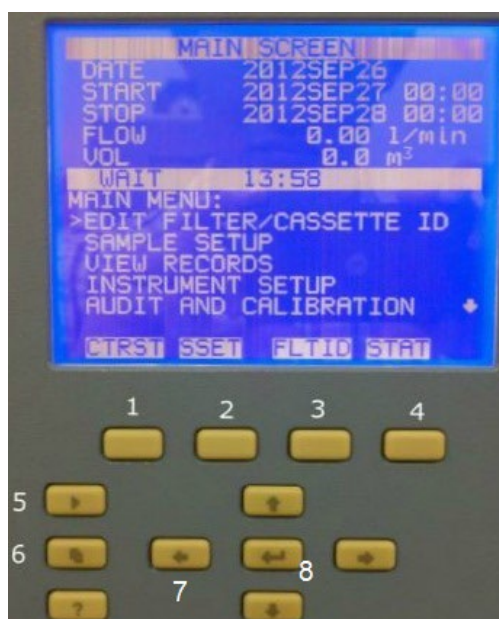


Figure 6. Screen with Soft Keys.

Number	Name	Definition
1.	CTRST	Soft key that adjusts main operating screen contrast.
2.	SSET	Soft key that allows user to go directly to the sample setup screen.
3.	FLTID	Soft key that allows user to go directly to the filter setup screen.
4.	STAT	Soft key that allows user to go directly to the status code screen.
5.	Run/Stop Key ▶	One press goes to full screen statistics, second press changes between RUN/WAIT and STOP modes.
6.	Menu Key ☰	Allows user to go back one menu level.
7.	Arrow Keys ↑ ↓ ← →	Allows the user to navigate around the menus.
8.	Enter Key ↵	Allows the user to confirm and save settings.

## 5.2 Menus

### 5.2.1 Main Menu

If the display contrast is not optimal, but the content on the screen is visible, in the Main Menu, choose Service > Screen Contrast, or press the CTRST soft key on the front panel, and adjust the screen contrast by pressing  $\uparrow$  or  $\downarrow$  as appropriate to change the contrast. Press  $\leftarrow$  to save the setting. If the content on the screen is not visible, press the leftmost front panel soft key once (the CTRST soft key), press  $\uparrow$  or  $\downarrow$  as appropriate to adjust the screen contrast, and press  $\leftarrow$  to save the setting.

**Note:** The optimal contrast will change with changes in temperature.

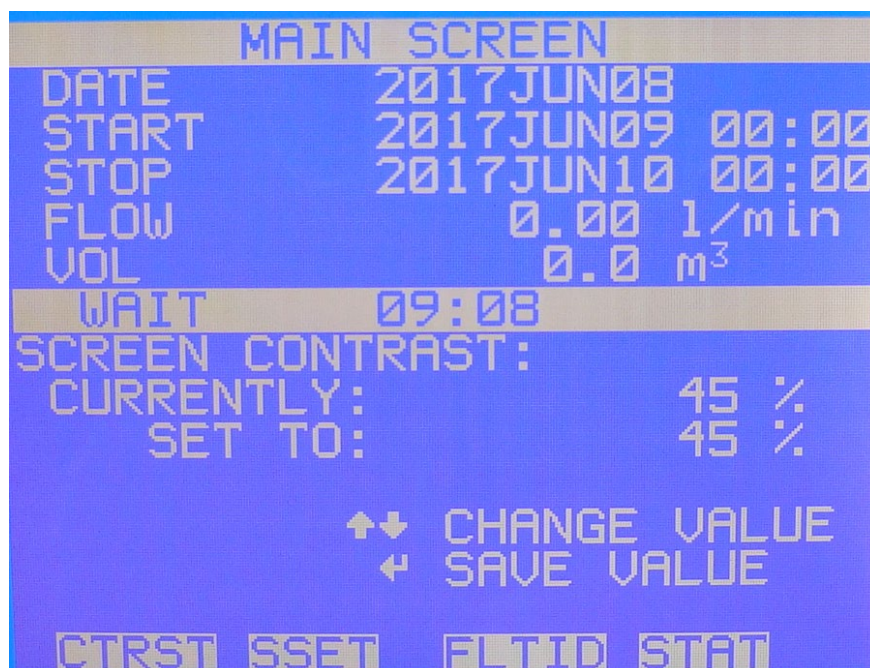


Figure 7. Screen Contrast Display.

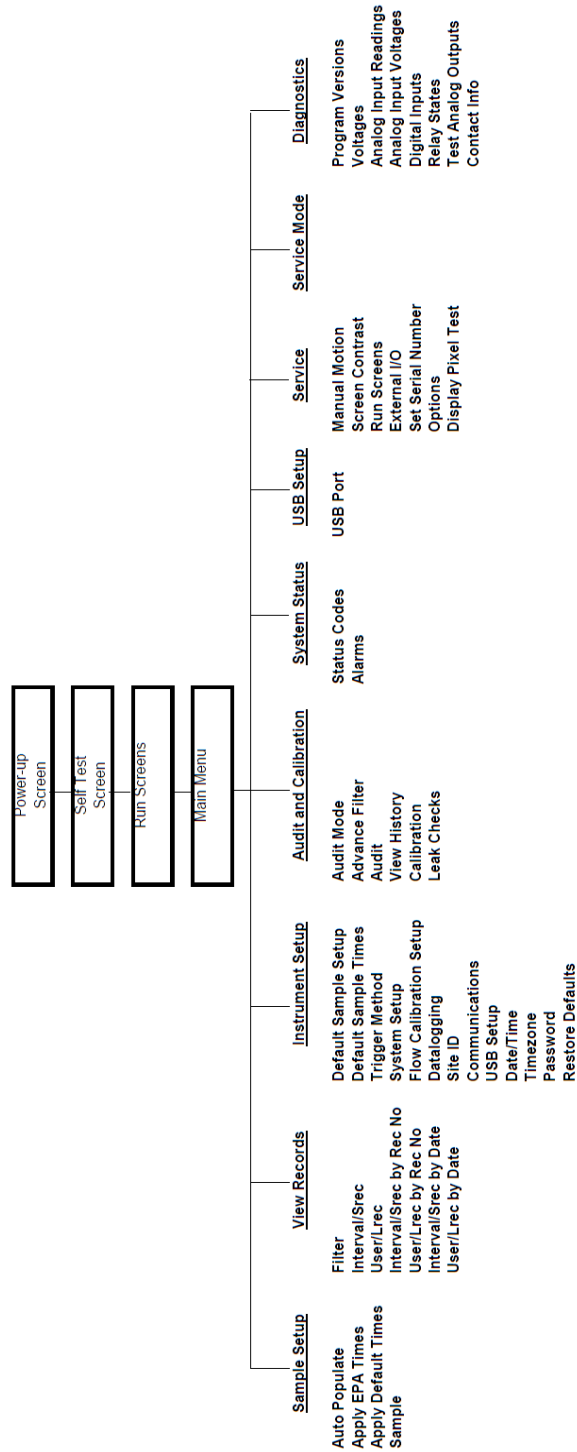
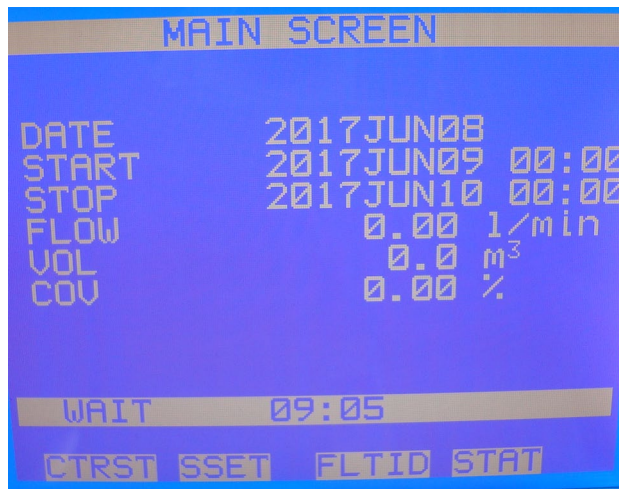
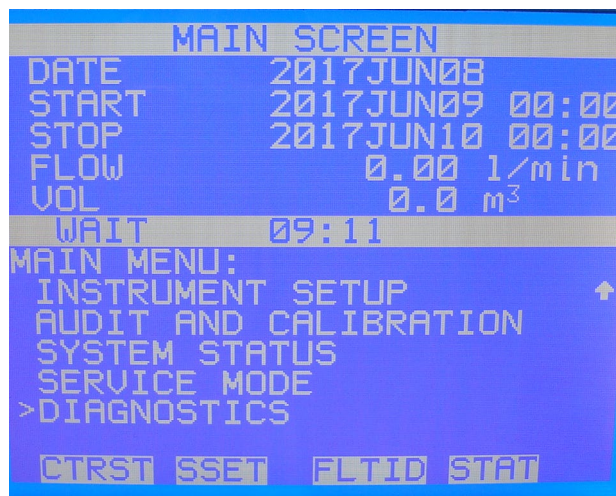


Figure 8. 2025i Flowchart of Menu-Driven Screens.



**Figure 9.** Main Menu when “Asleep”.



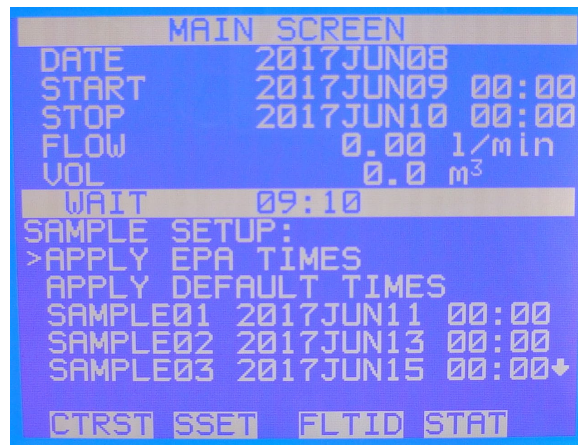
**Figure 10.** Main Menu when “Active”.

The Main Menu contains several submenus. Instrument parameters and settings can be read and modified within the submenus per their function. The measurement readings appear above the Main Menu and submenus in every screen and can be selected from the Main Menu “Asleep” screen by using the ↑ and ↓ arrows to select your desired option. The Service menu is visible only when the instrument is in the Service mode.

**Note:** The Service mode should be turned off when not in use, as it prevents remote operation.

Most setup functions can be reached by pressing  $\square$  from the main menu and using the ↑ and ↓ arrows to select your desired option. Pressing  $\square$  once from any menu screen returns you to the main screen. For a more detailed overview of the other sub menus, refer to the Thermo Scientific Inc. 2025i operator’s manual.

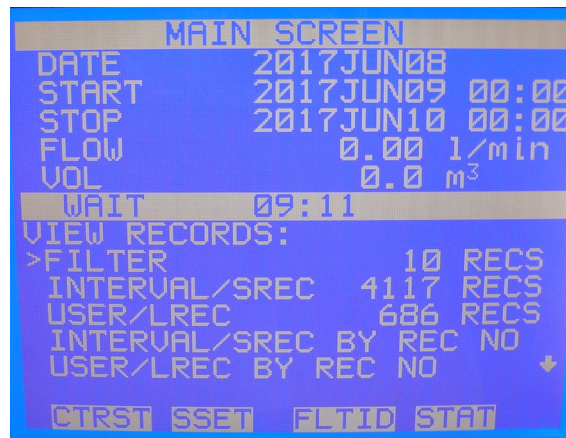
## 5.2.2 Sample Setup Menu



**Figure 11.** Sample Setup Menu.

The Sample Setup Menu allows the user to set default sampling parameters for the operation of the 2025i, such as Auto Populate, which calculates the default start time and date once sample 01 is programmed; Apply EPA Times, which is a shortcut key for midnight-to-midnight, 24-hour continuous sampling; and Apply Default Times, which automatically applies the default time settings.

## 5.2.3 View Records Menu

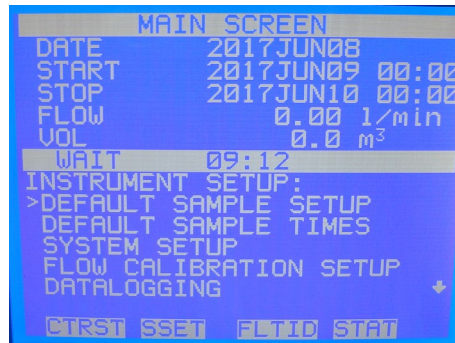


**Figure 12.** View Records Menu.

The View Records Menu items are used to view stored records. The 2025i stores three types of data in its internal data logger: filter data, interval data, and user data. This information can be viewed on the 2025i screen and/or downloaded through the Universal Serial Bus (USB), RS232 or Ethernet ports. If the storage capacity for the certain data type is reached, the oldest data points are replaced with the most recent information (“first in, first out”).



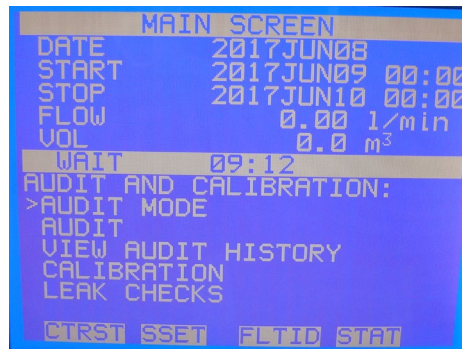
## 5.2.4 Instrument Setup Menu



**Figure 13.** Instrument Setup Menu.

The Instrument Setup Menu is used to specify the system and instrument control parameters such as, default sample setup, default sample times, trigger method, system setup parameters, flow calibration setup, data logging, site ID, communications, USB setup, date/time, time zone and password.

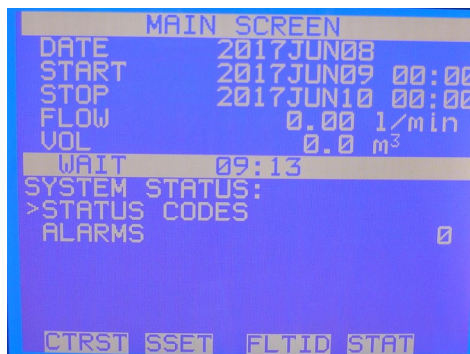
## 5.2.5 Audit and Calibration Menu




**Figure 14.** Audit and Calibration Menu.

The Audit and Calibration Menu provides the parameters for the audit and calibration functions.

## 5.2.6 System Status Menu



**Figure 15.** System Status Menu.

The System Status Menu displays a list and description of the currently active status conditions. Refer to Table 2 for a list of the status codes. With the occurrence of any status conditions, the 2025i will display a  icon in the status bar on the main screen. The single or double letter abbreviation for the situation that applies will be displayed in the status codes screen. In the case of multiple status conditions, the 2025i displays the single or double letter codes and text for each status condition in the status codes screen along with the description of the status code.

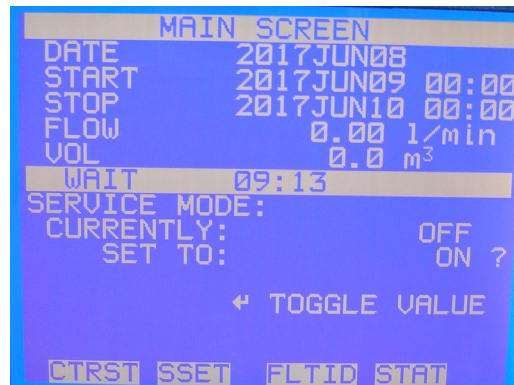
**Table 2. Status Codes.**

Status Codes	Description
Ok	No status conditions.
M	Flash Memory. The Sampler detected an error in its flash memory.
Z	Power Failure. A power outage occurred during sampling on the current filter. Power outage events of less than 60 seconds are not logged by the Sampler.
F1	Flow Out of Range. The measured sample flow rate through the flow channel deviated by $\pm 5\%$ from its set point for more than 5 minutes.
F2	Flow 2 Out of Range. The measured sample flow rate through the flow channel deviated by $\pm 5\%$ from its set point for more than 5 minutes.
S	User Pressed Stop. The user pressed the Run button while the unit was in the WAIT or SAMP (sampling) mode.
S1	Flow Stop. The measured sample flow rate through the flow channel deviated by $\pm 10\%$ from its set point for more than 5 minutes. This is a critical status condition, causing the Sampler to enter the Error or Wait Operating mode and the status lights to blink.
A	Ambient temperature sensor. The ambient temperature sensor was not installed correctly or indicated an invalid value. For ambient temperature, this corresponds to a reading of less than $-60\text{ }^{\circ}\text{C}$ or greater than $70\text{ }^{\circ}\text{C}$ .
T	Filter Temperature. One of the filter compartment temperature sensors was not installed correctly or was out of range, i.e., less than $-60\text{ }^{\circ}\text{C}$ or greater than $70\text{ }^{\circ}\text{C}$ .
PA	Ambient Pressure Sensor. The ambient pressure sensor is not installed correctly or is indicating an invalid value (less than 300 mmHg or greater than 900 mmHg).
E	Electronics Temperature. The temperature of the unit's electronics compartment was outside of its usual operating range, i.e., less than $0\text{ }^{\circ}\text{C}$ or greater than $70\text{ }^{\circ}\text{C}$ .
R1	Filter Temperature 1 Range. The measured temperature of Filter #1 (high flow filter) exceeded the measured ambient temperature by more than $5\text{ }^{\circ}\text{C}$ for more than 30 consecutive minutes.
X	Filter Exchange Failed. The Sampler encountered a mechanical problem in attempting to exchange a filter cassette. This is a critical status condition, causing the Sampler to enter the Error Operating mode and the status lights to blink continuously.

**Table 2. Status Codes.**

Status Codes	Description
N	No filters. This status condition indicates that there are no filters left in the supply Magazine. V Flow. This status condition indicates there is flow greater than 1 LPM through the system in Wait mode, when there should be no flow.
O1	Coefficient of Variation 1. The coefficient of variation of the sample flow #1 rate (high flow), expressed as a percentage, was greater than 2 (2%) during the exposure of a filter.
P	Elapsed Sample Period. For sampling programs of $\geq 12$ -hour duration without conditional sampling, the Sampler issues this status code if the elapsed time of a sample differed by $\pm 1$ hour from the selected duration. Sampling programs of $\leq 12$ hours will not indicate an elapsed time error.
L	Leak Check Failed. This error code will appear if the leak check failed. A leak check fails if the vacuum created in the sampling system leaks at a rate of 25 mmHg or greater, which is equal to the maximum leak rate of 80 milliliters per minute that is indicated as acceptable by the EPA.
D	Audit Performed. This status condition indicates to the user that an audit was performed during sampling. It does not indicate an error. It is for information purposes only. This status code appears only in the filter data screen.
B	Blank Filter. Indicates that "sample" was a zero-time blank.
V	Hi Wait Flow. This status condition indicates there is flow greater than 1 LPM through the system in Wait mode, when there should be no flow.

## 5.2.7 Service Menu



**Figure 16.** Service Menu.

The Service Menu provides access to all critical operating and configuration parameters, and advanced diagnostic functions. Access to the Service Menu should usually be restricted to trained service technicians, since changes in this portion of the firmware can result in instrument malfunctions that could be difficult to diagnose and correct.



## 5.3 Sampling

### 5.3.1 Powering Up the 2025i

Use the following procedure to turn on the 2025i sampler.

1. Press the power switch on the main panel to its "ON" position to activate the Sampler.
2. If necessary, adjust the liquid crystal display (LCD) to view the display.

**Note:** Once the power switch is pressed, the pump in the unit may start up momentarily. This is the default setting of the unit in case it is being turned on under extreme cold conditions where additional heat is necessary to warm the electronics.

### 5.3.2 Stop Mode

In Stop Mode, the user can exchange filter cassettes and define the sampling program using the Filter Setup Menu. As this is the only non-operational mode, all user-definable system parameters may be edited with the Sampler in this mode. Pressing in the run screen with the hardware in this mode causes the sampler to advance to the Wait or Operating Modes.

**If the sampler is in Run Mode, placing it in Stop Mode will result in the loss of the current sampling event and automatically invalidate the filter in the sampling position. To maintain the sampling list and sample filter order, an un-sampled/dummy filter must be advanced to the sampling position after the sampler has been placed in Stop Mode. At the start of the next sampling event, the dummy filter will be cycled through and the next filter cassette will be sampled.**

To manually advance a filter cassette:

1. Place a dummy filter at the top of the supply canister.
2. From the main menu, select Audit and Calibration then select Audit Mode.
3. Select Advance Filter to move the dummy filter into sampling position. The unused filter will be cycled through to the storage canister. Take the filter from the storage canister and place it back into the supply side canister at the top position. This filter will be sampled at the start of the next scheduled sampling date and the dummy filter will be pushed through to the storage canister.
4. To exit Audit Mode, return to the main menu, Select Audit and Calibration, then Audit Mode. Confirm your choice to return back to Stop Mode. At the main menu, press the ►, and then the ► key again to confirm to enter Run/Wait Mode.

### 5.3.3 Checking and Resetting Status Codes

The 2025i is equipped with a red lamp on the exterior of the unit to alert the operator of any errors. The lamp will illuminate when the sampler encounters an issue. An alarm icon will also show on the

instrument display. More information about each issue can be viewed in the instrument status code screen which can be accessed by pressing the STAT soft key button.

1. While in the status code screen, more information about certain status codes can be obtained by highlighting the individual status code and selecting it by pressing the  $\leftarrow$  key. Record the status code if necessary for future reference. Contact ECB or the Central Office Particulate Chemist for more detailed information about individual status codes.
2. To reset status codes, the sampler must be in STOP mode. To enter STOP mode, press the  $\blacktriangleright$  key from the main screen and confirm by pressing the  $\leftarrow$  key.
3. Enter the status code screen and highlight any status code. Press the  $\leftarrow$  key. Confirm with the  $\leftarrow$  key to clear the status code. All status codes except for shuttle errors will be cleared.

**Note:** If no filters are present during the filter exchange, a “No Filter” error will appear. The site operator will have to clear the error, load new filters, and manually advance a dummy filter into the head before the instrument will run again.

### 5.3.4 Time and Date Setup

Units of time are used in several aspects of sampler operation. Examples are the start and stop times, volume/flow calculations, run dates, etc. Therefore, it is necessary to document the time setting of the sampler. The requirement in 40 CFR Part 50, Appendix L, Section 7.4 states that the sampler must not lose or gain more than 1 minute per month. Change the date and time by:

1. Scroll to Instrument Setup and press  $\leftarrow$  .
2. Use the arrow keys to choose Date/Time and press  $\leftarrow$  .
3. Use the arrow keys to choose Date and press  $\leftarrow$  .
4. Enter the correct date and press  $\leftarrow$  .
5. Scroll to Time and press  $\leftarrow$  .
6. Enter the correct time and press  $\leftarrow$  .
7. Press  $\left[\text{Home}\right]$  to return to the Instrument Setup Menu. Select Time Zone and ensure that the sampler is set to EST (GMT).

### 5.3.5 Site ID Setup


The Site ID has two 32-character fields. The user can enter site identification numbers using one or both fields. If no entry is made in these fields, then no site identification numbers will appear in the 2025's data output from this screen. Setup the Site ID1 and ID2 as follows:

1. Scroll to Instrument Setup and press  $\leftarrow$  .
2. Use the arrow keys to choose Site ID and press  $\leftarrow$  .

3. Use the arrow keys to choose ID1 and press  $\leftarrow$  .
4. Enter the nine number AQS site ID1 and press  $\leftarrow$  .
5. Scroll to ID2 and press  $\leftarrow$  .
6. Enter the three number sampler ID2 and press  $\leftarrow$  .


### 5.3.6 Default Sampling Setup

The Default Sample Setup Menu allows the user to choose default sampling settings such as the sample definition method (default programming method), sample start time and duration, repeat time, filter type and the sample flow rate. Use the following steps to confirm the following settings:


1. To access the Default Sample Setup menu, press  repeatedly to display the main menu.
2. Scroll to Instrument Setup and press  $\leftarrow$  .
3. Scroll to Default Sample Setup and press  $\leftarrow$  .
4. Setup the instrument default sampling parameters by entering the Default Sample Setup screen. The following fields make up the default Sample Setup screen.

**Method:** Time  
**Flow:** 16.67  
**Filter Type:** T  
**Separators:** No

**Note:** In Basic Method, the sampler will automatically adjust the sampling schedule based on the initial sample run. In Time Method, the sampler will automatically adjust the sampling schedule after the initial sample and the user can also adjust individual sample runs. Time Method is recommended when running make-ups, blanks or extra filters. For a more detailed overview of the four other methods not used, please refer to the [Thermo Scientific Inc. 2025i Sequential Air Sampler Instruction Manual](#).



5. Select the  key to return to the Instrument Setup Menu. Choose Default Sample Times and press  $\leftarrow$ . The parameters should be as follows:

**Start Time:** 00:00  
**Duration:** 24 hr.  
**Repeat:** 24 hr. for everyday sampling  
 72 for 1 in 3-day sampling  
 144 for 1 in 6-day sampling  
 288 for 1 in 12-day sampling  
 (Dependent on the site sampling schedule).




6. Select the  key to return to the Instrument Setup Menu. Scroll down and select System Setup and press  $\leftarrow$  . The parameters should be as follows:

**Avg Temperature:** 99.0  
**Std Temperature:** 25.0  
**Avg Pressure:** 999  
**Std Pressure:** 760  
**Report Volume:** Actual (for both PM 2.5 and 10)  
**Filter Fan:** Automatic  
**Auto Run:** On  
**Flow Error Mode:** ERR

**Note:** The use of 99.0 and 999 is to direct the sampler to use the ambient temperature and pressure probes in calculating real time flow measurements. Auto Run is a feature that allows the sampler to automatically enter Wait Mode when no key has been pressed after three hours (in case the operator left the sampler in Stop Mode).

- The Flow Calibration Set Up allows the user to define the set flow points and the constants from an Flow Transfer Standard (FTS) if the user so prefers. Select the  key to return to the Instrument Setup menu. Scroll down and select System Setup and press . The parameters should be as follows:

**Set point 1:** 15.000  
**Set Point 2:** 16.670  
**Set Point 3:** 18.400  
**No. of Cal points:** 3  
**Reset Cal Flow:**  
**FTS Constant M** \_ . \_ \_ \_ \_  
**FTS Constant B** \_ . \_ \_ \_ \_

- Select the  key to return to the Instrument Setup menu. Scroll down and select Data Logging and press . Select Configure Data Logging and press . Select Logging Period Min and confirm that the averaged time interval is 30 minutes.

### 5.3.7 Filter Handling Procedures

Federal regulations stipulate specific time frames and environmental conditions for FRM PM<sub>2.5</sub> sample filters at various stages in the sampling program. If these time frames and conditions are not met, sample filters may be noted by the RTI lab, flagged, or invalidated by the DAQ reviewers. In addition to these requirements, operators should practice the usual care to prevent or minimize contamination of the sample filters, filter cassettes, or anything else which may come in contact with the sample filters.

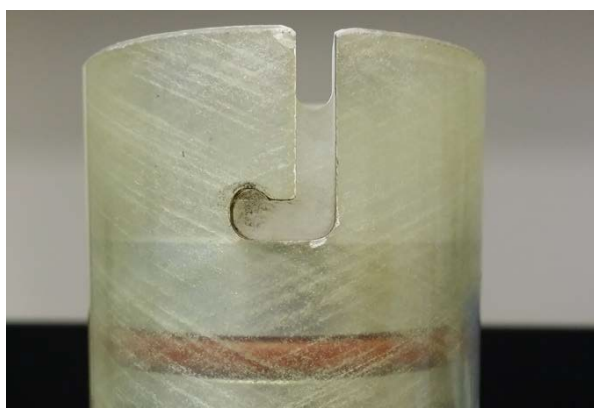
- Sample filters must be used within 30 days of the pre-weighing procedure. If 30 days have elapsed before the cassette is to be used, do not use the filter, but return it to the laboratory.
- The filter temperature must be within 5° C of the ambient temperature while installed in the sampler.

- Sampled filters must be removed from the sampler within 177 hours after the end of sampling and placed in cold storage immediately (40 CFR Part 50, Appendix L Section 10.10).
- Sampled filters must be kept at a temperature of less than 4°C during storage (without freezing) and shipping which allows the laboratory up to 30 days from the end of sampling for analysis. If at any time during storage or shipping the temperature exceeds but is kept at no greater than 25°C, the laboratory has up to 10 days to analyze.
- Sampled filters and the COCs will be shipped in an insulated shipping container containing sufficient Blue Ice or other chilled media to assure that sample filters arrive at the laboratory at a temperature no greater than 25°C, or preferably 4°C. Other cold storage methods may also be employed if they comply with these temperature requirements.
- A suitable means is necessary to determine whether temperature requirements of the sample filters have been exceeded during transit. At the request of DAQ, the RTI lab will use an IR gun for incoming sample temperature measurement. DAQ assumes that the temperature at receipt, as measured by the IR gun, is the highest temperature that the contents of the cooler reached.
- Samples received at the laboratory at temperatures greater than 4°C will be noted on the COC form and in the laboratory data base. The lab will automatically flag the sample so that gravimetric analysis is prioritized to meet the 10-day analysis deadline.
- Sampled filters should be shipped to the laboratory weekly on Monday, Tuesday, or Wednesday to avoid Saturday, Sunday, or holiday arrivals when staff may not be present to receive the samples. Note: If there is a shipping schedule conflict, contact the RTI lab [GravimetryLab@rti.org](mailto:GravimetryLab@rti.org).

### 5.3.8 Supply and Spent Canister Setup

1. Obtain an empty canister from its transport case. Remove the orange cap on the supply canister. Use a bulb pump to move the piston in the supply canister to the top of the canister. Detach the bulb pump from the canister.
2. Place one filter cassette on the piston and push it down until the top of the cassette is level with the top of the canister. Repeat with additional filter cassettes if loading multiple filters.
3. Note the order of the filters for future reference. Replace the orange cap when finished to protect the filters from contamination. Place the canister back in the transport case for transport to the site.
4. Once at the site, open the sampler door to access the filter transport assembly. The left canister mount is the supply side (new filters). The right mounting position is the take-up side (sampled filters).

5. Remove the orange cap on the canister. Align the grooves on the top of the cassette with the mounting studs on the left mounting ring. Mount the canister so that the hose connection faces to the left. Push the canister upward and twist counterclockwise to lock it in place.
6. Position the piston on the second canister to line up with the “J” notch as shown in Figure 17 to prevent the shuttle errors. Align the grooves on the top of the cassette with the mounting studs on the right mounting ring. Push the canister upward and twist counterclockwise to lock it in place.
7. Connect the air supply tube to the supply (left side) canister by pushing it onto the connector until it snaps into place (Figure 18).









**Figure 17.** Piston Position for Spent Canister.





**Figure 18.** Sampler Compartment Layout.

### 5.3.9 Filter Setup

The following procedure is used to setup the filter list.

1. Return to the main menu using the  key and select the Sample Setup Menu or press the SSET key.
2. Select "Apply Default Times" to seed the Filter List. Press the  key.
3. Select "Sample01". Select Start Time. The next sampling event will automatically be set to midnight of the default day. Change the start date, if necessary.
4. Press the FLTID button to access the filter ID screen. In the FLTID screen, column 1 is Filter ID, column 2 is Cassette ID, and column 3 is filter blank status.
5. Move the cursor to Filter ID and label the sample with the laboratory cassette ID using the     keys. The Filter ID will help you identify the correct filter when looking up the sample run records.
6. Repeat Step 5 for the rest of the filters in the supply canister.
7. If a sample is a filter blank, move the cursor to the Filter Blank column and press the enter key to toggle the selection to "YES". If a sample is labeled a filter blank, the filter will be adjusted to a 0-minute run time and the filter dates on subsequent filters will automatically be adjusted to maintain your original sampling schedule. Filter blanks will run immediately following the preceding filter in the list.

**Note:** If a filter blank is programmed anywhere in a filter list prior to exiting Stop Mode, the blank will automatically run after the first scheduled run, no matter where it was previously inserted in the run schedule.

8. Verify the start date and time for all samples. In TIME Method, the site operator can adjust individual sample times after the filter list is populated.
9. If the sampler is in STOP Mode, press the  key to return to the main screen and  again to place the sampler in WAIT Mode.

### 5.3.10 Make-up Runs

Per US EPA regulations (40 CFR Part 50, Appendix N), valid PM<sub>2.5</sub> make-up samples must run prior to the next sampling day or exactly seven days after the missed or invalid sample. Because of these requirements, 1-in-1, or daily, sites are not able to run make-up samples. Valid make-up samples are necessary to maintain data completeness if regular samples are missed or voided. For a site to gain/maintain attainment status, three years of complete data for that site is required. A year meets data completeness requirements when the quarterly data capture rates for all four quarters are at least 75 percent. Having data completeness <75% can result in non-attainment status. Samples that do not run on the scheduled run dates and do not meet the criteria of make-up samples but are otherwise considered valid are called extra samples. Per the CFR, "extra samples are used in mean calculations and are included in the series of all daily values subject to selection as a 98th percentile value but are not used to determine which value in the sorted list represents the 98th percentile."

The 2025i allows for the user to schedule make-up runs in the cases of missed or invalid samples. In BASIC method, the 2025i cannot run user adjusted filter sampling schedules needed to run make-up filters. The filter sampling is limited to running at a pre-determined time interval such as every 72 hours for a 1-in-3 sampling schedule. The TIME sampling method (which DAQ uses), however, does allow the user to program start and stop times for each filter in the filter list. This mode will allow the user to program valid make-up samples. Use the following procedure for programing make-up samples:

1. From the Main Menu, select Audit and Calibration. Enter Audit Mode. Load a dummy filter to the top position of the supply canister and select Advance Filter. Load the makeup filters in the supply canister. Exit Audit Mode.
2. TIME sampling method allows the user to program custom sampling times for each filter in the filter list. Therefore, all filters must be entered into the filter list. From the main menu select "Sample Setup" or Select SSET soft key to enter the Sample Setup screen. Select "Apply Default Times" to reset the run schedule to match your default settings. Program the Start time for each filter starting from the top of the list. Define filter blanks as necessary. Filter blanks will automatically be set for a 0-minute run time. Label each filter with the cassette ID in the Filter ID field. Verify the sample list and any changes made.
3. Select the ► key to enter WAIT mode.
4. After all the make-up samples have been completed, select "Apply Default Times" prior to the next scheduled sample to avoid losing a scheduled sample. Verify that the sampling list matches your site's sampling schedule.

#### **5.3.10.1 Makeup Procedure for a Three-Day Sampler**

- The makeup sample must be collected before the next scheduled sample day, or exactly one week after the missed sample.
- Preference is given to collect the sample as soon as possible after the missed sample day.

#### **5.3.10.2 Makeup Procedure for a Six-Day Sampler**

- The makeup sample must be collected before the next scheduled sample day or one week after the missed sample.
- Preference is given to collect the sample on the third day after the missed sample day because it is a national collection day for one in three-day samplers, or if that is not possible, as soon as possible after the missed sample day.

#### **5.3.10.3 Makeup Procedure for a Collocated QA Sampler**

- The Federal Register requires collocated QA samplers to run on a one in twelve-day schedule. By running on a one in six-day schedule, makeups for missed precision pairs are automatically being collected. Although only eight valid precision pairs are required each



quarter, it is prudent to make up all precision pairs because of the uncertainty of voids in the data validation process.

- If a makeup sample is required, the makeup sample must be collected on a day the primary monitor operates.
- For a six-day QA monitor collocated with a three-day primary monitor, the makeup sample must be collected on the next scheduled three-day sample.
- For a six-day QA monitor collocated with a six-day primary monitor, the makeup sample must be collected either on the third day after the missed sample day, or before the next scheduled sample day. Both samplers must be set up to run on the makeup day to provide a pair of samples
- For a six-day QA monitor collocated with a daily primary monitor, the makeup sample may be collected any day before the next scheduled sample day, or one week later.

#### 5.3.10.4 Makeup Procedure for a Daily Sampler

- Makeup samples cannot be collected for a daily sampler however, substitutions are allowed. If a daily sampler misses 14 samples in a quarter, a second monitor should be collocated at the site and operated on a daily sampling schedule.

#### 5.3.11 Field and Trip Blank Handling Procedures

Upon receipt and identification of filter blanks, treat these filters the same as filters to be sampled with the exception that no air will be drawn through the filter. Field blanks are to be installed in the sampler for the same time period as a valid filter sample, cycled through the sampler, stored in a cooler and returned to the laboratory with the sampled filters. Once programmed into the sample schedule, field blanks will automatically cycle through immediately following a regular or make-up sample.

Trip blanks are to accompany all standard filters and field blanks but are not loaded into the instrument. For Trip Blanks, include on the COC and Field Sample Log with day and time of site visit.

## 6.0 CALIBRATION

A full monitor calibration consists of a beginning “as found” external leak check, the calibration of ambient temperature and pressure sensors, a three-point flow calibration, a one-point flow evaluation and a final “as left” leak external leak check. It is a good practice to complete all outstanding maintenance activities prior to initiating a full calibration. *Note: A flow verification must be completed prior to a calibration if the sampler was previously operating at the site.* New samplers installed at a site do not need a flow verification prior to a calibration because there is no collected data to envelope. Annual calibrations are required each calendar year and within 365 days of the prior calibration.

## 6.1 When to Calibrate

A calibration is required under the following circumstances:

- Upon initial sampler set up.
- Annually (each calendar year and no more than 365 days from the last calibration).
- After a sampler is replaced.
- After a sampler is moved or relocated, no matter the distance.
- After the pump or flow controller is replaced.
- If flow check or a flow audit are not within specifications.
- If the device once used for flow calibration needs to be used as the audit device.
- If the sampler is without power for longer than 48 hours and the flow verification fails.

## 6.2 Calibration Equipment



**Figure 19.** BGI Tetra Cal with Optional Temperature Probe.

All device certifications must be current within 365 days of use. Listed below is the necessary equipment needed for completing a calibration:

- A leak check device or flow audit adapter for performing leak checks.
- A certified Tetra Cal unit or Streamline Flow Transfer Standard (FTS).
- If using a FTS, a digital, water or oil manometer, capable of measuring to a tenth of an inch of water.

- If using a FTS, a 12-18" piece of 1/4" diameter Tygon® tubing to connect the FTS to the manometer.
- A glass thermometer capable of measuring to the nearest half a degree Celsius, that is traceable to a National Institute of Standards and Technology (NIST) standard, or the thermistor probe included with a certified Tetra Cal unit.
- A digital barometer, that is NIST traceable, or the barometer that is part of a certified Tetra Cal unit.
- The most recent revision of the 2025i electronic logbook.





*Note: If using a glass thermometer, hang the thermometer from the shaded side of the ambient temperature probe's solar shield or sampling inlet. Allow all devices, whether a Tetra Cal or digital barometer, to equilibrate for approximately 10 minutes, making sure to keep them out of direct sunlight.*


### 6.3 Calibration E-Log Setup

1. Open the most recent scrolling e-log for the site. If this is a new site or the first visit of the calendar year, obtain the proper e-log from the IBEAM documents module or contact the RCO Particulate Chemist.
2. Select the "Calibration" tab of the e-log.
3. Enter in the information for all the white boxes under the Visit Information, Thermometer Information, Manometer Information, Barometer Information, Flow Device Information sections. If using a Tetra Cal, just place the Tetra Cal's certification dates in the needed cells.
4. Do not proceed if any of the devices fail the certification requirement (certified within 365 days of use).

### 6.4 Calibration "As Found" Leak Check

Before calibrating the flow of the sampler, it is important to ensure that the sampling train does not have a leak. An external leak check should be performed prior to a calibration. Use the following procedure to perform an external leak check. Take the following steps to perform an "as found" leak check:

1. Press  return to the Audit and Calibration menu, scroll to Advance Filter, and press to advance the audit filter cassette into sampling position.
2. Attach the flow audit adapter (Figure 20) to the sample tube and close the valve on the flow audit adapter.
3. Scroll to Leak Checks, press  , scroll to External, and press  . The following message displays: MAKE SURE THAT FILTER IS IN PLACE AND LEAK CHECK ADAPTER IS CLOSED!!! Press  to begin testing.

4. A Pass or Fail message will display at the end of the leak check cycle. The leak check pass criterion is a pressure drop of 25 mmHg or less.
5. If the leak check passes, continue to the other calibration tasks. If the leak check fails, isolate, and correct the issue, then confirm that the sampling train is sound by performing another leak check.
6. After a successful leak check, slowly open the valve on the flow audit adapter.
7. Return to the Audit and Calibration menu by pressing the  key.



**Figure 20.** Leak Check Adapter.

## 6.5 Ambient Sensor Calibration








The temperature and pressure must be calibrated prior to the flow because the actual flow is calculated using both ambient temperature and pressure. *Note: An ambient temperature or pressure sensor calibration always requires a flow calibration afterwards.*

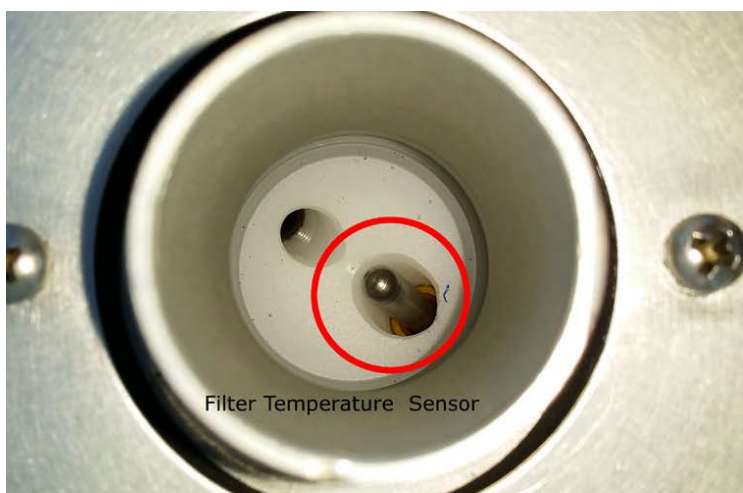
### 6.5.1 Temperature (Ambient, Filter and Compartment) Sensor Calibration



**Figure 21.** Proper Shaded Inlet and Solar Shield Location.




1. If using a glass thermometer, hang the thermometer from the shaded side of the ambient temperature probe's solar shield or sampling inlet (Figure 21). Allow all devices, whether a Tetra Cal or digital barometer, to equilibrate for approximately 10 minutes, making sure to keep them out of direct sunlight.
2. A calibration of any sort can only be completed while the instrument is stopped and in Service Mode. To stop the instrument, press the ► key twice and confirm to place it in Stop mode. To place the monitor then in Service Mode, navigate to and select Service Mode from the main menu. Press the ← key to enable service mode.
3. Select the 📄 key to return to the main menu. Scroll to Audit and Calibration and press the ← key.
4. Scroll to Calibration and press the ← key.
5. Scroll to **Ambient Temp** and press the ← key. The instrument will display the current ambient temperature reading.
6. Read and record the stated ambient temperature (° C) given by the 2025i in the e-log on the Calibration page under the Ambient Temperature Calibration section.
7. Read and record the actual ambient temperature (° C) given by your NIST thermometer in the e-log on the Calibration page under the Ambient Temperature Calibration section.
8. In the Ambient Temperature Calibration screen, use the pushbuttons to enter the reference value in °C into the "Set To" field and press the ← key to save the value. The sampler will automatically adjust the corresponding offset based on this input.

9. Select the  key to return to the Audit and Calibration screen. and press the  key.
10. Scroll to **F Comp Temp** and press the  key. The instrument will display the current ambient temperature reading.
11. Read and record the stated cabinet temperature (° C) given by the 2025*i* in the e-log on the Calibration page under the Cabinet Temperature Calibration section.
12. Read and record the actual cabinet temperature (° C) given by your NIST thermometer in the e-log on the Calibration page under the Cabinet Temperature Calibration section.
13. In the Ambient Temperature Calibration screen, use the pushbuttons to enter the reference value in °C into the “Set To” field and press the  key to save the value. The sampler will automatically adjust the corresponding offset based on this input.
14. Following the previously listed steps to manually advance a filter, advance an empty Delrin cassette to the sampling position.
15. Unlatch the top cover of the instrument and remove the VSCC. Position the external probe as close as possible to the sampler’s filter temperature sensor (see Figure 22).
16. Press  to return to the Calibration Menu. Scroll to **Filter Temp** and press  .
17. Determine the current temperature (°C) at the location of the filter sensor in the ventilated filter compartment using a reference thermometer. Position the external probe as close as possible to the sampler’s filter temperature sensor.
18. Read and record the stated filter temperature (° C) given by the 2025*i* in the e-log on the Calibration page under the Filter Temperature Calibration section.
19. Read and record the actual filter temperature (° C) given by your NIST thermometer in the e-log on the Calibration page under the Filter Temperature Calibration section.
20. In the Filter Temperature Calibration screen, use the pushbuttons to enter the reference value in °C into the “Set To” field and press the  key to save the value. The sampler will automatically adjust the corresponding offset based on this input.




**Figure 22.** Filter Temperature Sensor.

### 6.5.2 Pressure Sensor Calibration

1. Press  to return to the Calibration Menu. Scroll to **Ambient Pressure** and press  .
2. Read and record the stated ambient pressure (mm Hg) given by the 2025i in the e-log on the Calibration page under the Ambient Pressure Calibration section.
3. Read and record the actual ambient pressure (mm Hg) given by your NIST barometer, rounding to the nearest whole number, in the e-log on the Calibration page under the Ambient Pressure Calibration section.
4. In the Ambient Pressure Calibration screen, use the pushbuttons to enter the reference value in mmHg into the “Set To” field and press the  key to save the value. The sampler will automatically adjust the corresponding offset based on this input.
5. Replace the VSCC and downtube adapter onto the downtube. Close the top cover of the instrument and secure the two black latches.

### 6.6 Flow Calibration

1. If using a Tetra Cal, place the Tetra Cal flow audit adapter on top of the sample downtube. Connect the Tetra Cal to the flow adapter with the provided tubing. If an FTS is used, place the FTS on top of the sample downtube and connect the manometer to the FTS with your Tygon<sup>®</sup> tubing.
2. Zero the Tetra Cal or manometer.
3. Make sure that a calibration filter is in the sampling position.
4. From the Audit and Calibration Menu, scroll to Flow and press  .

5. Default calibration setpoints are already entered in the sampler. The following values are used for a three-point calibration of the 16.7 LPM flow rate setpoint:
  - Setpoint 1 (Min. Flow): 15.0 LPM (10% below the usual 16.7LPM set point)
  - Setpoint 2 (Operational Flow): 16.7LPM setpoint
  - Setpoint 3 (Max. Flow): 18.4 LPM (10% above the usual 16.7 LPM set point)
6. Scroll to Start Calibration and press  $\leftarrow$  . The system will start the flow calibration at 15.0 LPM.
7. Let the flow stabilize.
8. Read and record the stated flow rate (LPM) given by the 2025*i* in the Calibration page under the Flow Calibration section.
9. Read and record the actual flow rate (LPM) given by your certified Tetra Cal, or calculated from your FTS, in the Calibration page under the Flow Calibration section.
10. Change the Actual field to match the NIST flow standard and press  $\leftarrow$  .
11. The 2025*i* will automatically proceed to the flow rate plateau. Repeat steps 7-10 for the 16.7 LPM and the 18.4 LPM points.
12. Once all points have been completed, the sampler will adjust the Offset and Span values automatically.
13. Ensure that the slope and intercept have been updated.
14. Remove the flow audit adapter and reinstall the PM<sub>10</sub> inlet.

## 6.7 Post Calibration Flow Evaluation

The calibration must be verified by performing a single point evaluation using the same certified flow device the monitor was just calibrated with. *Reminder: A post calibration flow evaluation is not interchangeable with a monthly verification. The two processes are not the same.*



1. Zero the Tetra Cal or manometer (the Tetra Cal or FTS should still be in place from your flow calibration).
2. From the Audit and Calibration Menu, scroll to Audit and press  $\leftarrow$  . Scroll to Flow (off-on) and press  $\rightarrow$  to turn the flow on, and  $\leftarrow$  to turn the flow off.
5. Allow the unit to regulate the flow until the 2025*i* reading reaches the target flow rate of approximately 16.7 LPM.
6. Read and record the stated flow rate (LPM) given by the 2025*i* in the Calibration page under the Flow Evaluation section.
7. Read and record the actual flow rate (LPM) given by your certified Tetra Cal, or calculate the flow from your FTS using the given pressure drop in inches of water from the manometer and



the formula on the corresponding FTS certification, by the 2025i in the Calibration page under the Flow Evaluation section.

8. Using the automatic calculation in the e-log, verify that the flow is +/- 2% of the current flow (%A) and +/- 2% of the theoretical flow (%AD) of 16.7 LPM. **The monitor must be recalibrated if these specifications are not met.**
9. Press ← to turn off the flow.

## 6.8 Calibration “As Left” Leak Check

1. Press  return to the Audit and Calibration menu, scroll to Advance Filter, and press to advance the audit filter cassette into sampling position.
2. Attach the flow audit adapter (Figure 20) to the sample tube and close the valve on the flow audit adapter.
3. Scroll to Leak Checks, press ←, scroll to External, and press ←. The following message displays: MAKE SURE THAT FILTER IS IN PLACE AND LEAK CHECK ADAPTER IS CLOSED!!! Press → to begin testing.
4. A Pass or Fail message will display at the end of the leak check cycle. The leak check pass criterion is a pressure drop of 25 mmHg or less.
5. If the leak check passes, continue to step 6. If the leak check fails, isolate and correct the issue, then confirm that the sampling train is sound by performing another leak check. If the sampler continues to fail contact ECB and the RCO PM Chemist.
6. After a successful leak check, slowly open the valve on the flow audit adapter.
7. Return to the Audit and Calibration menu by pressing the  key.

## 7.0 QUALITY CONTROL

A **Flow Verification** must be performed once every thirty days (a.k.a. Monthly Verification). It is a test of the monitor’s sensors against certified standards. It is preferred, **but not required**, that the verification be completed with devices that are different from the devices used for the calibration. A flow verification is also required before any action that requires the operator to envelope the data (e.g. moving the monitor, performing maintenance that will break the sampling pathway or shutdown). A flow verification is also required after a power outage lasting more than 48 hours. A monthly flow verification cannot be completed on the same day as a calibration unless it is the final day of the calendar month.

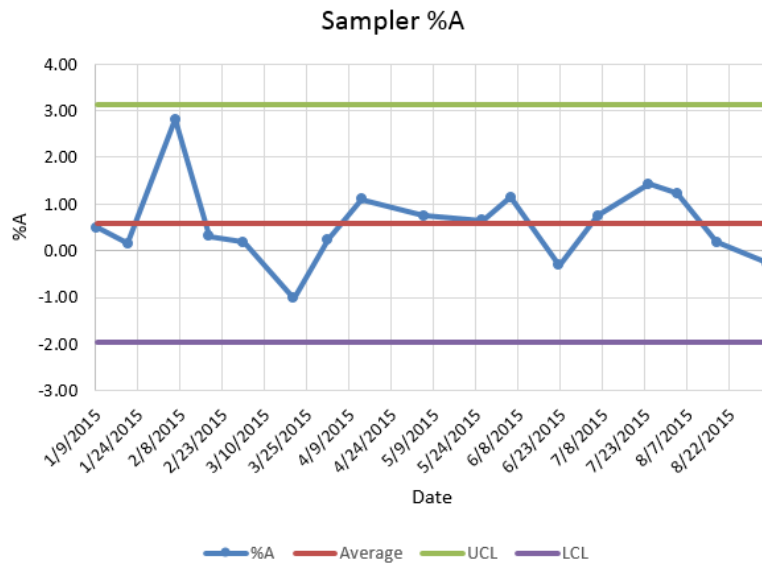
A **Mid-Month Verification** is a test of the monitor’s sensors against certified standards. The mid-month verification was implemented to avoid invalidating large amounts of data if a monthly flow verification fails. The mid-month verification must follow a verification by 14 to 18 days. The mid-month verification process is the same as the monthly verification procedure. The audit replaces the mid-month verification in the second month of each calendar quarter.

An ***Audit*** must be performed for every quarter that a monitor operates. It should be performed in the second month of each calendar quarter, if possible, unless the monitor is being shut down before the second month of the quarter, in which case the audit should be performed prior to an ending verification and subsequent shut down. It is a test of the monitor's sensors against certified standards ***that were not used*** for the previous calibration, monthly verifications or mid-month verifications. Standards that have been recently recertified are candidates for becoming audit equipment. Audits are also to be performed by personnel other than the normal site operator. If the audit cannot be performed during the second month due to abnormal circumstances (such as extreme weather events), the mid-month verification must be completed instead. The audit should then be performed in the third month, before the quarter ends. An audit cannot be used as both an audit and a flow verification, that is, an audit cannot be used to bracket data.

After each verification or audit, operators must analyze the Flow Rate Accuracy (%A) and the Flow Rate Accuracy vs. Design (%AD) control charts (Figure 24) in the e-log to determine if there are any unfavorable trends on the same sampler including, but not limited to:

- Four or more consecutive decreasing points.
- Four or more consecutive increasing points.
- Differences of  $\pm 3\%$  between points.
- Any points falling outside of the upper confidence level (UCL) or the lower confidence level (LCL).

Operators should consider repeating a verification or audit if it is outside of the LCL or UCL. Changes in the sampler, mass flow controller, or pump might distort the control charts and do not require additional investigation. Report any abnormal trends in the control charts to the RCO particulate matter lead. *Note: the control charts are generated based on flows from a calendar year (per the annual e-log). The first few flows of the year will not produce a valid control chart due to the limited data. The previous year's flow data can be imported into the electronic logbook if desired.*



**Figure 23.** Example Electronic Logbook Control Chart

All device certifications must be current within 365 days of use. Listed below is the necessary equipment needed for completing a verification or audit:

- A leak check device or flow audit adapter for performing leak checks (Figure 20).
- A certified Tetra Cal unit or Streamline Flow Transfer Standard (FTS).
- If using a FTS, a digital, water or oil manometer, capable of measuring to a tenth of an inch of water.
- If using an FTS, a 12-18" piece of 1/4" diameter Tygon® tubing to connect the FTS to the manometer.
- A glass thermometer capable of measuring to the nearest half a degree Celsius, that is traceable to a NIST standard, or the thermistor probe included with a certified Tetra Cal unit.
- A digital barometer, that is NIST traceable, or the barometer that is part of a certified Tetra Cal unit.
- The most recent revision of the 2025i electronic logbook.

*Note: If using a glass thermometer, hang the thermometer from the shaded side of the ambient temperature probe's solar shield or sampling inlet. Allow all devices, whether a Tetra Cal or digital barometer, to equilibrate for approximately 10 minutes, making sure to keep them out of direct sunlight.*

## 7.1 Tolerances and Corrective Actions for Verifications, Checks, and Audits

If any parameter fails the tolerance listed in Table 3, corrective action is required as indicated. **Do not perform a calibration until after you have first verified, checked, or audited all parameters.**

**Table 3. Operation Evaluations**

<b>CRITERIA</b>	<b>TOLERANCES</b>	<b>FREQUENCY</b>	<b>CORRECTIVE ACTION</b>
External Leak Check	$\leq 25$ mm Hg	<ol style="list-style-type: none"> <li>Before and after each verification and quarterly audit.</li> <li>Before and after each time the VSCC is removed.</li> </ol>	<ol style="list-style-type: none"> <li>Use different cassette.</li> <li>Check or replace the V-seals.</li> <li>Check VSCC (O-rings).</li> <li>Perform internal leak check.</li> <li>If unit fails to pass, call ECB.</li> </ol>
Ambient Temperature Verification or Audit	$\pm 2$ °C of NIST Thermometer	During each monthly, mid-month verification and quarterly audit.	Perform a flow verification prior to an ambient temperature adjustment. Follow with complete calibration.
Filter Temperature Verification or Audit	$\pm 2$ °C of NIST Thermometer	During each monthly, mid-month verification and quarterly audit.	Perform filter temperature adjustment.
Pressure Verification or Audit	$\pm 10$ mm Hg of NIST Barometer	During each monthly, mid-month verification and quarterly audit.	Perform a flow verification prior to an ambient pressure adjustment. Follow with complete calibration.
Post Calibration Evaluation	%A $\pm 2\%$ %AD $\pm 2\%$	After each sampler calibration.	Calibrate again. If unit fails, call ECB and Particulate Lead.
Monthly Verification	%A $\pm 3\%$ and %AD $\pm 4\%$ are DAQ action limits ( $\pm 4\%$ and $\pm 5\%$ are EPA control limits)	<ol style="list-style-type: none"> <li>Monthly.</li> <li>After a power outage &gt; 48 hours.</li> </ol>	Investigate the cause for the failure. If no other cause is identified other than monitor drift, perform a calibration. If unit fails to pass, call ECB and Particulate Lead.
Mid-Month Verification	%A $\pm 3\%$ and %AD $\pm 4\%$ are DAQ action limits ( $\pm 4\%$ and $\pm 5\%$ are EPA control limits)	14-18 Days after Flow Rate Verification (in non-audit months).	Investigate the cause for the failure. If no other cause is identified other than monitor drift, perform a calibration. If unit fails to pass, call ECB and Particulate Lead.
Quarterly Audit	%A $\pm 3\%$ and %AD $\pm 4\%$ are DAQ action limits ( $\pm 4\%$ and $\pm 5\%$ are EPA control limits)	Quarterly (preferably second month of each quarter).	Investigate the cause for the failure. If no other cause is identified other than monitor drift, perform a calibration. If unit fails to pass, call ECB and Particulate Lead.

## 7.2 Verification or Audit: E-Log Setup

1. Open the most recent scrolling e-log for the site. If this is a new site or the first visit of the calendar year, obtain the proper e-log from the IBEAM documents module, the Ambient/Documents/PM Monitoring SharePoint folder or contact the RCO PM lead.
2. Select the Verification/Audit tab of the e-log.
3. Enter in the information for all the white boxes under the Visit Information, Thermometer Information, Manometer Information, Barometer Information, Flow Device Information sections. If using a Tetra Cal, just place the Tetra Cal's certification dates in the needed cells.
4. Do not proceed if any of the devices fail the certification requirement (certified within 365 days of use).


## 7.3 Clock Verification and Adjustment


Units of time are used in several aspects of sampler operation. Examples are the start and stop times, volume/flow calculations, run dates, etc. Therefore, it is necessary to document the time setting of the sampler. The requirement in 40 CFR Part 50, Appendix L, Section 7.4 states that the sampler must not lose more than 1 minute per month.

1. Observe the sampler time from the Main Screen. Record your results in your electronic logbook.
2. At the same time, note the value of your atomic based time keeping device.
3. If the sampler time is off by more than  $\pm 2$  minutes, an adjustment to the clock should be made. Navigate to the main menu and select Instrument Setup. Scroll to select Date/Time and press  $\leftarrow$ . Make the necessary adjustments to the clock and record this action in the comments section of the e-log.



## 7.4 Verification or Audit: "As Found" Leak Check

Use the following procedure to perform an external leak check. Take the following steps to perform an "as found" leak check:

1. Press  key to return to the Audit and Calibration menu, scroll to Advance Filter, and press to advance the audit filter cassette into sampling position.
2. Attach the flow audit adapter (Figure 20) to the sample tube and close the valve on the flow audit adapter.
3. Scroll to Leak Checks, press  $\leftarrow$ , scroll to External, and press  $\leftarrow$ . The following message displays: MAKE SURE THAT FILTER IS IN PLACE AND LEAK CHECK ADAPTER IS CLOSED!!! Press  $\rightarrow$  to begin testing.
4. A Pass or Fail message will display at the end of the leak check cycle. The leak check pass criterion is a pressure drop of 25 mmHg or less.


5. If the leak check passes, continue to the other calibration tasks. If the leak check fails, isolate and correct the issue, then confirm that the sampling train is sound by performing another leak check.
6. After a successful leak check, slowly open the valve on the flow audit adapter.
7. Return to the Audit and Calibration menu by pressing the  key.

#### **7.5 Verification or Audit: Temperature (Ambient, Filter and Compartment) and Pressure Sensor “As Found” Leak Check**



1. If using a glass thermometer, hang the thermometer from the shaded side of the ambient temperature probe’s solar shield or sampling inlet. Allow all devices, whether a Tetra Cal or digital barometer, to equilibrate for approximately 10 minutes, making sure to keep them out of direct sunlight.
2. A verification or audit of any sort can only be completed while the instrument is in Audit Mode. To enter this mode, press the  key to access the main menu. Scroll to Audit and Calibration and press  $\leftarrow$ .
3. Scroll to Audit and press  $\leftarrow$ . The Audit screen will display the temperature (ambient, filter and compartment) and ambient pressure readings.
4. Read and record the stated temperatures ( $^{\circ}$  C) and pressure (mmHg) given by the 2025*i* in the e-log on the Verification/Audit tab under the appropriate sections.
5. Read and record the actual temperatures ( $^{\circ}$  C) and pressure (mmHg) given by your NIST thermometer in the e-log on the Verification/Audit tab under the appropriate sections.
6. If the temperature and pressure readings are out of their acceptable limits, the sensors must be recalibrated.
7. Select the  key to return to the main menu.
8. Replace the VSCC and downtube adapter onto the downtube. Close the top cover of the instrument and secure the two black latches.

#### **7.6 Verification or Audit: Flow**

1. If using a Tetra Cal, place the Tetra Cal flow audit adapter on top of the sample downtube. Connect the Tetra Cal to the flow adapter with the provided tubing. If an FTS is used, place the FTS on top of the sample downtube and connect the manometer to the FTS with your Tygon<sup>®</sup> tubing.
2. Zero the Tetra Cal or manometer.
3. Make sure that a calibration filter is in the sampling position.

4. From the Audit and Calibration Menu, scroll to Audit and press  $\leftarrow$  . Scroll to Flow and press  $\leftarrow$  .
5. Press the  $\rightarrow$  key to start the pump.
6. Let the flow stabilize.
7. Read and record the stated flow rate (LPM) given by the 2025i in the Calibration page under the Verification/Audit tab under the appropriate sections.
8. Read and record the actual flow rate (LPM) given by your certified Tetra Cal or calculate the flow from your FTS using the given pressure drop in inches of water from the manometer and the formula on the corresponding FTS certification, in the Verification/Audit tab under the appropriate sections.
9. Stop the pump by pressing the  $\leftarrow$  key.
10. Select the  key to return to the main menu.
11. Remove the flow audit adapter and reinstall the PM<sub>10</sub> inlet.

### 7.7 Verification or Audit: “As Left” Leak Check

1. Press  return to the Audit and Calibration menu, scroll to Advance Filter, and press to advance the audit filter cassette into sampling position.
2. Attach the flow audit adapter (Figure 20) to the sample tube and close the valve on the flow audit adapter.
3. Scroll to Leak Checks, press  $\leftarrow$  , scroll to External, and press  $\leftarrow$  . The following message displays: MAKE SURE THAT FILTER IS IN PLACE AND LEAK CHECK ADAPTER IS CLOSED!!! Press  $\rightarrow$  to begin testing.
4. A Pass or Fail message will display at the end of the leak check cycle. The leak check pass criterion is a pressure drop of 25 mmHg or less.
5. If the leak check passes, continue to the other calibration tasks. If the leak check fails, isolate and correct the issue, then confirm that the sampling train is sound by performing another leak check.
6. After a successful leak check, slowly open the valve on the flow audit adapter.
7. Return to the Audit and Calibration menu by pressing the  key.

### 8.0 MAINTENANCE

All sampler maintenance must be recorded on the Maintenance Log tab of the e-log. An “as found” and “as left” leak check must be performed if any maintenance item requires the operator to break the seal of the VSCC and downtube.

It is recommended that operators carry the following items in their field maintenance kit:

Canister of compressed air with tube	Cotton cloth or Shop Towels
Cotton Tipped Applicators	Kimwipes
Phillips Head Screwdriver	O-rings for the VSCC
Allen Wrench (5/64-inch)	Downtube cleaning kit
Vacuum grease (silicone based)	BAM tape
91% Isopropyl Alcohol for cleaning the VSCC and PM <sub>10</sub> head	Scotch tape
Distilled water	Flashlight

**Table 4.** Summary of Sampler Maintenance

Maintenance Activity	Frequency
<ol style="list-style-type: none"> <li>Clean VSCC</li> <li>External leak check</li> <li>Check sampler clock</li> <li>Inspect cassette magazines</li> <li>Wipe down interior/exterior of sampler</li> <li>Inspect air intake fan filters, clean if dirty</li> <li>Empty water collection bottle</li> </ol>	Monthly
<ol style="list-style-type: none"> <li>Clean PM<sub>10</sub> head and downtube</li> <li>Inspect inlet tube water seal gasket</li> <li>Clean air intake fan filters</li> <li>Inspect O-rings, grease if necessary</li> </ol>	Quarterly
<ol style="list-style-type: none"> <li>Battery replacement</li> <li>Upgrade Software, if necessary</li> <li>Replace worn or cracked keypad, if necessary</li> <li>Replace V Seals</li> <li>Inspect proper threading and O-rings on VSCC</li> <li>Check filter exchange guide arm and bumpers</li> <li>Perform pressure test on pump</li> <li>Inspect or replace vacuum tubing, if necessary</li> <li>Install "FT" connector</li> <li>Replace sintered filter, if necessary</li> <li>Clean external temperature probe and plug</li> <li>Check rubber feet of sampler/ensure that sampler is secured</li> <li>Check cassette magazine O-rings</li> <li>Check seal on hood hinge</li> </ol>	Annually
<ol style="list-style-type: none"> <li>Data purge</li> <li>Check sampler clock</li> </ol>	Periodically, When in STOP mode



## 8.1 Cleaning the PM<sub>10</sub> Inlet

The PM<sub>10</sub> inlet has two primary components: The Acceleration Assembly and the Collector Assembly (Figure 25). These components must be disassembled and cleaned quarterly.



Figure 24. The PM<sub>10</sub> Inlet Components.

### 8.1.1 Disassembling the Inlet

1. Remove the PM<sub>10</sub> head by lifting the inlet up and off the sample tube.
2. Using Figure 25 as a guide, unscrew the collector assembly from the accelerator assembly by turning the top portion counterclockwise.

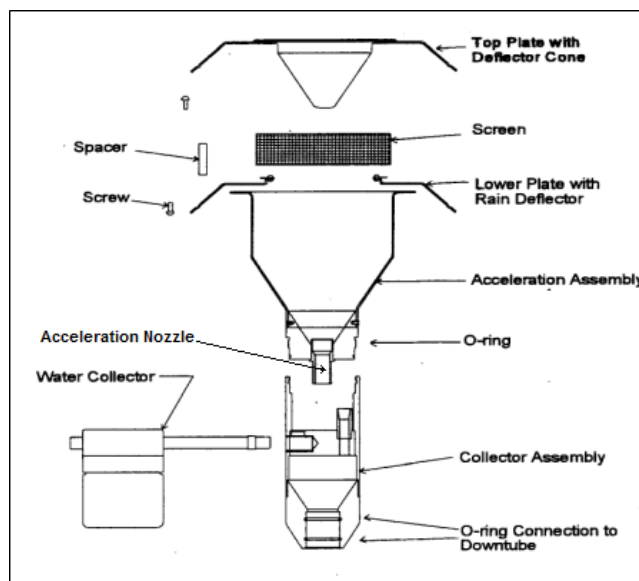


Figure 25. Exploded view PM<sub>10</sub> Inlet Assembly.

### 8.1.2 Cleaning and Maintaining the PM<sub>10</sub> Accelerator Assembly

1. Remove four Philip head screws from the top and remove the top plate.
2. Clean the top plate with a lint-free cloth and water (or alcohol).
3. Remove the insect screen from the lower plate and clean.
4. Clean the lower plate with a lint free cloth and water (or alcohol) with specific attention paid to the internal sides of the acceleration chamber.
5. Use water (or alcohol) and a cotton swab to clean the acceleration nozzle.
6. Inspect the large O-ring between the accelerator and collection assembly. Lightly lubricate with the vacuum grease if necessary.
7. Reinstall the insect screen and screw the top plate back onto the bottom plate of the Acceleration Assembly.

### 8.1.3 Cleaning and Maintaining the PM<sub>10</sub> Collector Assembly

1. Clean the threads of the Collector Assembly to ensure smooth separation and assembly.
2. Clean the Collector Assembly walls, bottom plate and three vent tubes using a cloth, water (or alcohol) and cotton swab.
3. Clean the hole in the collector plate where the condensate runs to the moisture trap with a cotton swab.
4. Remove the rain jar and clean with a cloth. Inspect the brass nipple. Replace rain jar and lightly coat the threads with grease.
5. Inspect the inlet tube O-rings for wear and lightly grease if necessary.
6. Reassemble the collector assembly by hand tightening.
7. Place the reassembled PM<sub>10</sub> head back onto the sampler tube.

## 8.2 Cleaning the VSCC



**Figure 26.** Disassembling the VSCC for Cleaning

The VSCC (Figure 27) is an essential component of the inlet system. It needs to be diligently maintained or it will corrode. The VSCC must be cleaned every 30 days. A spare O-ring kit should be kept on hand.

Disassemble and clean the VSCC following these steps:

1. Remove the PM<sub>10</sub> head from the sampler tube and VSCC.
2. Remove the VSCC from its installed position in the instrument.
3. Pull off the side transfer tube. Care should be taken to avoid damaging the two O-ring seals.
4. Unscrew the top cap and the grit chamber.
5. Use alcohol, or if unavailable, water, along with a cotton swab to remove all visible deposits. These deposits are most likely to be found at the bottom of the cone (located beneath the grit chamber) and inside the grit chamber.
6. Inspect all O-rings for shape and integrity. If at all suspect, replace the O-rings.
7. Assemble in reverse order and reinstall on the sampler tube.

### 8.3 Inlet Downtube Cleaning

1. Remove the PM<sub>10</sub> head from the inlet tube.
2. Loosen the waterproof flange around the inlet tube where it enters the top of the monitor.
3. Slowly advance the downtube up out of the unit
4. Visually inspect to determine if the down tube is clean.
5. Clean as needed. Remove deposits with a lint free wipe or a soft brush. If it is sticky, clean with mild detergent and water and air dry.
6. Reinsert the inlet tube into the inlet tube flange and then tighten the inlet tube flange.
7. Reattach the VSCC and PM<sub>10</sub> head.

### 8.4 Air Intake Filter Cleaning

1. One of the air intake filters is located on the filter compartment of the sampler.
2. Snap off the cover to the air intake filter.
3. Remove the filter and shake clean or use a soft brush. If it is sticky, clean with mild detergent and water.
4. Reinstall the filter and cover.

5. Now, locate the intake fan in the pump compartment, remove and clean filter as described above.

## 8.5 Changing the Data Storage Back-Up Batteries

1. Place sampler in the STOP mode and turn the sampler off.
2. Remove the three screws on the pump compartment cover.
3. Open the LCD screen compartment and locate the CR2032 battery.

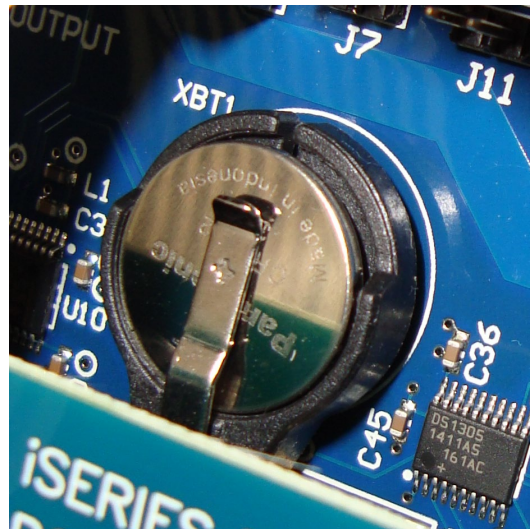


Figure 27. Backup Battery


4. Remove the battery and install a fresh cell.
5. Replace the LCD and pump compartment covers and screw in place.
6. Power on the sampler.

## 9.0 DATA HANDLING

Regional staff must download filter, interval and user data from each sampler every two weeks. The Regional Ambient Monitoring Coordinator (RAMC) must review this data for timeliness, completeness, and accuracy for each sample every two weeks. Only after review should the data be uploaded to the file transfer protocol (FTP) server and imported to the IBEAM module. IBEAM is an internet accessed database and can be reached through the internet address <https://ibeamaq.ncdenr.org>.


The sampling information for the 2025i samplers can be obtained either manually or electronically downloaded to a USB flash drive.

### 9.1 Viewing Sampling Summaries

1. Select the  key until you are in the Main menu.

2. Select View Records and then scroll to Filter Records. Press  $\leftarrow$  to bring up the stored filter records.
3. Use the  $\uparrow\downarrow$  keys to scroll through the filter runs. The oldest record will appear at the top of the list. Pressing the  $\uparrow$  arrow will bring you immediately to the bottom of the list and the most recent sample run. The  $\leftarrow \rightarrow$  keys are used to scroll through the data fields for a specific run.
4. Review or record the pertinent data as needed.

## 9.2 USB Data Download

1. Insert a USB flash drive into an available USB port on the front of the instrument.
2. Press the  key and scroll down to the USB menu. *Note: It may take up to a minute before the USB flash drive is recognized and for the USB menu to appear.*
3. Select the port used in Step 1 and press the Enter key to select your desired file destination.
4. Scroll down to instrument sample data and select Export Data Logs. The types of exportable data logs include:
  - **Filter Data:** 24 hour run data and filter and ambient meteorological values recorded for the last 64 runs.
  - **User Data:** Instrument status and conditions recorded at 30 minute intervals.
  - **Interval Data:** Instrument status and conditions recorded at 5 minute intervals.
5. Select Filter Data Log and follow the on-screen instructions to download the necessary data logs for the laboratory chain of custody form.
6. The USB flash drive can be removed when the download is complete.
7. The data is in the 2025i folder in the root directory of the USB drive and can be viewed on a computer using Microsoft Excel.

## 10.0 QUALITY ASSURANCE

Field operators are responsible for the initial quality assurance (QA) of the data and samples. Operators must examine the start date, start time, end time, average flow, coefficient of variation (CV), volume, max temperature differential, filter damage, and status codes for each sample during each site visit. Table 5 lists the critical parameters, their acceptable ranges, and the associated corrective actions. It is imperative that all possible deviations in the data be recognized as soon as possible to collect make-up samples. Furthermore, operators must ensure that the filter IDs match the appropriate sample run date. The e-log must be updated with any pertinent information regarding each sample.

**Table 5.** Field Operator QA Criteria for Samples

Parameter	Acceptable Range	Corrective Action
Start Date	MM/DD/YYYY	Ensure that the start date on the filter file matches that of sampling calendar.
Start Time	0:00	Run a make-up sample if the start time on the filter file is not 0:00.
End Time	0:00	Run a make-up sample if the end time on the filter file is not 0:00.
Average Flow	15.9 to 17.5 LPM	Run a make-up sample.
CV	<2.0	Run a make-up sample.
Volume	23 to 25 m <sup>3</sup>	Run a make-up sample.
Max Temperature Differential	<5 °C	Run a make-up sample if temperature differential is >5 °C and a status code of 2000 is displayed.
Total Minutes	23 to 25 Hours (1380 to 1500 minutes)	Run a make-up sample.
Filter Damage	No visible deformities	Run a make-up sample.
Status Codes	Misc.	Run a make-up sample if status code refers to some critical criteria.

## 10.1 Regional Ambient Monitoring Coordinator Biweekly Quality Assurance

The RAMC is responsible for reviewing all raw data and logbooks prior to submitting the data to RCO. The specific QA duties for the RAMC are described in the following sections.

### 10.1.1 Filter Data Review

The RAMC must verify that each filter record downloaded meets the criteria listed in Table 5. Furthermore, the RAMC must ensure that the following parameters are correct:

1. The Site ID in the filter file matches that of the site.
2. The filter ID in the filter file matches that of the e-log.
3. All sample or sampler issues in the filter file are clearly documented in the e-log.
4. All sample dates are accounted for per the EPA sampling calendar.

### 10.1.2 Electronic Logbook Review

The e-logs are an additive yearly scrolling document. The RAMC must review the e-log for each site monthly. E-log reviews are recommended, but not required, to be conducted every 15 days to ensure the operators and the monitors are meeting the necessary requirements.

1. The RAMC must review all e-logs for completeness, verifications, audits, calibrations, and sampler problems. Specifically, the RAMC must verify that:

- There is a monthly and mid-month verification (or audit) for each calendar month.
  - All devices used were within certification dates.
  - Audit devices were different from the monthly verification devices.
  - %A and %AD are within the limits.
  - All leak checks passed.
  - All instrument issues and missed samples are clearly documented in the comments.
  - All samples required by the EPA monitoring calendar were collected.
  - All sample dates and filter IDs in the e-log match those in the downloaded filter data files.
  - VSCC, monthly, and quarterly maintenance items were completed.
  - There is one field blank per month.
2. The RAMC and the operator should discuss any discrepancies, errors, concerns, or questions before the e-log is submitted to RCO.
  3. The RAMC must sign and date each e-log record before submission to the RCO particulate matter lead. There are RAMC review spaces on the Maintenance, Calibration and Verification/Audit tabs. The RAMC should only make corrections in the comments section of the e-log to preserve the initial documentation of the operator. It is understood that the RAMC has reviewed the information on the Sample Log tab by uploading the filter data to IBEAM.
  4. The RAMC must bring any problem or suspect problem that affects the validity of the data to the attention of the RCO particulate matter lead by e-mail or telephone within 5 business days of discovery. It is recommended that the RAMC alert the RCO particulate lead as soon as possible to discuss corrective actions.
  5. After e-log approval, the RAMC must post the reviewed e-logs at P:\Ambient\Incoming\RegOffices.NC\ (your region) within fifteen days from the start of each month.

### **10.1.3 Regional Quality Assurance Report**

The Ambient Monitoring: Noncontinuous Region QA Report is located under the reports module in IBEAM. This report can assist the RAMC in reviewing the data downloads after they have been uploaded to IBEAM, as discussed in the next section. This report analyzes the following fields:

- Pass/Fail of Total Time
- Pass/Fail of Average Flow
- Pass/Fail of Flow CV
- Pass/Fail of Volume

- Pass/Fail of Max Temperature Differential
- Status Codes

Furthermore, the report user can determine if all the sample data have been uploaded to IBEAM based on the 1:3 or 1:6 date patterns. The RAMC must review this report after each data upload to prevent errors and to be aware of sampler trends.

## 10.2 Uploading Filter Data to IBEAM

The RAMC must upload the filter files to the IBEAM database after the level 2 review of the lab package is complete and the lab data are uploaded to IBEAM. Files must not be uploaded to IBEAM until they have been thoroughly reviewed using the steps in Section 10.1.1. and the criteria listed in Table 5.

### 10.2.1 Uploading Data Files to FTP Server

The RAMC must save the data download in the PM25.frm folder for the region on the group drive P:\Ambient\Incoming\RegOffices.NC\. The RAMC must also save the filter files in the PM25.frm folder for the region on the FTP server. The FTP server can be reached navigating to <ftp://ftp.ncdenr.org>. Contact the RCO Particulate Matter Lead for the username and password. The reviewed filter files downloaded from the sampler and reviewed must be uploaded to the FTP prior to upload on IBEAM. Once logged into the FTP server, the regional folders can be accessed at [aq/ambient/general/RegOffices](#).

### 10.2.2 Importing Filter Files into IBEAM

1. Log into the IBEAM database at <https://ibeamaq.ncdenr.org> using a valid NCID.
2. From the middle down menu, choose PM 25 FRM. A third drop down menu will appear on the far right (Figure 28).

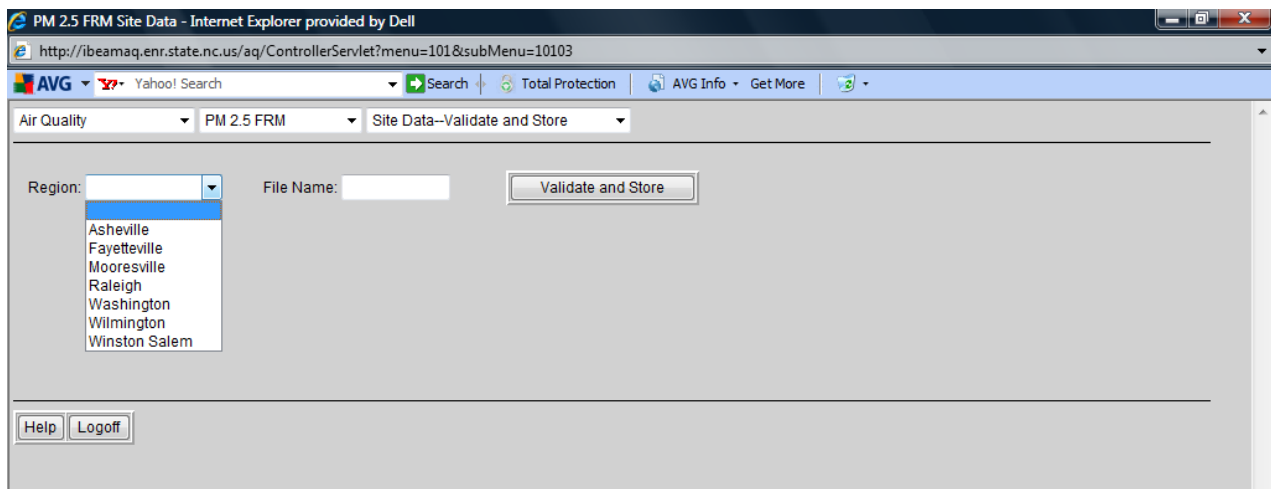
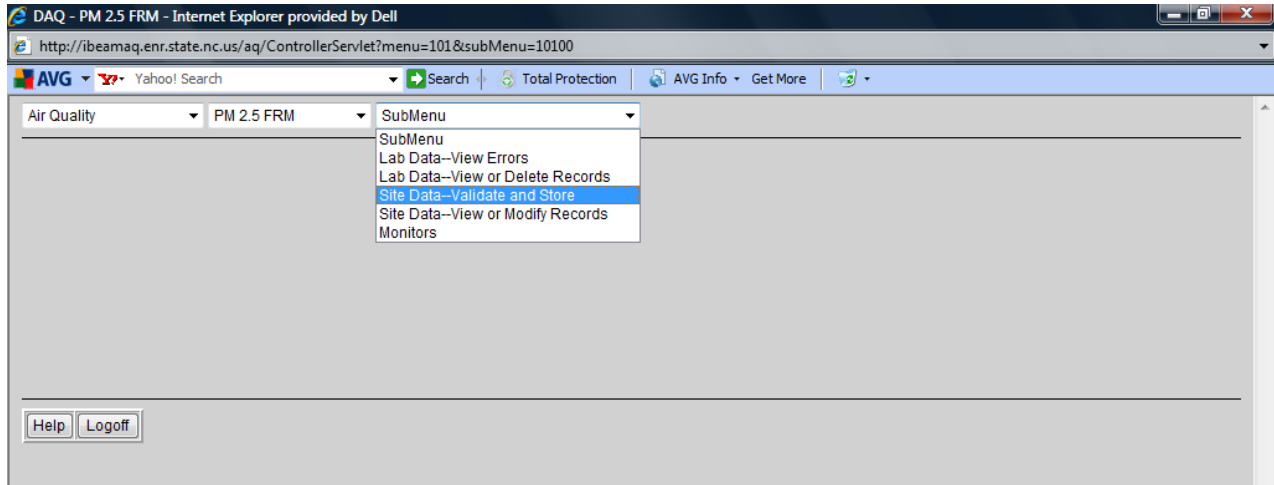


Figure 28. IBEAM PM 2.5 FRM Module.



- From the third drop down menu, choose "Site Data- Validate and Store". The IBEAM Validate and Store screen should now be visible (Figure 29).



**Figure 29.** IBEAM Validate and Store.

- From the first drop down menu of the newly appeared module, choose the region from which the data was collected. With your FTP window open to the saved files, type the name of the file that is being downloaded into the file name space as seen in the window below. Do not enter the .csv extension.
- Once the file name has been entered, click the "Validate and Store" button. If there are no errors, you will see the following message: "The file has been successfully added to the IBEAM database".
- If errors exist, a list of the errors will appear. Correct the errors within the file, FTP the file again and repeat the IBEAM upload steps.
- After the data is successfully loaded into IBEAM, the RAMC must ensure that all data files have been uploaded for each sample collected by checking the "Ambient Monitoring: Noncontinuous Region QA Report".
- Once the data has been entered, send an e-mail detailing any suspect data or monitor situations to the RCO particulate matter lead.

## 11.0 TROUBLESHOOTING AND CORRECTIVE ACTIONS

### 11.1 Filter Cassette Problems

Using the proper filter cassettes is critical in this sampler. The standard ARB filter cassette is the white Delrin cassette. Please note that the blue polycarbonate cassettes are no longer recommended for use in valid PM<sub>2.5</sub> samples. If the wrong filter cassettes are used, the sample cassette may become jammed

in the instrument. The proper filter cassettes have a beveled edge along the top outer rim of the ring. If the edges of the filter cassettes are unbeveled, contact the laboratory for replacements.

## 11.2 Shuttle Errors

To avoid a Shuttle Error, place the piston on the take-up canister even with the bottom of the J-shaped groove. More information on the cause of the shuttle error can be found by going to the Status Code screen and selecting the shuttle error status code. Record this status code for future reference. If the error code indicates “Initial Conditions”, proceed to the steps below to diagnose the problem.

1. Select Service Mode from the main menu and toggle the unit to enter service mode.
2. Return to the main menu by pressing the key. Enter the Service settings menu.
3. Check to ensure the following is true:

Lift/Push Actuator: 0  
Lift Status 2: Up  
Push Status 2: Dn  
Shuttle Status: Ret  
Filter Status 2: Off

4. If the Push Status 2 is not indicating “Dn”, remove the storage canister and recheck the condition.
5. If the condition indicates “Dn”, move the piston on the storage canister down to the J-shaped groove and reload the canister.
6. If a shuttle error leads to an invalid sample, it is imperative to schedule a make-up.

## 11.3 Leak Check Failure

Ensure that the leak check cassette is properly seated. If that fails, ensure that the leak check cassette is not worn or damaged. Request a new leak check cassette from the laboratory if necessary.

If the cassette is not the issue, clean and lubricate or replace the v-seals if necessary. If this fails, the sampler may need additional repair. More information about V-Seal maintenance can be found in the [instrument manual](#).

## 12.0 REVISION HISTORY

2019 is the first year for an approved SOP for the 2025i.

The following revisions were made in Revision 1:

Date	Person Revising the SOP	Revision	Page Number	Approved by/ date
May 25, 2022	Travis Funderburk	Section 4.2: Revised sample handling procedures with regard to completing the COC due to the change to the RTI gravimetric Lab	15	Joette Steger / May 27, 2022
		Section 4.2.1: Updated to replace the use of filter data sheets with the sample log	15	
		Section 5.3.7 Filter Handling Procedures was updated for using RTI as the gravimetric laboratory	28-29	
		Section 5.3.11 Field and Trip Blank Handling Procedures was updated for using RTI as the gravimetric laboratory	33	
		Section 6.3 Calibration E-Log Setup was updated to provide how to obtain the e-log	35	
		Section 10.2 Uploading Filter Data to IBEAM was updated for new time frames due to the transition to the RTI gravimetric laboratory	56	
		Appendix B was added with RTI's COC	61	

### 13.0 REFERENCES

1. Thermo Scientific Instruments, Inc., (2011) Partisol 2025i Sequential Air Sampler Instruction Manual. Prepared by Thermo Scientific Inc., Franklin, MA, Part Number 110100-00
2. United States Code of Federal Regulations, (2006) Title 40 Part 50 Appendix L, Reference Method for the Determination of Fine Particulate Matter as PM<sub>2.5</sub> in the Atmosphere. Prepared by the US Government Publishing Office
3. United States Code of Federal Regulations, (2013) Title 40 Part 50 Appendix N, Interpretation of the National Ambient Air Quality Standards for PM<sub>2.5</sub>. Prepared by the US Government Publishing Office
4. United States Code of Federal Regulations, (2013) Title 40 Part 58 Appendix E, Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring. Prepared by the US Government Publishing Office

**Appendix A: Frequently Used FRM Validation Codes****Table 6.** Frequently Used FRM Data Null Codes (Void Codes)

<b>Null Code</b>	<b>Qualifier Description</b>	<b>Example</b>
AC	Construction/Repairs in Area	Construction Adjacent to site
AD	Shelter Storm Damage	Shelter Storm Damage
AH	Sample Flow Rate out of Limits	Total Flow for BAM
AJ	Filter Damage	Tape Break/Hole/Damage for BAM
AK	Filter Leak	Filter Leak
AN	Machine Malfunction	Failure of MFC/Pump/Heaters/ Monitor Component
AO	Bad Weather	Water in Down Tube/Monitor
AP	Vandalism	Vandalism
AS	Poor Quality Assurance Results	Failed Flow Check or Failed Leak Check
AV	Power Failure	Power Failure
AW	Wildlife Damage	Animal and/or Insect Damage
AX	Precision Check	Monthly Flow Checks
AZ	Q C Audit	Regional Audit for BAM
BA	Maintenance/Routine Repairs	Scheduled and Unscheduled Maintenance
BC	Multi-point Calibration	Regional Calibration for BAM
BE	Building/Site Repair	Monitor Offline for Site/Bldg. Repairs HVAC Replacement for BAM
BJ	Operator Error	Monitor not Sampling following site activity
BK	Site Computer/Data Logger Down	Site Computer/Data Logger Down
SA	Storm Approaching	Storm Approaching

**Table 7.** Frequently Used FRM Data Qualifier Codes (Flags)

<b>QA Flags</b>	<b>Qualifier Description</b>	<b>Example</b>
1	Deviation from CFR	Missing monthly flow verification
2	Operational Deviation	Missed cleaning of VSCC
6	QAPP Issue	Shelter temperature not within specifications
IH	Fireworks	NC State Fair Fireworks display results in high PM
IM	Prescribed Fire	Planned burn
IP	Structural Fire	Nearby home on fire
IT	Wildfire	Unexpected wildlife fire
J	Construction	Pavement of parking lot; adjacent building construction

Appendix B: Example of Field Sample Log and RTI Chain of Custody Form

Example of the 2025i Field Sample Log

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Site Name	ACS ID	Site IDZ	Date of Setup Visit	Time of Setup Visit	Setup Op. Initials	Date of Post Sample Visit	Time of Post Sample Visit	Post Sample Op. Initials	Filter ID	Filter Weigh Date	Actual Sample Date	Status Code	Can As Scheduled?	Data Downloaded?	Days Weighing to Sample	Hrs. till Sample Pickup
1 Ashville	37-021-0034	101	9/14/2021	11:30	KL	10/14/2021	12:45	KL	TS15766	9/9/2021	10/7/2021	OK	Yes	No	28	15:6.8
58 Ashville	37-021-0034	101	10/5/2021	8:30	KL	10/5/2021	8:30	KL	TS15859	9/29/2021	10/5/2021	TB	Yes	No	6	1.0
59 Ashville	37-021-0034	101	10/5/2021	8:30	KL	10/14/2021	12:45	KL	TS15860	9/29/2021	10/13/2021	OK	Yes	No	14	12.8
70 Ashville	37-021-0034	101	10/5/2021	8:30	KL	10/14/2021	12:45	KL	TS15861	9/29/2021	10/14/2021	TB	Yes	No	15	12.8
71 Ashville	37-021-0034	101	10/5/2021	8:30	KL	10/26/2021	1:30	KL	TS15862	9/29/2021	10/19/2021	OK	Yes	No	20	145.5
72 Ashville	37-021-0034	101	10/5/2021	8:30	KL	10/26/2021	1:30	KL	TS15868	9/29/2021	10/25/2021	OK	Yes	No	26	1.5
73 Ashville	37-021-0034	101	10/15/2021	8:45	KL	10/14/2021	12:45	KL	TS15868	10/11/2021	10/14/2021	TB	Yes	No	3	1.0
74 Ashville	37-021-0034	101	10/15/2021	8:45	KL	11/9/2021	1:15	JR	TS15869	10/11/2021	10/31/2021	OK	Yes	No	20	97.3
75 Ashville	37-021-0034	101	10/15/2021	8:45	KL	11/9/2021	2:00	JR	TS15870	10/11/2021	11/6/2021	OK	Yes	No	26	26.0
76 Ashville	37-021-0034	101	10/29/2021	9:45	KL	10/29/2021	9:45	KL	TS15931	10/24/2021	10/29/2021	TB	Yes	No	5	1.0
77 Ashville	37-021-0034	101	10/29/2021	9:45	KL	11/19/2021	10:00	KL	TS15932	10/24/2021	11/13/2021	TB	Yes	No	19	154.0
78 Ashville	37-021-0034	101	10/29/2021	9:45	KL	11/19/2021	10:00	KL	TS15933	10/24/2021	11/13/2021	TB	Yes	No	20	10.0
79 Ashville	37-021-0034	101	10/29/2021	9:45	KL	11/19/2021	10:00	KL	TS15934	10/24/2021	11/18/2021	OK	Yes	No	25	10.0
80 Ashville	37-021-0034	101	10/29/2021	9:45	KL	11/19/2021	10:00	KL	TS15994	11/15/2021	11/19/2021	TB	Yes	No	4	1.0
81 Ashville	37-021-0034	101	11/19/2021	10:30	KL	12/1/2021	13:30	KL	TS15995	11/15/2021	11/24/2021	OK	Yes	No	9	157.5
82 Ashville	37-021-0034	101	11/19/2021	10:30	KL	12/1/2021	13:30	KL	TS15996	11/15/2021	12/6/2021	OK	Yes	No	15	13.5
83 Ashville	37-021-0034	101	11/19/2021	10:30	KL	12/1/2021	13:00	KL	TS15997	11/15/2021	12/6/2021	OK	Yes	No	21	85.0
84 Ashville	37-021-0034	101	11/19/2021	10:30	KL	12/1/2021	13:00	KL	TS15998	11/15/2021	12/7/2021	TB	Yes	No	22	13.0
85 Ashville	37-021-0034	101	11/19/2021	10:30	KL	12/1/2021	11:10	KL	TS15999	11/15/2021	12/12/2021	OK	Yes	No	27	35.2
86 Ashville	37-021-0034	101	12/10/2021	8:00	KL	12/10/2021	13:00	KL	TS16310	12/6/2021	12/10/2021	TB	Yes	No	4	1.0
87 Ashville	37-021-0034	101	12/10/2021	8:00	KL	12/10/2021	13:00	KL	TS16310	12/6/2021	12/10/2021	TB	Yes	No	4	1.0

The laboratory section of the COC is completed by RTI lab staff.

**RTI Chain of Custody  
 PM 2.5 Gravimetric Analyses**

Client: NCDEMR  
 Regional Contact Name: Kevin Lance  
 Region: Western North Carolina - Asheville

Project #: 0217963.000.001  
 Contact Phone #: 828-250-6763  
 Email: kevin.lance@buncombecounty.org  
jamesraiford@buncombecounty.org

**1. Laboratory**

Packaged By: Burnette  
 Batch #: 2  
 Shipped via: UPS

Date Shipped: 7/22/2023  
 Airbill #: 1Z2056950196019008

Laboratory					Field Site WNCQAQ
Filter ID	Cassette #	Magazine ID	Expiration Date	Blank Type	Comments
515379	RP081891	WNCQAQ	8/19/2021	Field Blk	
515380	RP007461	WNCQAQ	8/19/2021		
515381	RP003541	WNCQAQ	8/19/2021		
515382	RP008742	WNCQAQ	8/19/2021		
515383	RP003540	WNCQAQ	8/19/2021		

After completing the initial review, date and initial below. If there are issues regarding shipping, enter comments on this section of the COC. Note: Initialing and dating this section indicates the filters from the lab are acceptable for sampling.

Operators initially review data entered by RTI lab staff, reconcile the filter IDs on the COC with the actual filters shipped. Inspect filters in a clean area (office) to minimize contamination. If lab errors, damage to filters, incorrect cassette type, etc. are found, make comments in the comment section and contact RTI lab staff.

**2. Shipment to WNCQAQ**

Field Scientist: [Signature] Date Received: 7/23/21  
 Shipment OK?  Y  N  
 Comments: \_\_\_\_\_

Please Scan Completed Chain of Custody Form and email to [tdb@rti.org](mailto:tdb@rti.org), OR include a copy in the next return shipment to RTI.

Enter the batch number from Master list. Note: two different batch numbers can be listed here.

This part of the COC is prefilled by the RTI lab staff

**RTI Chain of Custody  
PM 2.5 Gravimetric Analyses**

Client: NCOENR

Regional Contact Name: Kimberly Homberger Project #: 0217953.000.001

Region: Winston-Salem Regional Office - Lexington Contact Phone #: 336-776-6600

Emails: kimberly.homberger@ncdenr.gov  
clawping.stan@ncdenr.gov

**1. Field Site-WSRO**

Filters From Batch #: 11

Packaged By: K. Homberger

Shipped via: UPS

Date Shipped: 3/14/22

Airbill #: 122056950191149065

Enter the shipping date

Enter the Air bill #

SITE 2-WSRO					
Filter ID	Magazine ID	Filter Expiration Date	Date Sampled	Operator	Field Comments
<u>516462</u>	<u>WSRO</u>	<u>3/19/22</u>	<u>3/16/22</u>	<u>KRH</u>	
<u>516463</u>	<u>WSRO</u>	<u>3/19/22</u>	<u>3/7/22</u>	<u>KRH</u>	<u>Field Blank</u>

Enter who packaged the filters for shipping.

Enter the filter ID, magazine ID, Filter Expiration Date, Date sample, operator, and field comments. Note: In the field comments, if applicable indicated a field blank and/or trip blank. Also, any conditions that may impact the sample weight or integrity of the sample record in the field comments.

**2. Receipt at RTI**

Received by: MM Date Received: 3-15-22

Shipment OK?  YES  NO Max. Temp. of Shipment: 1.6 °C

Comments:

This section is completed by RTI lab staff.