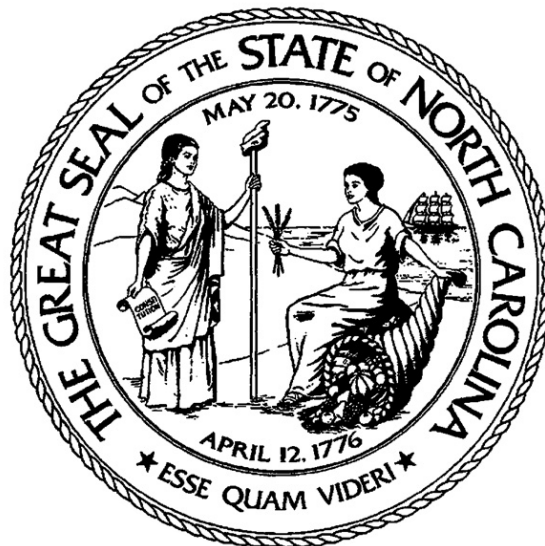


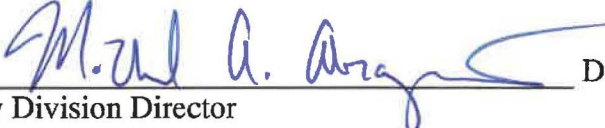
Standard Operating Procedure 2.44
Section 2:
URG 3000N Sequential Particle Speciation System
Standard Procedures for Operators


Revision 2020




Standard Operating Procedure Approval

Department of Environmental Quality

1. Signature:  Date 12/16/19
Air Quality Division Director

2. Signature:  Date 12-16-2019
Quality Assurance Manager
(Ambient Monitoring Section Chief)

3. Signature:  Date 12-16-2019
Projects and Procedures Branch Supervisor


4. Signature:  Date 12/16/19
Primary SOP Author

Table of Contents

| | | |
|------------|-----------------------------------------------------------------------|-----------|
| 1.0 | SCOPE AND PURPOSE..... | 10 |
| 2.0 | SAMPLER DESCRIPTION AND ASSEMBLY..... | 11 |
| 2.1 | Description of the URG 3000N Monitor | 11 |
| 2.2 | Controller Overview | 11 |
| 2.3 | Module C Overview | 13 |
| | 2.3.1 Cyclone and Inlet..... | 14 |
| | 2.3.2 Mass flow controller..... | 14 |
| | 2.3.3 Filter Cassette and Cartridges..... | 15 |
| 2.4 | Pump Enclosure Overview | 15 |
| 2.5 | Assembly | 16 |
| | 2.5.1 Packing List..... | 16 |
| | 2.5.2 Upper Stand and Rain Shield Assembly..... | 17 |
| | 2.5.3 Roof Assembly | 18 |
| | 2.5.4 Controller and Module C Installation..... | 18 |
| | 2.5.5 Inlet Installation..... | 18 |
| | 2.5.6 Support Feet Installation..... | 19 |
| 3.0 | SUMMARY INFORMATION SPECIFIC TO THE INSTRUMENT..... | 20 |
| 3.1 | AC Power Warning..... | 20 |
| 3.2 | Weight | 20 |
| 3.3 | Sighting Criteria..... | 20 |
| 4.0 | LOGBOOK SETUP, SITE VISIT PROCEDURES AND CHECKS..... | 21 |
| 4.1 | Initial Setup of the Electronic Logbook..... | 21 |
| | 4.1.1 Guidance for Useful Logbook Documentation..... | 21 |
| 4.2 | Site Visit Procedures and Checks | 22 |
| | 4.2.1 Site Inspection | 22 |
| | 4.2.2 Site Logbook | 23 |
| | 4.2.3 Equipment Inspection..... | 23 |
| 5.0 | SAMPLER SETUP..... | 24 |
| 5.1 | User Interface and Menus | 24 |
| | 5.1.1 Auto Mode..... | 25 |
| | 5.1.2 Menu Mode | 25 |
| | 5.1.3 Main Menu Map..... | 26 |
| | Below is a map of the main menus and first sub-menus of the URG. | 26 |
| 5.2 | Monitor Setup | 29 |
| | 5.2.1 Powering and Warm-Up Period | 29 |
| | 5.2.2 Set Date and Time | 30 |
| 5.3 | Sample Setup | 31 |
| | 5.3.1 Pre-Sampling..... | 31 |
| | 5.3.2 Sample Setup/Filter Change | 31 |
| | 5.3.3 Electronic Logbooks..... | 32 |
| | 5.3.4 Sample Shipment..... | 33 |

| | | |
|-------------|------------------------------------------------------------------------------|-----------|
| 6.0 | CALIBRATION | 34 |
| 6.1 | Calibration Requirements | 34 |
| 6.2 | Calibration Equipment | 35 |
| 6.3 | Calibration E-Log Setup | 36 |
| 6.4 | Ambient Pressure Sensor Calibration | 36 |
| 6.5 | Ambient Temperature Sensor Calibration | 37 |
| 6.6 | Calibration Leak Check | 37 |
| 6.7 | Flow Calibration | 39 |
| 6.8 | Post Calibration Flow Evaluation | 40 |
| 7.0 | QUALITY CONTROL | 41 |
| 7.1 | Tolerances and Corrective Actions for Verifications, Checks, and Audits..... | 43 |
| 7.2 | Verification or Audit: E-Log Setup | 44 |
| 7.3 | Verification or Audit: “As Found” Leak Check | 44 |
| 7.4 | Verification or Audit: Ambient Pressure | 46 |
| 7.5 | Verification or Audit: Ambient Temperature | 46 |
| 7.6 | Verification or Audit: Flow | 47 |
| 7.7 | Verification or Audit: “As Left” Leak Check..... | 47 |
| 8.0 | MAINTENANCE | 49 |
| 8.1 | Cleaning the URG Cyclone | 50 |
| 8.2 | Cleaning the URG Downtube | 50 |
| 8.3 | Cleaning the Housings..... | 51 |
| 8.4 | Inspecting the System..... | 51 |
| 9.0 | DATA HANDLING..... | 52 |
| 10.0 | QUALITY ASSURANCE | 53 |
| 10.1 | Data Review | 53 |
| 10.2 | Field Operator Quality Assurance | 53 |
| 10.3 | Regional Ambient Monitoring Coordinator Quality Assurance | 53 |
| | 10.3.1 URG Download Review..... | 54 |
| | 10.3.2 Electronic Logbook Review | 54 |
| 10.4 | DART | 55 |
| | 10.4.1 Opening Dart..... | 55 |
| | 10.4.2 Validating CSN Data within DART..... | 57 |
| 11.0 | TROUBLESHOOTING | 62 |
| 11.1 | Display not Shown..... | 62 |
| 11.2 | No Power | 62 |
| 11.3 | Leak Check Failed | 62 |
| 11.4 | Removing Exposed Filter Cartridge without Installing a New One | 63 |
| 11.5 | Preventing Sampler from Collecting on Previously Exposed Filter | 63 |
| 11.6 | Pump Will Not Start During Filter Change Procedure | 63 |
| 12.0 | REVISION HISTORY | 64 |
| 13.0 | REFERENCES..... | 64 |



List of Tables

| | |
|-------------------------------------------------|----|
| Table 1. Description of E-Log Spreadsheets..... | 21 |
| Table 2. Operation Evaluations..... | 43 |
| Table 3. Summary of Sampler Maintenance..... | 50 |

List of Figures

| | |
|---------------------------------------------------------------|----|
| Figure 1. URG Constituent Parts..... | 11 |
| Figure 2. Controller..... | 12 |
| Figure 3. Inside View of Module C..... | 13 |
| Figure 4. Flow Diagram..... | 14 |
| Figure 5. Pump Enclosure..... | 15 |
| Figure 6. Display Terminal..... | 24 |
| Figure 7. Current Status Screens..... | 25 |
| Figure 8. Authentication and Operator Select Screens..... | 26 |
| Figure 9. Main Menu Map..... | 26 |
| Figure 10. Main Menu Number One..... | 27 |
| Figure 11. Main Menu Number Two..... | 27 |
| Figure 12. Main Menu Number Three..... | 28 |
| Figure 13. Main Menu Number Four..... | 28 |
| Figure 14. Main Menu Number Five..... | 28 |
| Figure 15. Welcome Screen..... | 29 |
| Figure 16. Memory Check Screen..... | 30 |
| Figure 17. ID Codes Screen..... | 30 |
| Figure 18. BGI Tetra Cal with Optional Temperature Probe..... | 35 |
| Figure 19. Flow Audit Adapter Installed..... | 38 |
| Figure 20. Flow Audit Adapter Installed..... | 45 |
| Figure 21. DART Login Page..... | 56 |
| Figure 22. DART Tool Tab..... | 56 |
| Figure 23. DART Welcome Page..... | 57 |
| Figure 24. DART Data Manage Screen..... | 58 |
| Figure 25. DART Approval Window..... | 59 |
| Figure 26. DART Batch Window..... | 59 |
| Figure 27. Time Series Window..... | 60 |

1.0 SCOPE AND PURPOSE

In April 2005, the Clean Air Scientific Advisory Committee gave strong general support for making changes to the EPA PM_{2.5} Chemical Speciation Network (CSN) to improve comparability with the rural Interagency Monitoring of Protected Visual Environments (IMPROVE) PM_{2.5} carbon concentration data. The CSN currently includes about 185 sites and monitors PM_{2.5}, ions, elements and carbon species. The program's objectives are to:

- Provide data to support the development of modeling tools.
- Assess the effectiveness of emission reduction strategies.
- Support other air quality programs and the National Ambient Air Quality Standards (NAAQS).
- Support research studies.

The EPA plan of action, designed to achieve this comparability, included replacing the CSN carbon sampling channel with an IMPROVE-like sampler and using the IMPROVE carbon Thermal Optical Reflectance (TOR) analysis method, instead of the Thermal Optical Transmittance (TOT) method. In addition, the EPA requested the manufacturer of the IMPROVE sampler, URG (Chapel Hill, NC), to modify the IMPROVE sampler to incorporate mass flow control versus fixed-orifice flow control. The result was a new instrument, the URG-3000N Sequential Particulate Speciation System.

The objective of this Standard Operating Procedure (SOP) is to familiarize the station operator with the setup, field operations, and quality control checks of the URG-3000N speciation sampler, specifically for data generated by the National PM_{2.5} CSN. This SOP will not necessarily apply to other monitoring activities for which the URG 3000N may be capable and operated. Any such use will be described by the applicable Quality Assurance Project Plan(s). 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 in order to achieve a high level of data quality.

For more detailed information, refer to the URG-3000N Operations Manual or contact URG at (919) 942-2753, <http://www.urgcorp.com/index.php/email-form> or info@urgcorp.com.

2.0 SAMPLER DESCRIPTION AND ASSEMBLY

2.1 Description of the URG 3000N Monitor

A drawing of a URG-3000N Sequential Particulate Speciation System is shown below. The sampler consists of one Module C, one controller, one stand, one stand rain shield and one 36" inlet tube (the inlet tube is not shown in this illustration). There may also be an optional collocated Module C and stand. The controller contains the timer, the keypad, and other electronic equipment required to operate the sampler. The stand contains the pump and flow controller. The Module C collects PM_{2.5} particles on quartz filters. These filters are analyzed for organic and elemental carbon using Thermal Optics Analysis Method (TOA).

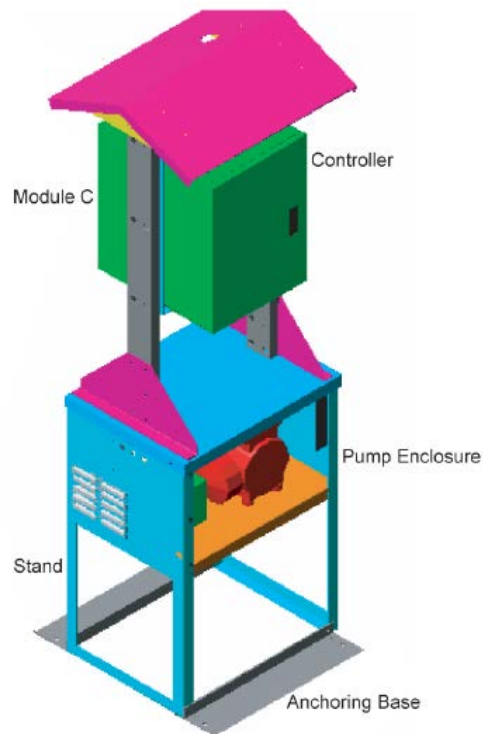


Figure 1. URG Constituent Parts.

2.2 Controller Overview

The sampler controller is used to control the sample collection and acquire data during sampling. This consists of a controller, a terminal with LCD screen, a twenty-button keypad and the appropriate electronics components. The controller is shown below. The lower portion of the figure shows the connectors on the bottom of the controller.

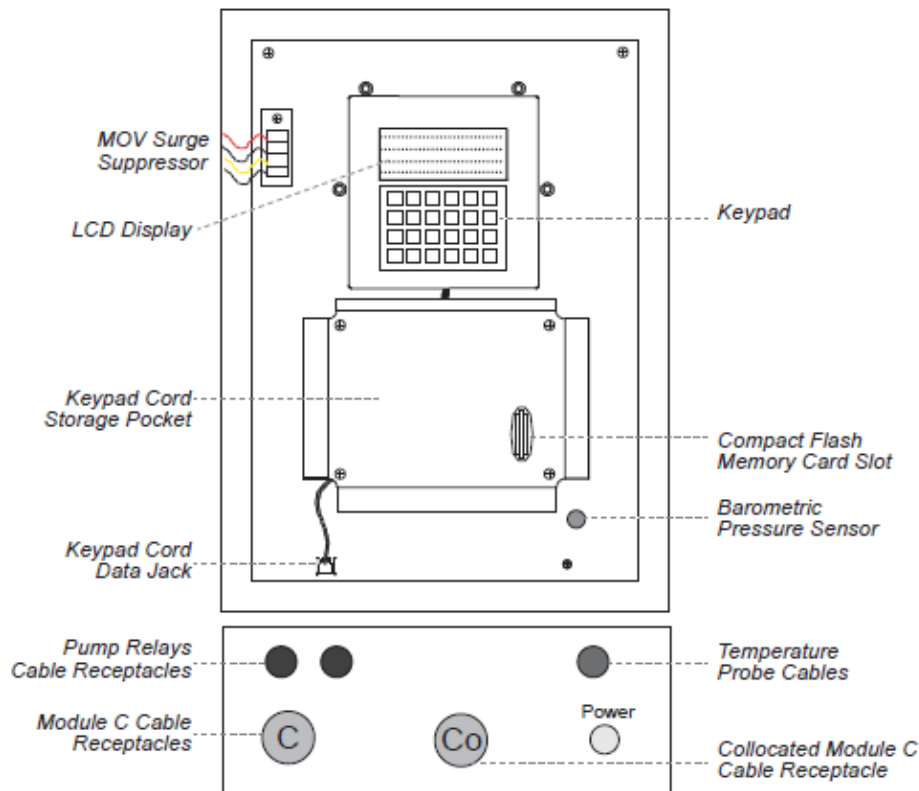


Figure 2. Controller.

The keypad and display terminal can be removed from the controller to be closer to a sampler module. When left in the controller, the cord is contained in a storage pocket. The controller:

- Provides a status of current sampler operations to the site operator.
- Provides an interface for recording initial and final measurements of the filters during sample changes to the site operator.
- Provides options for selecting sampling protocols.
- Keeps the current date and time.
- Switches the filter solenoids and pump relays on and off.
- Records pressure transducers' measurements. A standard configuration has 3 transducers: barometric pressure, one vacuum per module, and temperature. Measurements are taken once a minute and averages are recorded on the compact flash memory card every 15 minutes. The

averages are also recorded whenever there is a power outage or the operator starts the sample change.

- Records the solenoid valve number that is open.
- Downloads all the measurements to the removable compact flash memory card.

2.3 Module C Overview

The inside of a URG-3000N Sequential Particulate Sampler Module C and the flow diagram for the URG 3000N Module are shown below.

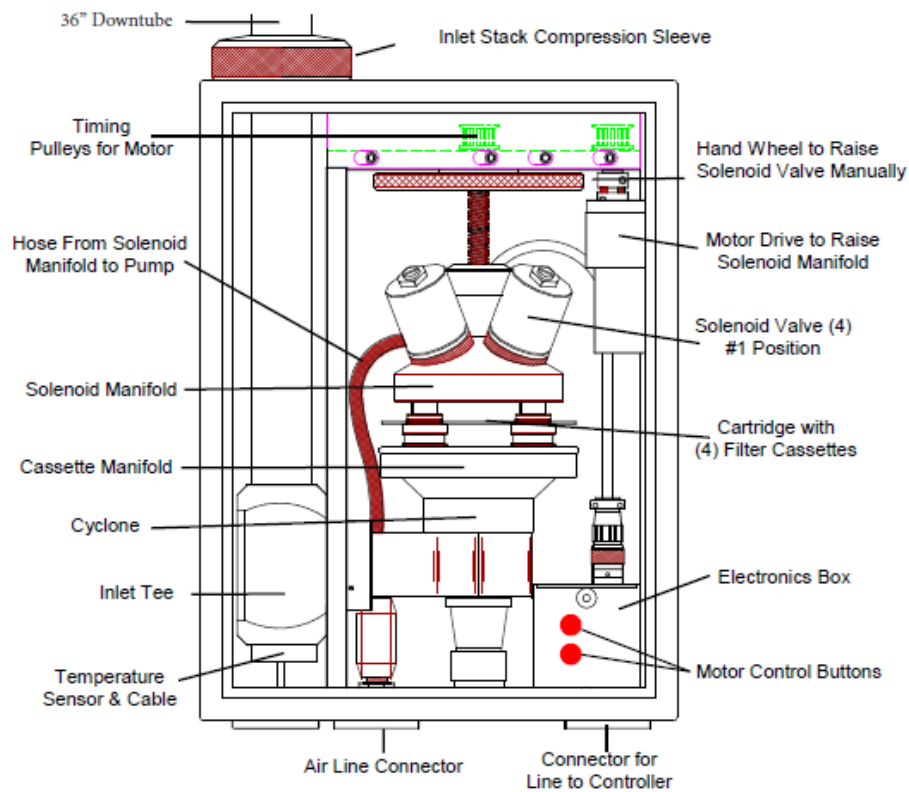


Figure 3. Inside View of Module C.

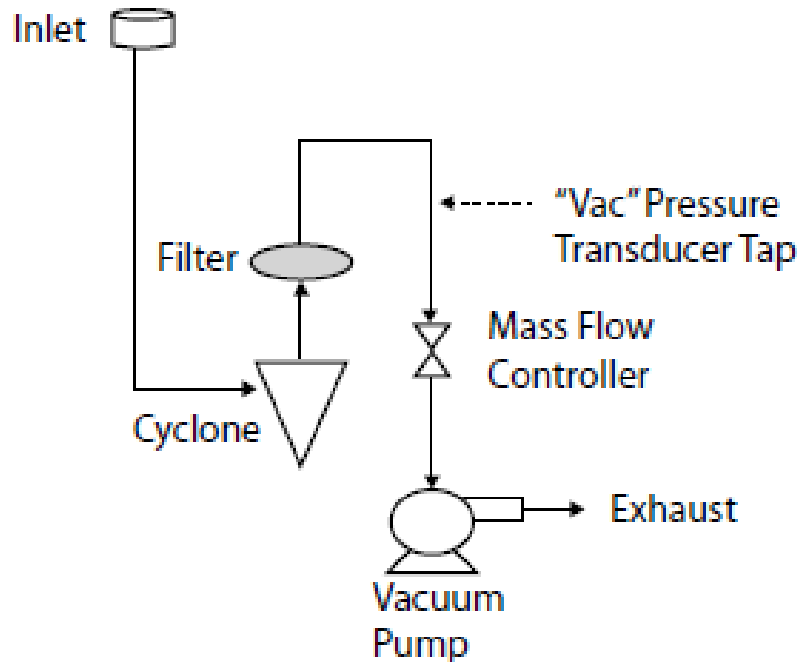


Figure 4. Flow Diagram.

2.3.1 Cyclone and Inlet

The ambient air enters through a screened inlet on top of the stack. The screened inlet removes bugs, rain, and particles larger than approximately 15 μm . The air stream then passes through a cyclone that removes particles larger than 2.5 μm . The cyclone is located inside the module, as shown on the previous page. The cyclone is 50% efficient at removing particles with aerodynamic diameters larger than 2.5 μm at the nominal flow rate of 22.0Lpm. It is volumetric flow controlled using a mass flow controller and corrections are made for temperature and barometric pressure variations. A temperature probe is inserted in the inlet tee of the Module C. The temperature probe is situated in the air stream just prior to the cyclone. The temperature is measured and the average temperature is recorded on the compact flash memory card.

2.3.2 Mass flow controller

The mass flow controller is used to maintain a constant flow rate during a sampling period. It is located within the pump enclosure, near the base of the stand.

2.3.3 Filter Cassette and Cartridges

The filter cassettes and cartridges are manufactured specifically for the URG-3000N sampler. They are made of acetyl homo-polymer with stainless steel screens. The two halves of the cassette snap together and are sealed with an o-ring. A special tool is required to separate and assemble the two halves. The individual cassettes are always installed in cartridges, with four cassettes per cartridge. Most cassettes are secured in the cartridges by a snap ring and cannot be removed easily. Each cartridge has a center hole and a small alignment hole. When the cartridge is placed on the cyclone manifold, alignment pins on the manifold prevent the cartridge from being installed incorrectly.

2.4 Pump Enclosure Overview

Shown below is a photo of the inside of the pump enclosure, part of the URG-3000N stand. The additional photos show a close-up of the sidewall.

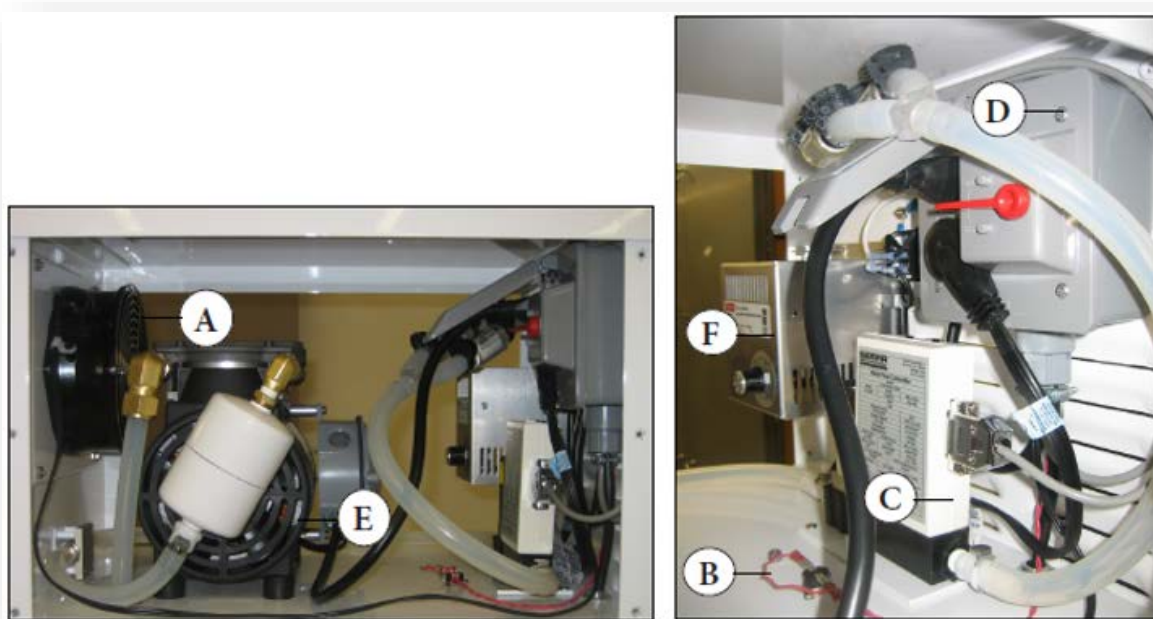


Figure 5. Pump Enclosure.

The components located inside the enclosure are labeled and listed below:

- A. Fan: The pump enclosure fan is used to regulate the temperature within the enclosure.
- B. Snap Thermostat: The snap thermostat regulates the pump enclosure fan. When the enclosure temperature rises above 85 degrees Fahrenheit, the fan is turned on. When the enclosure temperature drops below 65 degrees Fahrenheit, the enclosure fan is disabled.
- C. Mass flow controller: The mass flow controller is located on a bracket within the pump enclosure.
- D. Power Terminal: Behind the door shown in the photo are two power outlets. The top outlet is the correct outlet for usage with the pump. This outlet is controlled to power on and off the pump. The bottom outlet is to be used for the optional enclosure heater.
- E. Pump: The URG-3000N utilizes a 120V pump that is seated in the pump enclosure as shown. It mounts with four nuts from the bottom.
- F. Enclosure Heater (Optional): An optional enclosure heater is available for usage with the URG-3000N in colder environments.

NOTE: *The red lever is a dummy lever and does not perform any function.*

2.5 Assembly

Assembly consists of constructing the URG-3000N stand and attaching the Module C and controller module, installing the module inlet, connecting the cables between the controller, Module C and pump, and connecting the vacuum hoses between the Module C and pump.

2.5.1 Packing List

The following list details all of the individual boxes that the URG-3000N ships in, and the contents of each box. All quantities are one (1) unless noted otherwise.

- Module C
- Controller Module
- Pump Enclosure: Mass Flow Controller, Snap Thermostat, Fan, Power Terminal
- Lower Stand Components
- 20" 12-pin Standard Control Cable for attaching Module C to Controller and Mass Flow Controller
- Temperature Probe (Partially Installed in Inlet Tee)
- Leak Check (Flow Audit) Assembly: Downtube Reducer, Leak Check (Flow Audit) Adapter (1.25" to brass hose barb with shutoff valve), Audit cassette cartridge tray
- Inlet Cap
- Roof Flashing for Inlet
- 120" Extended Pump Relay Cable
- 72" 115VAC Power Cable
- Compact Flash Memory Card
- 36" Inlet Stack
- Stand Rain-shield Roof
- Rain-shield Left Side Support
- Rain-shield Right Side Support
- Assorted Assembly Hardware
- 120V Pump
- Exhaust Tube
- Rubber Feet

2.5.2 Upper Stand and Rain Shield Assembly

1. Install one roof support to the roof with (6) stainless steel nuts with integrated lock washers and tighten.
2. Install both H-body base supports with (12) stainless steel washers and nuts.
3. Turn the H-body on its side, using a thin screwdriver, slide one washer on the screwdriver. Align the screwdriver with the stud and let the washer slide down onto the stud.
4. Turn the H-body over far enough that the washer does not slide off and the stainless steel nut in a nut-driver will stay in the driver. Tighten the nut. Repeat the washer/nut installation until all (12) studs have been secured.
5. Install the second roof support on the H-body.

2.5.3 Roof Assembly

1. Line up all the studs with the holes and press fit everything together.
2. Install and tighten all connectors. The roof connector nuts require an 11/32" open end wrench to access the studs at the peak.
3. Install the completed H-Body on the pump house studs. Align the "Controller Side" labels on the pump box and H-body on the same side.

2.5.4 Controller and Module C Installation

1. Hang the controller on the side labeled "Controller Side."
2. Install feet first into the precut holes.
3. Loosen the stainless steel cap screw to allow the controller carrying handle to clear the cap screw and slide into the receiver.
4. Hand-tighten the cap screw so the controller is captive.
5. Repeat the process for the sampler module.
6. Install the (6) stainless steel acorn nuts and washers on the H-body base studs.
7. Use Loctite on the studs at this time, then tighten all nuts.

2.5.5 Inlet Installation

1. Slide the inlet tube into the roof jack, then into the sampler module.
2. Open the door to the Module and guide the inlet tube into the Tee until it is past the O-ring and seated on the stop inside the Tee.
3. Slide the roof jack mate onto the tube into contact with the roof jack creating a weather proof seal.

4. Tighten the lock ring at the top of the Sampler Module by hand until it is secure around the inlet tube. This keeps melting snow and wind blown precipitation out of the Sampler Module.

2.5.6 Support Feet Installation

The mounting feet are installed in the wrong direction to allow for easier shipping. You will have to remove the support feet and install them correctly before operating the URG-3000N.

1. Remove the (2) screws that hold the feet onto the base and re-install them with the larger flat surface facing down onto the ground.
2. There are (4) holes in the part of the feet that face the ground. The (2) larger holes are to allow the stand to be bolted to a sampling platform.

3.0 SUMMARY INFORMATION SPECIFIC TO THE INSTRUMENT

3.1 AC Power Warning

CAUTION: AC voltage can be dangerous. Special care should be taken to avoid personal injury. The URG-3000N should be in the OFF position when the AC power is applied to the system.

3.2 Weight

The URG-3000N sampler can weigh as much as 135 pounds when completely assembled. Special care should be taken to prevent injury when lifting or moving a sampler. The URG-3000N should be assembled where it will be operated.

3.3 Sighting Criteria

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

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

4.0 LOGBOOK SETUP, SITE VISIT PROCEDURES AND CHECKS

4.1 Initial Setup of the Electronic Logbook

An electronic logbook (e-log) must be created for each site at the beginning of the calendar year or upon setup. The URG 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 RCO particulate matter lead.

Table 1. Description of E-Log Spreadsheets.

| E-Log Spreadsheet | Description |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Instructions | Setup of site information (Site Name, AQS ID, SiteID2). Provides a summary of operational evaluations and sampler maintenance for users. |
| 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. |
| Maintenance Log | Table for documenting monthly, quarterly, and annual maintenance activities, as well as, leak checks, clock verifications, etc. |

Initial setup of the e-log requires selecting the site name from a pull down menu on the “Instructions” tab of the e-log (Figure 1). The AQS ID, pollutant, and URG 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 QA/QC programs. In particular, EPA has discussed the role that logbooks play in providing proof that 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 inlet head and replaced one of the two gaskets". In particular, 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 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 Site Visit Procedures and Checks

4.2.1 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/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 log book and may prove to be invaluable if

the data is challenged. The station operator is responsible for making several observations during the station inspection. Any of the above described observation must be thoroughly detailed in the site log book.

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.

4.2.2 Site Logbook

A station log book must be maintained at each monitoring site and should accurately reflect site operations. The log book will be identified with the station name and station number. All entries shall include the date, time, operator, 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.

4.2.3 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 URG Particulate Monitor Operation Manual and compile personal notes on troubleshooting as they gain experience with the instruments. The operator is encouraged to contact ECB or the manufacturer when attempting any repairs.

The operator's manual is the best resource the station operator has for the information on the operation and maintenance of the URG monitor.

5.0 SAMPLER SETUP

5.1 User Interface and Menus

The display terminal is shown in detail below. The LCD has 4 lines that display 20 characters each. The keys/buttons consist of number 0 through 9, decimal, SPACE, BKSP (backspace), ↑F1, ↓F2, ←F3, →F4, YES, NO, and ENTER. Keys will generally be shown in with “<>” throughout the software section.

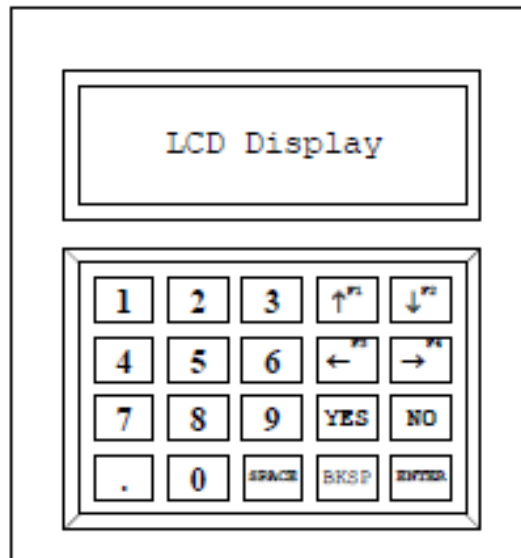


Figure 6. Display Terminal.

The ENTER key is generally used to proceed to the next main step or to return to a previous menu. The →F4 or ENTER keys are used to move to the next or previous screens. The <No> key usually acts as an escape key when possible.

NOTE: In most cases, the LCD will list the available options for navigation. From the main menu, pressing ENTER will return to the previous main menus (if possible), and then to AUTO MODE.

The controller program has two modes: auto mode and menu mode. The program is normally in the auto mode, whether the sampler is running or not. In the auto mode, the LCD will display the current status of the sampler module(s). All sampler functions are performed using menus and submenus in the menu mode, as discussed in this section.

To move from the auto mode to the menu mode, press the <Enter> key. This will prompt you for authentication and site operator Initials, followed by the main menu.

5.1.1 Auto Mode

When the sampler is in auto mode, the current status of the sampler is displayed. The display shows whether the sampler is collecting, idling, or waiting for samples. An example of auto mode is shown below.

The first line displays the current date and time. For this example, the date is December 20th, 2006. The time is 4:00 PM. After the time, the day of the week is listed, in this case Wednesday. The third line indicates the sample status. The fourth line shows that the sampler is off.

This screen is the same as previously shown, except that it is displaying that the sampler is currently on. At this time, the sampler is recording the flow rate, temperature, and other parameters. Pressing ENTER will allow you to authenticate and proceed to menu mode.

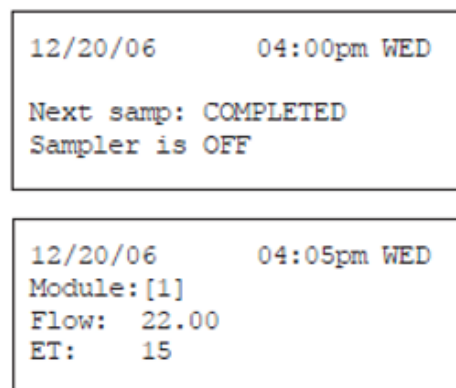


Figure 7. Current Status Screens.

5.1.2 Menu Mode

The menu mode has a five screen main menu and several sub-menus. The main menu can be accessed by pushing the ENTER key while the sampler is displaying the status in auto mode.

The authentication screen is still included in the menu tree, but there is no longer a password associated with it. You can simply press the ENTER key to proceed.

Now you are prompted to select/modify the current operator. There is space for one primary and two backup operators' initials to be stored. To select an operator, press the ENTER key corresponding to

the initials. To change the operator initials, select the →F4 key. These values all begin as blank until edited for the first time. After selecting an operator, you will be presented with the initial main menu.

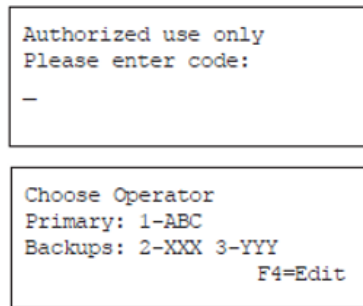


Figure 8. Authentication and Operator Select Screens.

5.1.3 Main Menu Map

Below is a map of the main menus and first sub-menus of the URG.

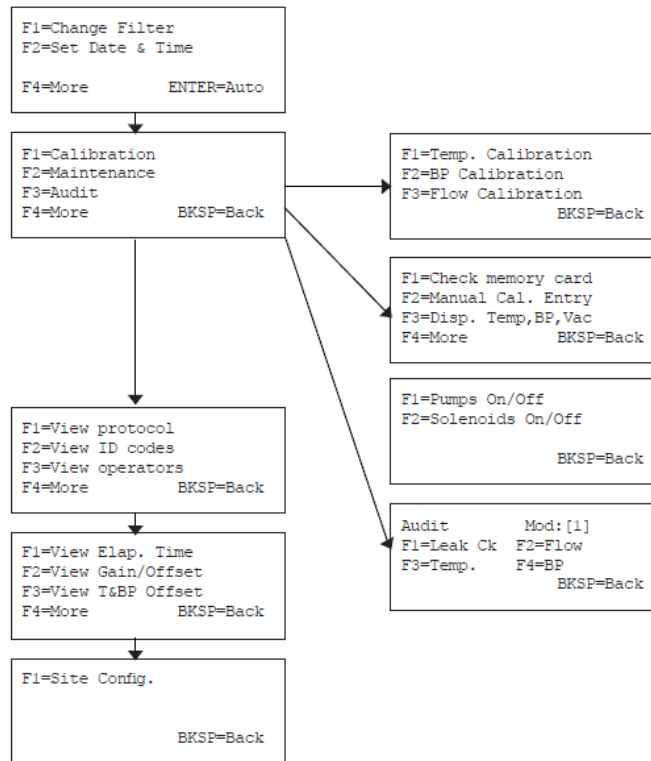


Figure 9. Main Menu Map.

5.1.3.1 Main Menu Number One

The first main menu screen allows you to change filter, set the date & time and progress to the next main menu screen by pressing →F4 key for more options. *NOTE: Pressing the ENTER key on this screen will return to auto mode, requiring you to re-authenticate before accessing the menu again.*

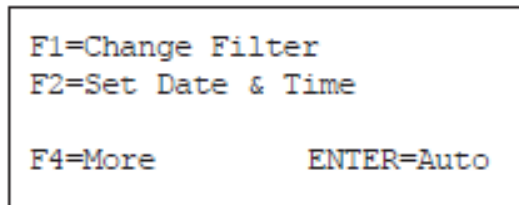


Figure 10. Main Menu Number One.

5.1.3.1 Main Menu Number Two

The second main menu screen allows you to perform calibration maintenance and audit procedures. Pressing the →F4 key will again allow you to access the next main menu, pressing ENTER will return to the first main menu.

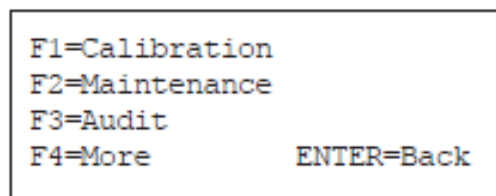


Figure 11. Main Menu Number Two.

5.1.3.2 Main Menu Number Three

The third main menu allows for you to view sampling protocol, sampler ID codes or view the initials of the site operator.

```
F1=View protocol  
F2=View ID codes  
F3=View operators  
F4=More          ENTER=Back
```

Figure 12. Main Menu Number Three.

5.1.3.3 Main Menu Number Four

The fourth main menu allows you access to view the elapsed time and the gain/offset by pressing the appropriate keys. Pressing the F4 key proceeds to the fifth and final main menu, whereas pressing the BKSP key will return to the third main menu.

```
F1=View Elap. Time  
F2=View Gain/Offset  
F3=View T&BP Offset  
F4=More          BKSP=Back
```

Figure 13. Main Menu Number Four.

5.1.3.4

The fifth main menu allows you to run the site configuration procedure. Press ↑F1 to step through site configuration, or press ENTER to return to the previous main menu.

```
F1=Site Config.  
  
BKSP=Back
```

Figure 14. Main Menu Number Five.

5.2 Monitor Setup

The URG user interface is a LCD display. All of the features and functions for monitor setup are accessed using the display.

WARNING!

To avoid damage to the monitor, ensure that the AC power voltage matches the voltage indicated on the monitor's model/specifications label located on the rear panel before plugging the URG into line power. High voltages are present inside the instrument. Ensure that the power cord being used is capable of carrying the power rating of the instrument (see rear panel label). Note:

- Power connection must have functioning ground connection.
- Do not defeat the ground wire on power plug.
- Turn off instrument power before disconnecting or connecting electrical subassemblies.
- Do not operate with cover off.

Some repair and troubleshooting operations need to be carried out with the monitor open and running. Use common sense when operating inside a running monitor. Exercise caution to avoid electrical shocks and electrostatic or mechanical damage to the monitor. Do not drop tools into the monitor or leave those after your procedures. Do not short or touch electric connections with metallic tools while operating inside the monitor. For monitors installed in small shelters, beware of external elements (i.e., weather conditions) when performing maintenance exposing the monitor.

5.2.1 Powering and Warm-Up Period

Put a compact flash memory card into the controller and then plug in the monitor. The URG power switch is located on the side panel of the pump compartment. When the power is switched on, the main menu screen should appear after a few seconds and will display the welcome message. The date will display in YYYY.MM.DD.

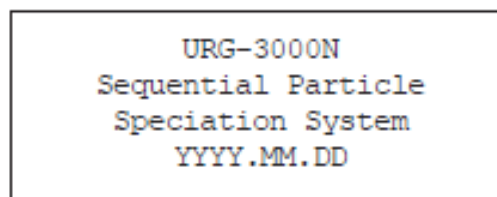


Figure 15. Welcome Screen.

After initializing, the URG will check the presence and status of the compact flash card located in the slot. If the card is present and working properly, "Card is OK" will be displayed. Otherwise, an error will be shown.

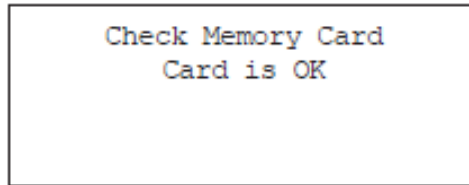


Figure 16. Memory Check Screen.

After checking memory, the display will briefly show the ID codes before entering auto mode. Here, the display shows the Location Code (LOC), the 15 Character Chain of Custody (Q), the 15 Character Module ID (Comp), and the Serial Number (SN). This screen will proceed to auto mode after a short pause, or the <ENTER>key can be pressed at any time to skip this screen.

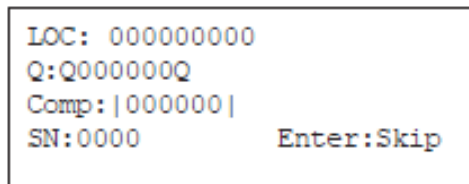


Figure 17. ID Codes Screen.

5.2.2 Set Date and Time

The URG clock time must agree with NIST time to within ± 1 minute, Eastern Standard Time. The date/time settings menu allows changes to time zone, hour, minutes after the hour, and date, including auto-adjust for Daylight Savings Time. To set the current date and/or time:

1. Press <↓F2> in the main menu.
2. By pressing <←F3> and <→F4> keys, the operator can move the cursor to select the month, day, year, hour or minute. Pressing <↑F1> or <↓F2> will alter values.
3. The day of the week changes based on the month, day, and year. If you enter an invalid date, the screen will prompt you to re-enter the proper date.

5.3 Sample Setup

5.3.1 Pre-Sampling

During shipment from the support laboratory to the sampling locations, there are no requirements for temperature control. However, the sampling cassette should remain in its protective transport containers. Avoid exposure to excessive heat (avoid storing transport containers in direct sunlight or enclosed vehicles during the summer months).

Upon receipt at the field office:

- The site operator should notate the date the sample arrives at the field office on the enclosed custody and field data form (CAFDF).
- Inspect the exterior of the shipment container notating any evident damage or contamination on the CAFDF.
- Ensure that each identifying number printed on the CAFDF corresponds to an enclosed sample cassette. Do not use any unidentified component and notify the support laboratory should there be discrepancies.
- Sign and date the custody portion of the CAFDF.
- Keep all sample components together in an air conditioned, secure area until transport to the sampling site.
- Freeze the enclosed ice packs for use in transport back to the support laboratory. It is recommended that ice packs be frozen for at least three days at a temperature of $-32\text{ }^{\circ}\text{C}$ to ensure filters arrive at the support laboratory at or under $4\text{ }^{\circ}\text{C}$.

Once the cassette is removed from its transport containers, extreme care should be taken to avoid potential contamination. It should remain capped until installation in the sampler and protected from exposure to dust, gases, or abrasion.

5.3.2 Sample Setup/Filter Change

1. The first main menu will allow for filter change operations. Press <F1>.
2. Follow the directions, as prompted by the software, to gather information for the previous sample run (flow, temperature, pressure, elapsed time).

3. Next, the operator will be prompted to replace the compact flash memory card. Remove the old memory card and insert the new one.
4. The system will verify the placement of a new card and check for read errors.
5. Replace the exposed filter cartridge as prompted. Press the top red motor control button to raise the manifold. Remove the exposed cassette cartridge.
6. Place the red cartridge caps on the filter modules to protect the filters from contamination.
7. Press <Enter>. Align the new cartridge and press the bottom red motor control button to lower the manifold. Press <Enter>.
8. You will be prompted to enter the filter ID #'s and comp ID to store this data on the new memory card. Press <Enter>” to proceed.
9. The sampler will read the temperature and pressure for the new filter and store this information on the compact flash memory card.
10. The mass flow controller (MFC) will warm up for 300 seconds and then conduct a vacuum check. If the vacuum check is satisfactory (>50 mmHg), press <Enter> and the sampler will return to the auto mode.
11. The filter change operation is now complete. Return all equipment and supplies including the spent filter cartridge and memory card to the station or field office.

5.3.3 Electronic Logbooks

All actions affecting the operation of the sampler should be recorded in the URG electronic logbook, such as:

- Actual sample date.
- Filter IDs.
- Date of sample set-up/retrieval.
- Time of sample set-up/retrieval.
- Monthly verifications (flow rate, temperature and pressure verifications, leak check).
- Quarterly audits.
- Routine maintenance (radiation shield cleaning, SCC replacement, pump change).
- Annual and non-routine calibrations.

5.3.4 Sample Shipment

Spent sampling cassettes must be stored in a protective transport container and transported to the support laboratory/field office within 48 hours of the sample run. Situations that cause this time frame to be extended (Friday runs, Holidays, staff issues, extreme weather conditions, etc.) must be noted on the CAFDF. The operator should retain the second page of the three page CAFDF and package the top copy in the shipping container. Package the cassettes and ice packs, then contact the shipping agent. Chain-of-custody seals on the shipping coolers or containers are not required.

6.0 CALIBRATION

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 within 365 days of the prior calibration.

Note: If the monitor is being turned on for the first time, or being restarted after a period of stoppage, it is recommended that the user allow the URG to warm-up for 10 minutes prior to performing a leak check or adjustments.

6.1 Calibration Requirements

A calibration is required under the following circumstances:

- Upon initial sampler set up.
- 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 18. 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 URG specific flow audit adapter.
- Audit cassette cartridge/tray.
- 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 URG 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, the Ambient/Documents/PM Monitoring SharePoint folder or by contacting the RCO particulate matter lead.
2. Select the "Calibration" tab of the e-log.
3. Enter in the information for all of the white boxes under the Visit Information, Thermometer information, Manometer Information, Barometer Information, Tetra Cal or FTS information sections.
4. Do not proceed if any of the devices fail the certification requirement (certified within 365 days of use).

6.4 Ambient Pressure Sensor Calibration

From the calibration menu:

1. With the NIST traceable device operating and measuring the ambient pressure, press <F2> and <Space>.
2. Enter a reference pressure value from your NIST traceable device in mmHg using the digit keys. ↑F1 / ↓F2 will change between positive and negative values. Use the BSKP key to clear incorrect data.
3. After pressing <Enter>, you are shown the final calibration temperature. Read and record the stated pressure drop in the "Calibration" page of the e-log.
4. Press <Yes> to save the calibrated pressure to the compact flash memory card. Pressing <No> will cancel the calibration.
5. After a brief pause, you will be returned to the calibration menu.

6.5 Ambient Temperature Sensor Calibration

From the calibration menu:

1. Press <F4>, <F1> and <F1> again.
2. Locate the ambient temperature sensor located at the base of the inlet tee. Slowly loosen and remove the sensor plug exposing the probe to ambient conditions.
3. Place the reference thermometer alongside the sampler sensor and allow them both to equilibrate. Minimize any interference from wind, sunlight, or precipitation.
4. Press <Space>. Enter the positive or negative (toggled by ↑F1) temperature value from your NIST traceable device by reusing the keypad in Celsius or Fahrenheit (toggled by ↓F2). Use the BSKP key to clear the currently entered values.
5. After pressing <Enter>, the monitor displays the final calibration temperature. Read and record the stated pressure drop in the “Calibration” page of the e-log.
6. Press <YES> to save the calibrated temperature to the compact flash memory card. Pressing <No> will cancel the calibration.
7. After a brief pause, you will be returned to the calibration menu.

6.6 Calibration Leak Check

Since the system was disturbed by calibrating the temperature probe, a leak check should precede a flow calibration.

The maximum allowable leak rate for the URG-3000N is 2.5% of the nominal flow rate of 22 LPM. The internal volume of the Module C components is approximately 1.2 L. Therefore, the leak rate cannot exceed approximately .55 LPM. This is derived using the following equation:

$$\text{Leak Rate} = V * \Delta P / t * P_{\text{ATM}}$$

Take the following steps to perform a leak check:

1. Each URG ships with a cassette cartridge/tray labeled "AUDIT" to be used during leak check and audit procedures. Install an audit cassette at this time.

2. To do so, press the red "up" button on the electronics box to release the current filter cassette. Insert this cassette properly, and press and hold the red "down" button on the electronics box to install the audit cassette.
3. From the main menu, press <→F4> and then <←F3> key to enter the audit menu.
4. Press <↑F1> and <Enter> to begin the leak check.
5. Remove the inlet cap and install the flow audit adapter onto the down-tube in the open position. Press <Enter> when prompted.



Figure 19. Flow Audit Adapter Installed.

6. The monitor will indicate that both the pump valve (on the side of the pump housing) and the flow audit adapter should be open. The pump will turn on and a timer will countdown for 15 seconds to reach maximum vacuum.
7. When directed by the software, close the shut off and flow adapter valves.
8. Press <Enter> and the vacuum will begin to drop. When it reaches 380 mmHg a timer will measure the vacuum for 35 seconds. After the 35 seconds, the results (PASSED or FAILED) will be displayed.
9. Read and record the stated pressure drop in the "Calibration" page of the e-log.

10. The acceptance criterion for the vacuum drop is 225 mmHg inside of 35 seconds. If the sampler fails the leak check, repeat the above procedure.
11. If the sampler fails to pass a second leak check attempt, troubleshoot and contact the particulate chemist or ECB for further assistance.
12. When prompted by the software, slowly open the shut off and flow adapter valves.
13. The option will be given to save the audit results. Press <YES> to save. Pressing <No> will delete the leak check.
14. Press <Enter> to return to the audit menu.

6.7 Flow Calibration

Note: Flow calibrations should be conducted after verifications, and after the pressure and temperature calibrations, and a leak check have all been performed.

1. If not already done, remove the inlet cap and place the flow audit adapter on top of the down tube.
Note: An audit cartridge must be in place in the sample filter manifold.
2. At the calibration menu, Press <F3>, <Enter>, <Enter> and then <Yes>. The screen should display the first (one of three) calibration point. Press <Enter>.
3. The next screen will prompt you to install the reference flow meter. The mass flow controller will warm-up for a few seconds and the pump will warm up for an additional 300 seconds.
4. After the warm-up period is completed, the gain, offset, raw, and flow values are shown for the selected module. Press <Enter> to continue.
5. The operator will be prompted by the software to enter the NIST reference flow rate for the 19.8 LPM flow setpoint. Read and record the stated flows in the “Calibration” page of the e-log. Using the keypad, enter the reference reading. Press <Enter>.
6. The software will advance through the second and third calibration points exactly the same way it did for the first.
7. After entering the reference flow rate for calibration point three, the screen will display the new gain, offset and correlation. Press “YES”, to save the calibration results to the compact flash memory card.

8. Press <Enter> to return to the calibration menu screen. Press <Enter> twice. This concludes the verification of the calibration and returns the sampler to operational mode.

6.8 Post Calibration Flow Evaluation

For the evaluation procedure:

1. From the Audit Menu, Press <F2> and <Yes>. The mass flow controller initiates and runs for 300 seconds at the design flow rate of 22.0 LPM.
2. Press <Enter> and use the keypad to enter the NIST reference flow rate.
3. Save the flow rate verification results to the memory card when prompted.
4. Disconnect the transfer standard and replace the sampler inlet.
5. Return the sampler to normal operating conditions.

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. The monthly flow verification requirement cannot be fulfilled 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 every quarter. It should be performed in the second month of each calendar quarter if possible. 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 (having been used for calibrations/verifications and not used since) 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 the monitor being inoperable or extreme weather events), the mid-month verification must be completed instead. The audit should then be performed in place of the mid-month verification during the third month, before the quarter ends.

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 URG specific flow audit adapter.
- Audit cassette cartridge/tray.
- 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 URG 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 2, corrective action is required as indicated. *Note: Do not perform a calibration until after you have verified, checked, or audited all of the parameters.*

Table 2. Operation Evaluations.

| CRITERIA | TOLERANCE | FREQUENCY | CORRECTIVE ACTION |
|-------------------------------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| External Leak Check | < 225 mmHg in 35 seconds | <ol style="list-style-type: none"> 1. Before and after any flow verification. 2. Before and after each quarterly audit. | Make sure all hoses are well connected. If unit fails to pass, call ECB and Particulate Lead. |
| Ambient Temperature Verification or Audit | ± 2 °C of NIST Thermometer | <ol style="list-style-type: none"> 1. During each monthly and mid-month check. 2. During each quarterly audit. | Perform a flow verification prior to an ambient pressure adjustment. Follow with complete calibration. If unit fails to pass, call ECB and Particulate Lead. |
| Ambient Pressure Verification or Audit | ± 10 mm Hg of NIST Barometer | <ol style="list-style-type: none"> 1. During each monthly and mid-month check. 2. During each quarterly audit. | Perform a flow verification prior to an ambient pressure adjustment. Follow with complete calibration. If unit fails to pass, call ECB and Particulate Lead. |
| Post Calibration Evaluation | 22.0 LPM ± 10% | After each monitor calibration. | Calibrate again. If unit fails, call ECB and Particulate Lead. |
| Monthly Verification | 22.0 LPM ± 10% | <ol style="list-style-type: none"> 1. Each calendar month. 2. Power outage > 48 hours. | 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 | 22.0 LPM ± 10% | 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 | 22.0 LPM ± 10% | Quarterly (preferably the second month). | 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 of the white boxes under the Visit Information, Thermometer information, Manometer Information, Barometer Information, Tetra Cal or FTS information sections.
4. Do not proceed if any of the devices fail the certification requirement (certified within 365 days of use).

7.3 Verification or Audit: “As Found” Leak Check

Take the following steps to perform an “as found” leak check:

1. Each URG ships with a cassette cartridge/tray labeled "AUDIT" to be used during leak check and audit procedures. Install an audit cassette at this time.
2. To do so, press the red "up" button on the electronics box to release the current filter cassette. Insert this cassette properly, and press and hold the red "down" button on the electronics box to install the audit cassette.
3. From the main menu, press <→F4> and then <←F3> key to enter the audit menu.
4. Press <↑F1> and <Enter> to begin the leak check.
5. Remove the inlet cap and install the flow audit adapter onto the down-tube in the open position. Press <Enter> when prompted.



Figure 20. Flow Audit Adapter Installed.

6. The monitor will indicate that both the pump valve (on the side of the pump housing) and the flow audit adapter should be open. The pump will turn on and a timer will countdown for 15 seconds to reach maximum vacuum.
7. When directed by the software, close the shut off and flow adapter valves.
8. Press <Enter> and the vacuum will begin to drop. When it reaches 380 mmHg a timer will measure the vacuum for 35 seconds. After the 35 seconds, the results (PASSED or FAILED) will be displayed.
9. Read and record the stated pressure drop in the “Calibration” page of the e-log.
10. The acceptance criterion for the vacuum drop is 225 mmHg inside of 35 seconds. If the sampler fails the leak check, repeat the above procedure.
11. If the sampler fails to pass a second leak check attempt, troubleshoot and contact the particulate chemist or ECB for further assistance.
12. When prompted by the software, slowly open the shut off and flow adapter valves.
13. The option will be given to save the audit results. Press <YES> to save. Pressing <No> will delete the leak check.
14. Press <Enter> to return to the audit menu.

7.4 Verification or Audit: Ambient Pressure

1. From the Audit Menu, Press <F4>. Allow the NIST pressure standard to equilibrate.
2. Enter the reference pressure into the software as directed. Pressing <↑F1> will toggle positive/negative values, and the BSKP key can be used to make any corrections.
3. Read and record the stated pressure and the NIST pressure reading in the “Verification Audit” page of the e-log.
4. Save the verification results onto the memory card when requested. Press <Yes> to save the results or <No> to cancel.
5. The pressure should agree within ± 10 mmHg. If they do not, continue with the rest of the verification and contact the particulate chemist for assistance.
6. After all information has been recorded, return the sampler to normal operating conditions

7.5 Verification or Audit: Ambient Temperature

1. From the audit menu, Press <F3>.
2. Locate the sampler’s ambient temperature probe. Remove the plug, exposing the probe to ambient conditions. Place the temperature transfer standard alongside the sampler probe. Allow the temperatures to equilibrate. Minimize any interference from wind, sunlight, or precipitation.
3. When the results are stable, enter the NIST reference temperature into the software as directed.
4. Read and record the stated temperature and the NIST temperature in the “Verification Audit” page of the e-log.
5. Save the verification results onto the memory card when requested. Press <Yes> to save the results or <No> to cancel.
6. The temperature readings should agree within $\pm 2^{\circ}\text{C}$. If they do not, continue with the rest of the verification and contact the particulate chemist for assistance.
7. After all information has been recorded, return the sampler to normal operating conditions

7.6 Verification or Audit: Flow

1. If not already done, remove the inlet cap and place the flow rate adapter and its certified NIST flow standard onto the down tube.
2. From the audit menu, Press <F2> and <Yes>.
3. The mass flow controller initiates and the pump runs for 300 seconds at the design flow rate of 22.0 LPM.
4. Press <Enter> and use the keypad to enter the NIST reference flow rate.
5. Read and record the stated flow and the NIST flow in the “Verification Audit” page of the e-log.
6. Save the flow rate verification results to the memory card when prompted. Press <Yes> to save the results or <No> to cancel.
7. Disconnect the transfer standard and replace the sampler inlet.
8. Return the sampler to normal operating conditions.

7.7 Verification or Audit: “As Left” Leak Check

Since the system was disturbed by verifying or auditing the temperature probe, an ending or “as left” leak check should follow a verification or audit. Take the following steps to perform a leak check:

1. Each URG ships with a cassette cartridge/tray labeled "AUDIT" to be used during leak check and audit procedures. Install an audit cassette at this time.
2. To do so, press the red "up" button on the electronics box to release the current filter cassette. Insert this cassette properly, and press and hold the red "down" button on the electronics box to install the audit cassette.
3. From the main menu, press <→F4> and then <←F3> key to enter the audit menu.
4. Press <↑F1> and <Enter> to begin the leak check.
5. Remove the inlet cap and install the flow audit adapter onto the down-tube in the open position. Press <Enter> when prompted.

6. The monitor will indicate that both the pump valve (on the side of the pump housing) and the flow audit adapter should be open. The pump will turn on and a timer will countdown for 15 seconds to reach maximum vacuum.
7. When directed by the software, close the shut off and flow adapter valves.
8. Press <Enter> and the vacuum will begin to drop. When it reaches 380 mmHg a timer will measure the vacuum for 35 seconds. After the 35 seconds, the results (PASSED or FAILED) will be displayed.
9. Read and record the stated pressure drop in the “Calibration” page of the e-log.
10. The acceptance criterion for the vacuum drop is 225 mmHg inside of 35 seconds. If the sampler fails the leak check, repeat the above procedure.
11. If the sampler fails to pass a second leak check attempt, troubleshoot and contact the particulate chemist or ECB for further assistance.
12. When prompted by the software, slowly open the shut off and flow adapter valves.
13. The option will be given to save the audit results. Press <YES> to save. Pressing <No> will delete the leak check.
14. Press <Enter> to return to the audit menu.

8.0 MAINTENANCE

Very little maintenance is required for the operation of the URG. The following procedures should be followed for reliable continuous operation of the system. Most maintenance involves inspection of components for damage or wear, as well as performing regular checks and calibrations of the system. All sampler maintenance must be recorded on the “Maintenance Log” tab of the e-log.

The URG system contains both electronic and pneumatic components. Historically the vacuum pumps of most ambient air sampling systems require at least annual maintenance. The dual headed Thomas™ diaphragm pump used in the URG can be removed by the operator from the field and new diaphragms and valves placed into the pump insuring another year of operation without failure.

The O-rings used in the URG are made from Viton™ rubber. These O-rings should continue to provide a leak free system for several years. However, if leaks are detected during operation or during leak checking, these O-rings could be leaking. It is recommended to replace O-rings every two to three years depending on use and wear. However, they should be inspected on a regular basis.

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

- Can of compressed air with tube
- Cotton Tipped Applicators
- Phillips Head Screwdriver
- Vacuum grease (silicone based)
- 91% Isopropyl Alcohol for cleaning the SCCs
- Distilled water
- Cotton cloth or Shop Towels
- Kimwipes
- O-rings for the SCCs
- Flashlight

Table 3. Summary of Sampler Maintenance.

| Maintenance Activity | Frequency |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <ul style="list-style-type: none"> • Download data, settings, and alarm files | Every 14 – 18 days |
| <ul style="list-style-type: none"> • Disassemble and clean the inlet head • Disassemble and clean the cyclone • Wipe down interior/exterior of sampler • Check clock time against NIST | Every 30 days |
| <ul style="list-style-type: none"> • Clean the sample down tube • Clean the and inspect the pump housing • Inspect and clean control box, cables and sampling lines • Confirm sampler is connected to grounding rod • Inspect O-rings | Every 91 days |
| <ul style="list-style-type: none"> • Purge the data from the internal memory | Every 181 days |
| <ul style="list-style-type: none"> • Inspect electrical connections • Change filters in audit cassette | Every 365 days |

8.1 Cleaning the URG Cyclone

1. Having removed the cyclone from the sampler, unscrew the grit pot from the main body of the cyclone and set aside.
2. Using a cotton tipped applicator and Isopropyl Alcohol, clean the grit pot, the outlet and the inlet of the cyclone body.
3. Using a new applicator with Isopropyl Alcohol, clean the internals of the cyclone with downward strokes, taking time to completely move around the inside of the orifice.
4. Use a Kimwipe to remove any remaining dust or debris from the body of the cyclone.
5. Reassemble, taking time to inspect the O-rings for excessive wear or breaks.
6. The operator may also choose to disassemble the cyclone for further cleaning (removing the outlet head) at intervals of their choosing.

8.2 Cleaning the URG Downtube

1. Remove the inlet cover from the sample tube.
2. Raise the rubber cover up and away from the rain hood.

3. Loosen the lock ring between the rain hood and the sampling module.
4. Slowly raise the tube vertically, up and out of the sampling module. Be sure to keep an eye on the lock ring and its associated O-ring.
5. Clean the sample tube with damp Kimwipes. Finish the cleaning by swabbing a Kimwipe with isopropyl alcohol inside the tube and allowing it to dry.
6. Re-insert the sample tube, being sure to allow for the O-ring and lock ring. Make sure the end of the sample tube is seated squarely in place on the T-joint containing the ambient temperature probe.

8.3 Cleaning the Housings

The pump housing should be inspected and cleaned at least every quarter. Using a brush or a compressed air source, clean the insides of the enclosure and in particular the screen located below the pump assembly.

The control box and cables should be inspected for damage or dirt and dust accumulation. The control box can be cleaned with a wet cloth or if required a dilute soap and water solution. The screen of the control box electronics should only be cleaned with a damp cloth, and no liquids should be allowed to enter the electronics package.

8.4 Inspecting the System

As part of the normal maintenance and operation, the various components of the system should be inspected for wear, damage, and changes in previous operation. Most inspections rely on visual checks during normal operation of the system. These should be performed each time anything is done to the system.

9.0 DATA HANDLING

The operator should retain the second page of the three page CAFDF and package the top copy in the shipping container. This second page of the CAFDF serves as a record of the sampling run data and a chain of custody. A download or copy is warranted of the compact flash memory card that is shipped along with the samples. Data will also accessible, if needed, in DART (Data Analysis and Reporting Tool, see section 10.0 Quality Assurance) at a later date.

10.0 QUALITY ASSURANCE

10.1 Data Review

The downloaded URG data must be reviewed by the regional office staff. The URG concentrations should be reviewed. It is at the discretion of the regional ambient monitoring coordinator (RAMC) as to how this process should be executed. At a minimum, each operator should review their site data and report abnormalities to either the RAMC or the RCO PM Chemist.

10.2 Field Operator Quality Assurance

Upon arriving at the site, the field operator is responsible for ensuring that the monitor has collected what appears to be valid data since the previous site visit. This includes reviewing the alarms and collected data. Below is a suggested list of items that operators should be verifying during each site visit:

- Possible changes near the site that could bias the data (fires, construction, etc.)
- Encroachment of wildlife or vegetation
- Vandalism
- Obstructions of the inlet
- Alarms on the screen of the Super SASS
- Abnormalities in the Super SASS downloads.
 - Ensuring that there are no gaps in the data
 - Investigating repetitive patterns of numbers
 - Checking the ambient temperature data (no abnormal trends, repeating values)

10.3 Regional Ambient Monitoring Coordinator 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 regional ambient monitoring coordinator are described in the following sections.

10.3.1 URG Download Review

The RAMC is responsible for reviewing the URG download data, alarms, and settings to ensure that there are no abnormalities:

- Ensuring that there are no gaps in the data
- Ensuring that repetitive patterns of numbers have been addressed
- Checking the ambient temperature data (no abnormal trends, repeating values)

10.3.2 Electronic Logbook Review

The e-logs are an additive yearly scrolling document. The RAMC must review the e-log for each site on a monthly basis. 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 monitor 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.
 - All leak checks passed.
 - All monitor issues and missing data are clearly documented in the comments.
 - Monthly, and quarterly maintenance items were completed.
 - There is downloaded data (alarms, data, and settings) for all collected data.
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. There are RAMC review spaces on the “Maintenance”, “Calibration”, “Site Visit”, and “Verification Audit” pages. The RAMC should only make corrections in the comments section of the e-log to preserve the initial documentation of the operator.
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 2 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.

10.4 DART

In the mid-1990s, Sonoma Technology, Inc. (STI) developed a software program, VOCDat, for validating and analyzing PAMS data. Many monitoring agencies have used VOCDat to validate and analyze PAMS data and other large sets of speciated ambient data (e.g., carbonyls, air toxics, or speciated PM_{2.5}).

Along the same lines as VOCDat, DART (Data Analysis and Reporting Tool) is a STI web-based data validation and analysis system that is integrated with AirNow Tech. It not only provides a framework for validating and analyzing air quality data, but it will also eventually enable access to complementary data sets from different sources and web services.

In its current form, DART contains many key features for validating and analyzing data collected, such as routine air quality measurements (e.g., PM, O₃, NO_x), routine meteorological measurements, and VOC measurements.

10.4.1 Opening Dart

1. To get started with DART, use an Internet browser to navigate to AirNow Tech (<http://airnowtech.org>). Google Chrome is the preferred Internet browser; however, Firefox and Internet Explorer version 10 or above are also supported.
2. Next, log in with a new or existing account. Choose to login at the upper right corner of the main page.

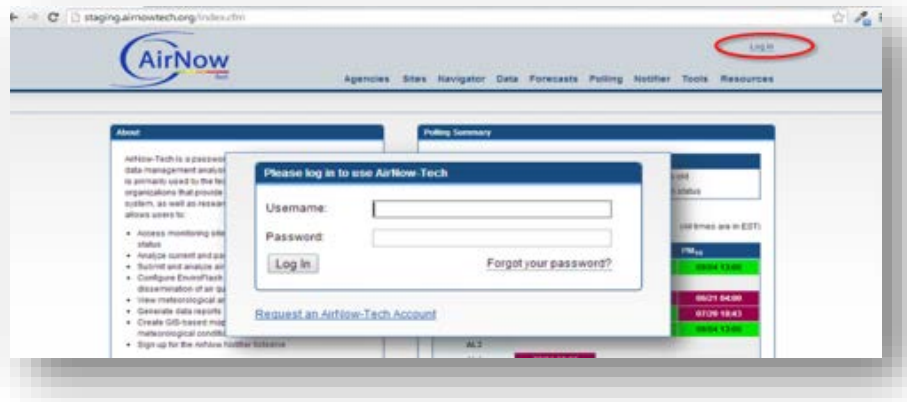


Figure 21. DART Login Page.

3. Find DART under the tools tab on the AirNow Tech home page.

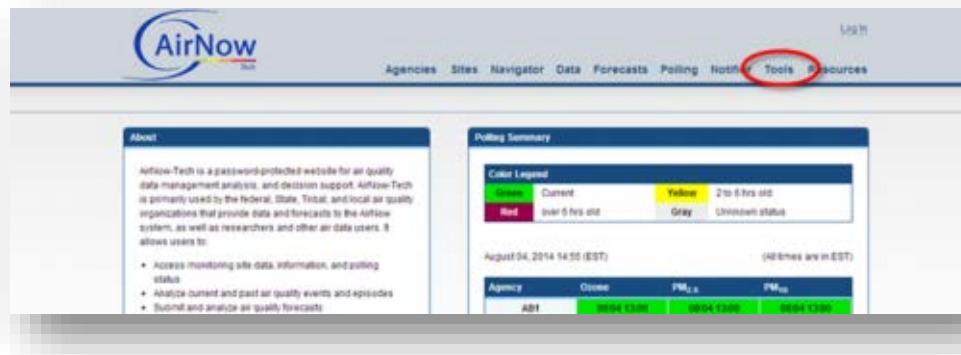


Figure 22. DART Tool Tab.

4. Next, you will see the DART welcome page, which explains the three basic steps to using DART. You can return to this page at any time by clicking the DART link at the top left of the screen.

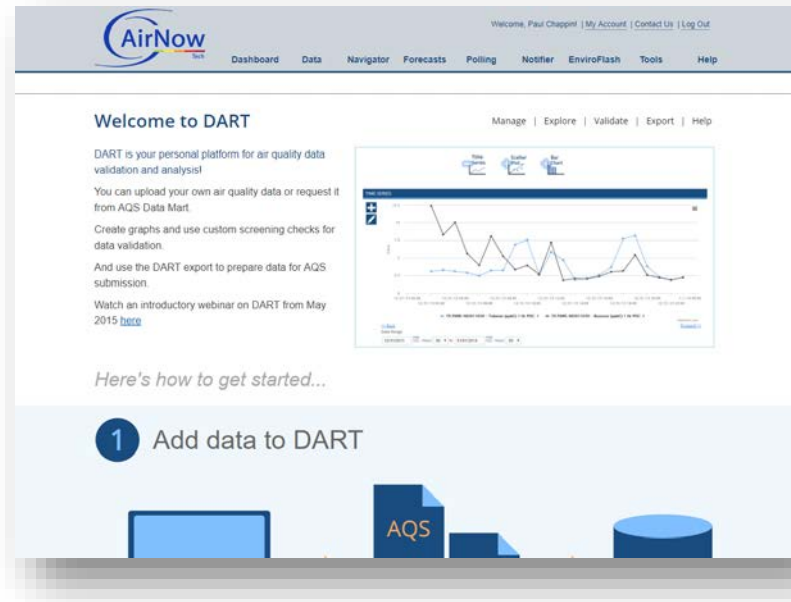


Figure 23. DART Welcome Page.

5. DART is organized into three general areas:

- Data Manager – upload and manage your data sets.
- Data Explorer – screen, validate, and explore your data using time series graphs, scatter plots, and bar charts.
- Data Validator – build and run automated screening checks and interactively explore results and your data using linked tables and time-series graphs.
- Data Exporter – export your data files and prepare them for submission to AQS.

6. You can access each area by clicking on the manage, explore, validate, and export links at the top right of every screen. The help link at the top right of the screen opens the DART help guide in a separate window.

10.4.2 Validating CSN Data within DART

On the manage page, you can begin to run screening checks to automatically identify problematic data, in order to make data validation more efficient.

1. To begin, click on the approval status icon.



Figure 24. DART Data Manage Screen.

2. DART’s approval mode includes the following tools to aid in data review:
 - Description of the number of samples, date range, and “Review by” deadline for the data batch.
 - Sample summary table for each sample in the batch, describing the number of species, number of qualifier and/or null codes applied to the data, data completeness, and percent of data above the method detection limit (MDL).
 - Batch data table displaying the parameter concentration value, MDL, data uncertainty, and null or qualifier codes, for all the data in the batch.
 - Time series and fingerprint plots for visually reviewing the data.
3. After the 30-day review period, CSN data are automatically sent back to the laboratory; data that were not marked as reviewed are assumed to be approved by the agency.
4. The laboratory reviews any null or qualifier code changes and the comments provided by the data validators; the laboratory then prepares the final data for submission to AQS.
5. Watch a [webinar](#) from March 2016 for more information about using approval mode for the CSN review process.

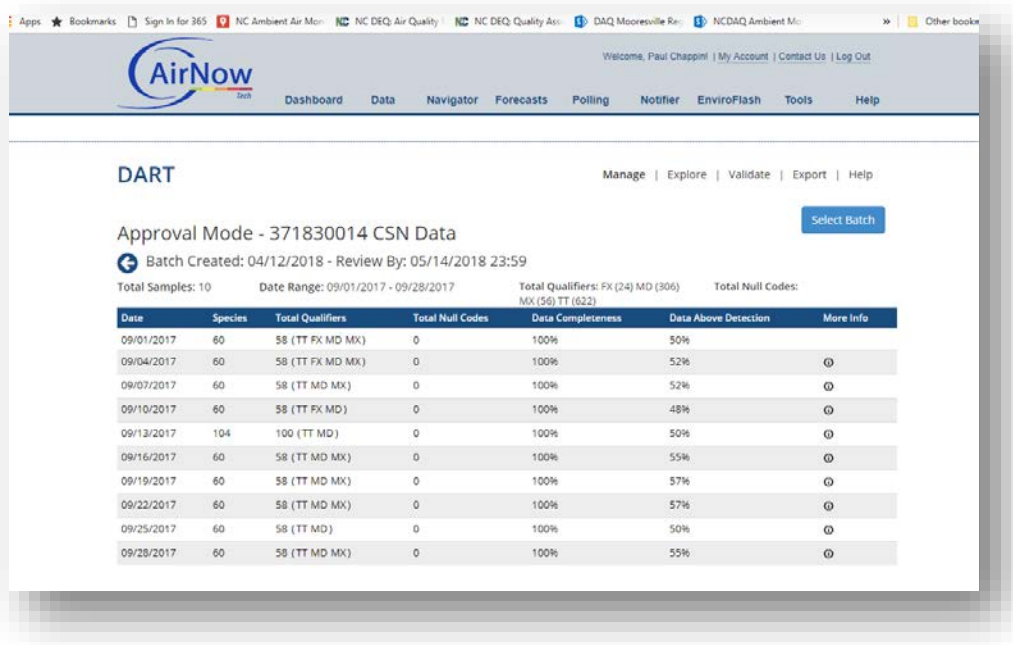


Figure 25. DART Approval Window.

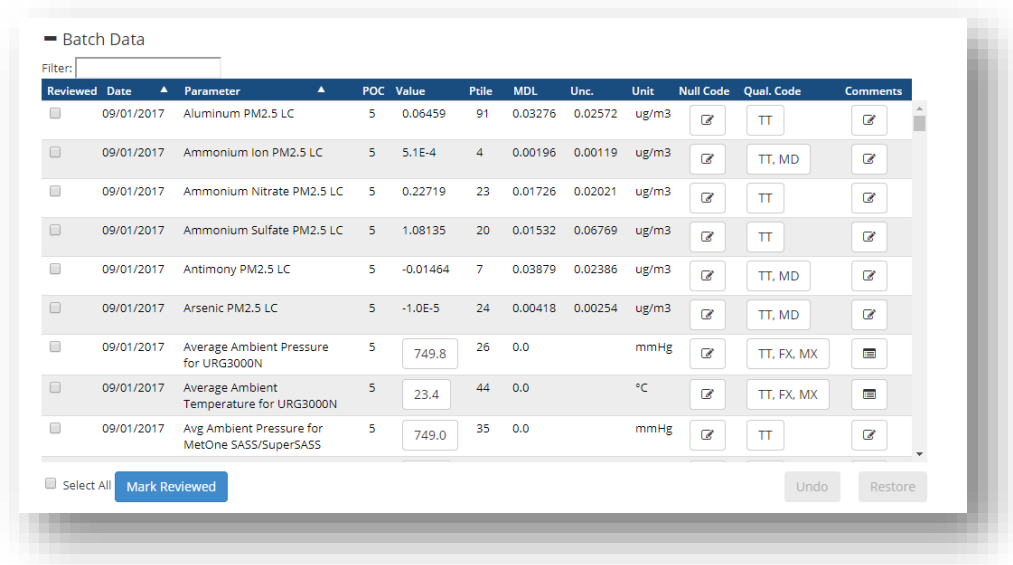


Figure 26. DART Batch Window.

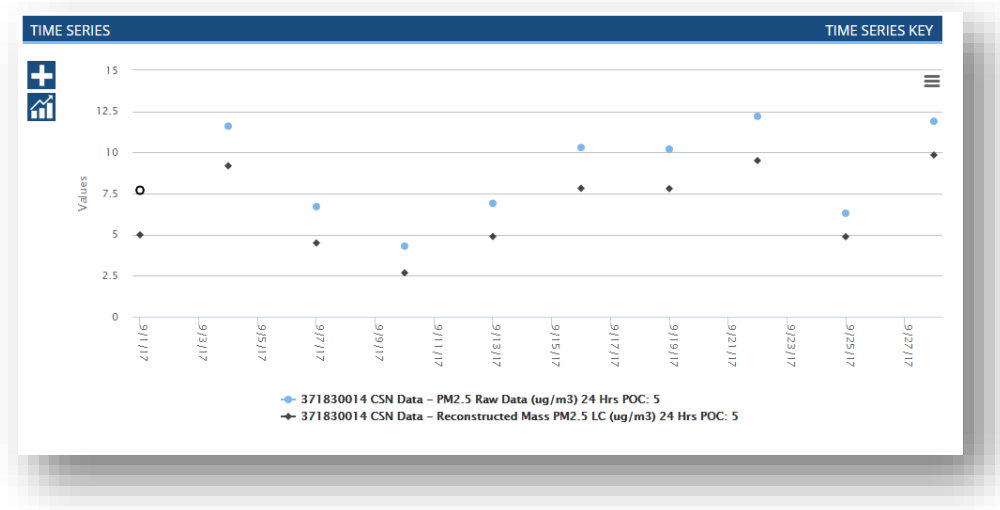


Figure 27. Time Series Window.

6. In approval mode, null and/or qualifier codes can be edited using the edit batch window.
7. To access the edit batch window, click on the icon in the null code or qualifier code column in the row of the batch data table for the species that you would like to edit.
8. Choose the species or group of species that you would like to edit. A listing of the groups of 39 species for CSN, organized by sampling filter type, is provided in the table below. The options include:
 - Selected Species: Only the species selected in the batch data table will be changed. The row for the selected species in the batch data table will be highlighted in blue.
 - Entire Sample: All of the species for the selected sample date will be changed. For example, if the row for the Potassium ion concentration is selected and “Apply to Entire Sample” is chosen from the drop-down menu, the null and/or qualifier code(s) for all of the species measured in the sample will be changed.
 - Metal Species in Selected Sample: All of the metal species for the selected sample date will be changed. For example, if the row for the Aluminum concentration is selected and “Apply to Metal Species” is chosen from the drop-down menu, the null and/or qualifier code(s) for all of the metal species measured in the sample will be changed.
 - Ions Species in Selected Sample: All of the ion species for the selected sample date will be changed. For example, if the row for the Ammonium ion concentration is selected and

“Apply to Ions Species” is chosen from the drop-down menu, the null and/or qualifier code(s) for all of the ion species measured in the sample will be changed.

- Carbon Species in Selected Sample: All of the carbon species for the selected sample date will be changed. For example, if the row in the batch data table for the Elemental Carbon (EC) concentration is selected and “Apply to Carbon Species” is chosen from the drop-down menu, the null and/or qualifier code(s) for all of the carbon species measured in the sample will be changed.
9. Choose the null code or qualifier code(s) that you would like to add or remove from the selected species by using the drop-down menus. A species measured in a sample can have either a null code or qualifier code(s), but not both.
 10. Therefore, if the selected species already has a qualifier code(s) and you would like to apply a null code, you must first remove the existing qualifier code(s) by clicking the “x” next to the code in the qualifier drop-down menu.
 11. Similarly, if the selected species already has a null code and you would like to apply a qualifier code or codes, you must first remove the existing null code by selecting “No null code” from the null code drop-down. If a species concentration is missing, which displays as the value -999 in DART, a null code is required.
 12. Add a comment to describe the changes you are making to the null code and/or qualifier code(s). Comments provide helpful information that is shared with other data validators in your agency. All comments and associated null or qualifier code changes are also provided to the laboratory at the end of the data review period.
 13. Click “Save” to apply your changes or click “Cancel” to exit the window. By default, only specific null and qualifier code(s) will be appended or removed based on the user’s selections in the Edit Batch window. All other existing null and qualifier code(s) that are currently applied to the species or a group of species (e.g., metals, ions, entire sample) will be retained. DART also has an option to overwrite all existing null and qualifier code(s) prior to applying the new null or qualifier code(s) specified by the user in the Edit Batch window. This option can be invoked by checking the “Overwrite Codes” box next to the “Apply to” drop-down menu.

11.0 TROUBLESHOOTING

This section is a description of commonly occurring problems.

11.1 Display not Shown

If the URG-3000N display is blank, first check the power, then check fuses.

11.2 No Power

Follow these steps to attempt to resolve the lack of power to the URG. If this does not help, contact ECB or the RCO PM Chemist for further assistance.

- Check that the power cable running to the stand pump Enclosure is properly plugged in an outlet.
- Attempt to use another device in the outlet the URG is using to determine if AC power is available.
- Disconnect the vacuum line from the pump and plug the pump into the lower outlet. If the pump activates, the power is available.
- Use a volt meter to check the voltage between the red and black wires in the MOV surge suppressor. The voltage should be 12 VDC. Then check that the voltage between the yellow and black wires in the MOV surge suppressor is 24 VDC. If no power is detected in either location, please contact ECB for further assistance.

11.3 Leak Check Failed

If a leak check has failed, the following steps may help to determine where the leak is occurring;

- Reset the audit cassette and re-attempt the leak check.
- Replace the audit cassette with an alternate and re-attempt the leak check
- Inspect the O-rings on cyclone manifold for tears or other damage.
- Inspect temperature probe plug O-rings for tears or other damage.

- Inspect O-rings in inlet tee for tears or other damage.

If damaged O-rings have been found, or none of these steps have resolved the failed leak check, please contact ECB for further assistance.

11.4 Removing Exposed Filter Cartridge without Installing a New One

There may be some instances that require the exposed filter cassette cartridge and the memory card to be removed without installing new ones because they are not available yet.

Only after completing the instructions on page 31 (section 5.3.2. and steps 1,2 and 3), you can remove the memory card and the exposed filter cassette cartridge. Do not proceed any further through the filter change procedure until you return to the sampler with the new filter cartridge and memory card.

The software should pick up exactly where it left off. If it does not, turn the controller module power off and then back on (by unplugging the cord). This should allow you to continue through the rest of the filter change procedure.

11.5 Preventing Sampler from Collecting on Previously Exposed Filter

There may be some instances when the sampler is scheduled to collect a new sample before the site operator has removed the previous filter cassette cartridge and memory card.

After a sample has been collected, the sampler display will read "Sample Completed." The software contains a lock out feature that prevents the collection of another sample until the site operator performs and completes the filter change procedure. This prevents the sampler from collecting an additional sample onto the exposed filter from the previous sample run.

11.6 Pump Will Not Start During Filter Change Procedure

The vacuum pump will occasionally contain some residual vacuum from the previous sample run. Even a small amount of residual vacuum can prevent the pump from starting. If this occurs, disconnect the black air line from the side of the sampler lower stand and then plug it back in. This will release the residual vacuum and allow the pump to start again.

12.0 REVISION HISTORY

13.0 REFERENCES

URG Corporation (2015) URG 3000N Sequential Particle Speciation System Operations Manual. Prepared by URG Corporation, Chapel Hill, NC

United States Code of Federal Regulations, (2006) Title 40 Part 50 Appendix L, Reference Method for the Determination of Fine Particulate Matter as PM_{2.5} in the Atmosphere. Prepared by the US Government Publishing Office

United States Code of Federal Regulations, (2013) Title 40 Part 50 Appendix N, Interpretation of the National Ambient Air Quality Standards for PM_{2.5}. Prepared by the US Government Publishing Office

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