OPERATION MANUAL

BC 1054

Black Carbon Monitor
BC 1054-9805
Rev B

Met One Instruments
POWERED BY ACOEM

Met One Instruments, Inc.
1600 NW Washington Blvd.
Grants Pass, OR 97526
Telephone: (541) 471-7111
Facsimile: (541) 471-7116
metone.com

Met One Instruments

POWERED BY ACOEM

Met One Instruments, Inc. is now part of the Acoem international group of companies.

Met One Instruments has been designing and manufacturing class-leading meteorological, ambient air sensing, and air quality monitoring instrumentation since its inception in 1989. Its line of robust industrial-grade meteorological equipment, air particulate monitoring equipment, and indoor air quality monitoring systems have set the standard for the industry. Headquartered in Grants Pass, OR, Met One Instruments, Inc. is fueled by a dedicated expert team who is diligently working to advance the technology required to ensure continued improvements in human and environmental health now and for generations to come.

Acoem is committed to helping organizations and public authorities find the right balance between progress and preservation — safeguarding businesses and assets and maximizing opportunities while conserving the planet's resources. Headquartered in Limonest, France, Acoem delivers unrivaled inter-operable AI-powered sensors and ecosystems that empower our customers to make enlightened decisions based on accurate and timely information.

In 2021, Acoem acquired Met One Instruments, marking a pivotal moment when two industry leaders in the air quality monitoring sectors converged — creating a single, stronger and more future-focused provider of holistic environmental monitoring solutions. Now, **Met One Instruments Powered by Acoem** has opened new possibilities through an extensive offering of class leading, multi-parameter environmental monitoring and industrial reliability solutions. These integrated measurement systems, technologies, and services deliver comprehensive solutions for a range of applications, including environmental research, regulatory compliance, and industrial safety and hygiene.

For more information about **Met One Instruments Powered by Acoem**, please visit: metone.com

For more information about **Acoem**, please visit: acoem.com

BC 1054-9805 Rev B

Table Of Contents

Table of Figures

Table of Tables

1. INTRODUCTION

1.1 *About This Manual*

This document is organized with the most important information grouped together for easy reference by the user. All BC 1054 instrument users should read and understand the sections on installation, setup, operation, and field calibrations. Other sections with information on subjects such as diagnostics, accessories, and alternate settings should be consulted as needed. An electronic version of this manual is also available.

1.2 *Technical Service*

This manual is structured by customer feedback to provide the required information for setup, operation, testing, maintenance, and troubleshooting the BC 1054 analyzer. Should additional support be required after consulting the documentation, please contact one of our expert technical service representatives during normal business hours of 7:00 a.m. to 4:00 p.m. Pacific Time, Monday through Friday. In addition, technical information and service bulletins are often posted on our website. Please contact us and obtain a return authorization (RA) number before sending any equipment back to the factory. This allows us to track and schedule service work and expedite customer service.

Contact Information:	Tel: + 541 471 7111 Fax: + 541 471 7116 Web: www.metone.com Email: service.moi@acoem.com	Address:	Met One Instruments 1600 NW Washington Blvd Grants Pass, Oregon 97526 U.S.A.

All BC 1054 monitors have two product labels with the serial number printed on them. The labels are located on the upper right corner of the back panel and inside on the backside of the door by the display. The calibration certificate also has the serial number printed on it. The serial number is needed when contacting the Met One technical service department to request information about repairs or updates for a specific monitor.

1.3 *About the BC 1054 – Ten Wavelength Black Carbon Monitor*

The Met One Instruments, Inc. model BC 1054 MultiSpectrum Carbon Monitor is a ten-wavelength black carbon monitor, which automatically measures and records optical transmission across filter media onto which particulate matter has been deposited at ten wavelengths ranging from 370 nm to 950 nm. From this information the concentration of black carbon "BC" and particulate matter absorbing in the near-ultraviolet regions may be determined.

Figure 1-1 The BC 1054 Front Panel

In addition to these two industry-standard measurements, the BC 1054 includes eight additional wavelength measurements. The additional wavelength channels allow analysis of carbon particulate at other wavelengths, as detailed in table 1-1, below.

Table 1-1 BC 1054 BC Measurement Labeling

Measurement Wavelength	BC 1054 Label
370 nm	BC1
430 nm	BC2
470 nm	BC3
525 nm	BC4
565 nm	BC5

Measurement Wavelength	BC 1054 Label
590 nm	BC6
660 nm	BC7
700 nm	BC8
880 nm	BC9
950 nm	BC10

Ambient air is drawn into the instrument at a controlled flow rate, generally through a size-selective $PM_{2.5}$ or PM_1 fractionator. The sampled air is subsequently drawn through a heated inlet and then through special glass fiber filter tape, trapping ambient particulate matter. Optical transmission at each of the wavelengths shown in **Table 1-1** is measured through the filter tape, thereby allowing BC mass concentrations to be calculated at

each wavelength. The filter tape is set to advance automatically when a sufficient amount of particulate matter has been deposited on the tape to cause the attenuation of channel one to exceed the factory-determined load level. These settings can be changed, but it is recommended to keep the factory settings unless local requirements state otherwise.

1.4 *Safety Warnings*

Optical Warnings: The BC 1054 monitor employs LED light sources ranging from the near UV (370 nm) to the near IR (950 nm). Some of them emit light that is outside the range of normal human vision, and thus could present a potential invisible ocular exposure hazard. The UV light source is a 20 mW LED, emitting at 370 nm. The infrared sources are a 40 mW near-IR LED emitting at 880 nm and a 55 mW near-IR LED emitting at 950 nm. Appropriate precautions should be taken.

A protective housing with this warning symbol fully encapsulates the light sources and optics system during normal operation. Whenever the optical module is disassembled for cleaning, the main power switch must be turned off and the power cord disconnected to prevent accidental exposure to UV and IR radiation.

Electrical Warnings: The BC 1054 is a 12 Volt DC powered system. There are no hazardous live voltages located anywhere inside the instrument. It is equipped with an external desktop power supply module with a 100-240 VAC 50/60Hz input range, and a 12 VDC, 8.5 A output. The external AC pump box (115 VAC or 230 VAC model) contains hazardous voltage.
Always disconnect pump box power before opening the pump box to conduct maintenance.
Neither the BC 1054 instrument, external pump assembly, nor the power supply module, are weatherproof and should ever be exposed to precipitation or wet conditions.

Thermal Warnings: The instrument contains a 12 Volt 40-Watt internal heater, in the form of two large, gold colored power resistors and a circulation fan located inside the electronics chassis. These resistors are usually hot and should not be touched while the instrument is powered on, or within several minutes after it is powered off.

1.5 *BC 1054 Instrument Specifications*

PARAMETER	SPECIFICATION
Optical Absorption Wavelengths:	BC1: 370 nm BC2: 430 nm BC3: 470 nm BC4: 525 nm BC5: 565 nm BC6: 590 nm BC7: 660 nm BC8: 700 nm BC9: 880 nm BC10: 950 nm
Measurement Range:	0.01 µg/m^3 to 100 µg/m^3 BC
Data Display Resolution	0.1 ng/m^3
LLD:	≤ 8 ng/m^3 at 5 LPM
Measurement Interval:	1 minute
Sample Rate:	2 or 5 LPM, user selectable
Filter Tape:	Proprietary treated glass fiber
Operating Temperature:	0 to +40°C (inside shelter)
Inlet Heater:	13 W (setpoints from 25 to 40 °C)
Power Supply	100 - 240VAC, 50/60hZ, 1.4A Smart Power Supply. Output: 12V DC
Pump Box Power	Input Options: 83055 - 110VAC 83054 - 220VAC
BC 1054 Power	Input: 12V DC Total Consumption 3.5A
Ambient Temperature:	-30 to +50°C
Ambient Sensor:	Model BX-597A combination AT/BP/RH digital smart sensor included.
Sensor Input:	Support for digital Wind Speed and Wind Direction inputs
Internal Data Storage:	~365 days of internal data storage.
Data Download:	One USB Flash Drive Port, USB Serial and DB-9 RS-232 serial and Ethernet.
User Interface:	4.75" (11.2 cm) x 6.75" (17.1 cm) graphic touchscreen display
Mounting Options:	Bench top or equipment rack mountable. A weatherproof shelter is required.
Unit Weight:	Approximately 40 lbs. (18 kg)
Unit Dimensions:	Height: 10.5" (26.7 cm) Width: 17" (43 cm) Depth: 15.8" (40 cm).

Specifications subject to change without notice. See BC 1054 datasheet for latest published specs.

2. ASSEMBLY and DEPLOYMENT

The BC 1054 is designed for easy setup and simple configuration for most applications. This section describes the basic assembly, setup, and start-up of the instrument.

2.1 *Unpacking The BC 1054*

NOTE: Please keep all the special shipping items (box, foam packing material, etc.) used to ship the BC 1054 Black Carbon Monitor. They should be re-used if the BC 1054 is to be transported (changing site locations, returning to the factory, etc.). Contact Met One Instruments for replacement packing materials if necessary.

2.1.1 Shipping Damage

Any damage incurred by the equipment during shipping is the responsibility of the carrier. If any damage to the shipment is noticed before unpacking, **a claim must be filed with the commercial carrier immediately**. Follow any special unpacking instructions provided by the carrier, as all items are carefully removed from the containers and each component inspected. It is recommended to document and photograph all damaged packages and items before, during, and after unpacking them. Contact Met One Instruments to arrange for any replacement items needed.

- Carefully unpack items from the box.
- Inspect all components for damage.
- Compare all components to the packing list to ensure all items have been shipped.
- After unpacking all components/sub-assemblies, take a photo of each with labels still attached and check to make sure they match all components/sub-assemblies listed on the packing list.

2.1.2 Shipment Contents

From the list below, check that all mandatory, standard equipment items have been included.

The normal configuration of the BC 1054 is supplied with the following standard items and accessories:

BC 1054 System Check-Off List

- ☐ Universal Input AC to 12 VDC Power Supply (**510634**)
- ☐ Two USA Power Cords (**400100**)
- ☐ RS-232 Serial Communications Cable (**550065**)
- ☐ Span Check Membrane (**81947-3**)
- ☐ Ambient AT/BP/RH Combination Sensor, with Cable (**BX-597A**)
- ☐ Digital Sensor Cable, 25-foot Length for BX-597A (**30010-25**)
- ☐ External AC Pump Box, 115 VAC (83055), or 230 VAC (**83054**)
- ☐ 10mm Pump Tubing (**960025**)
- ☐ TSP Inlet (**9441**)
- ☐ Sample Inlet (**8936-5**)
- ☐ Grounded Inlet Kit (**82934**) (includes 960216 flexible ESD inlet tubing)
- ☐ One Roll of Filter Tape (**460211**)
- ☐ Rack Mount Angle Brackets with Mounting Hardware (**8568-11**)
- ☐ Operation Manual (**BC 1054-9805**)
- ☐ Software Placard (USB Drivers and Comet Software)

The following optional accessories may be included:

- ☐ $PM_{2.5}$ Sharp Cut Cyclone, 2 LPM (**SCC 112**)
- ☐ PM_1 Sharp Cut Cyclone, 2 LPM (**SCC 111**)
- ☐ $PM_{2.5}$ Sharp Cut Cyclone, 5 LPM (**82336**)
- ☐ PM_1 Sharp Cut Cyclone, 5 LPM (**82344**)
- ☐ Dilution Flow System (**82480**)

NOTE: See the accessories section at the back of this manual for more details about parts and accessories.

2.2 Shelter and Mounting Options

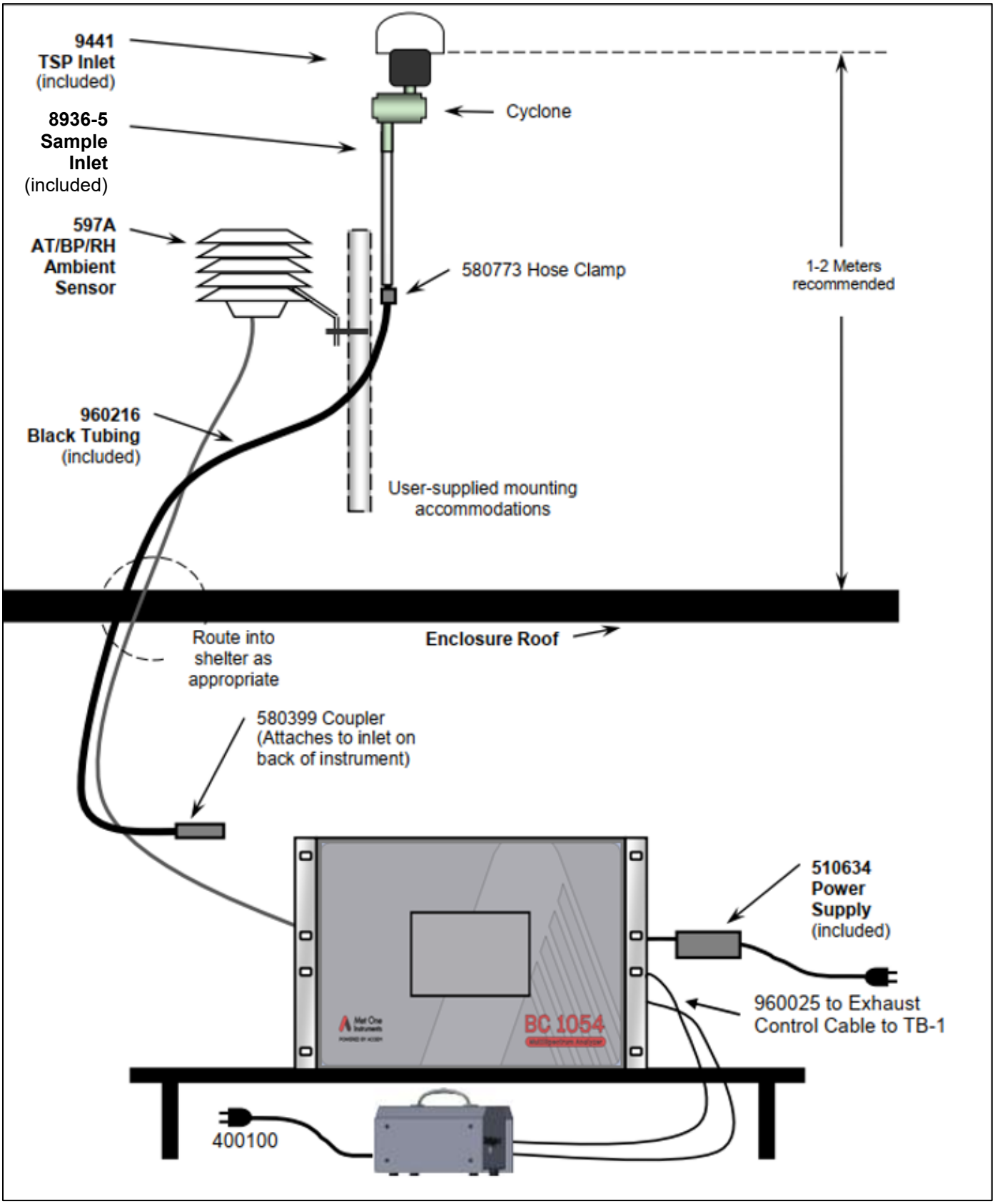


Figure 2-1 Typical BC 1054 Installation in a Walk-in Shelter

The BC 1054 must be installed in a clean, dry, weatherproof location such as a walk-in shelter, a trailer or mobile lab, a mini outdoor shelter, or in a permanent structure.

Instrument Temperature: BC 1054 must be operated at temperatures between 0°C and 40°C.

Rack Mounting: The BC 1054 may be installed in a standard 19" equipment rack and would require six rack-units of space (6U) if done so.

Benchtop Mounting: The BC 1054 may also be installed on a tabletop. Make sure the mounting surface is level and that the instrument is secured so that it won't "walk" due to vibration. Always leave adequate clearance at the back of the unit for access to the data ports, power switch, and sampling line.

2.3 *BC 1054 Assembly*

The following sections describes setting up the BC 1054 and its various sample inlet configurations. See **Section 2.3.2** for Dilution Flow setup. Set up the BC 1054 hardware items and accessories as described below:

2.3.1 Sample Inlet Configurations

The BC 1054 is designed to operate with an in-line $PM_{2.5}$ or PM_1 fractionator through flexible tubing connected to the back of the instrument or within the dilution flow system. The fractionators (sharp-cut cyclones or SCC) are designed to sample at 2 or 5 LPM. There are no special installation requirements for the BC 1054 other than the monitor be no more than 20 feet away from the source of ambient air being sampled and that the source be directly accessible.
At the sample location, the SCC is coupled directly to the bottom of the 9441 TSP inlet in stock configuration. It is then mounted on the 8936-5 support tube. The flexible ESD sample tubing is then slipped over the barbs on the support tube. A worm-gear hose clamp (pn: 480773) is used to secure the tubing to the support tube. The other end of the sample tubing is routed to the BC 1054, grounded to a terminal on the back of the instrument, and is then installed on the rear of the monitor using a push-to-connect fitting (pn: 580399). See **Figure 2-1**.

NOTE: The factory configuration varies from the dilution flow system configuration. (Section 2.3.2).

2.3.1.1 Stock Inlet Assembly Installation

1. **Connect the SCC to the TSP Inlet**: Install $PM_{2.5}$ or PM_1 SCC onto the bottom of the TSP inlet located in the sample area.
2. **Mount the SCC to the Support Tube**. Once the TSP and SCC are coupled, the assembly should be mounted on top of the support tube.
3. **Route the Flexible ESD Tubing**: Flexible tubing (pn: 960216) should be routed from the base of the support tube in the sample location to the back of the BC 1054. It should *not* be connected to the inlet fitting at this time. See **Section 2.3.1**.
4. **Ground and Install the Flexible ESD Tubing**: Place the inlet tubing grounding assembly (see **Figure 2-2**) over the BC 1054 end of the sample tubing. Position the clamp between one and two inches from the end of the tubing (see **Figure 2-3**) and tighten it until the clamp grips firmly.

CAUTION: Do not overtighten the clamp and crush the tubing.

Insert the tubing into the ½" Push-to-Connect adapter (pn 580399) and connect to the Sample Inlet (marked "Inlet" on the back of the BC 1054). Connect the green wire to the right-most terminal marked Shield on TB-1 on the back of the BC 1054 (see **Figure 2-4**).

Figure 2-2 Inlet Tubing Grounding Assembly

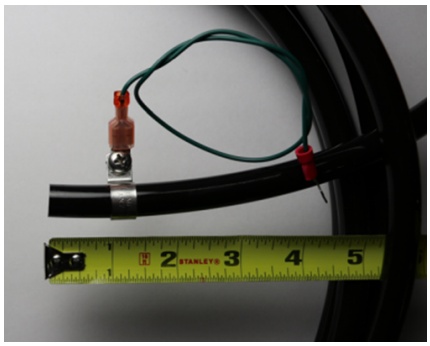


Figure 2-3 Grounding Clamp Position

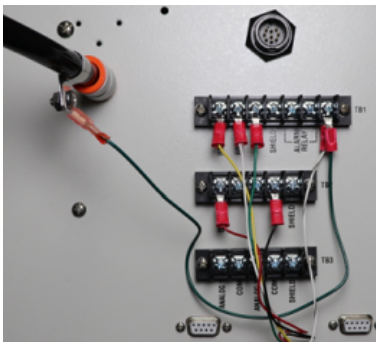


Figure 2-4 Installed Grounding Assembly

2.3.2 Dilution Flow System Option

NOTE: This section can be skipped if a dilution flow system will not be in use.

The following section describes setting up the BC 1054 with the Dilution Flow System. Set up the BC 1054 dilution flow system hardware and accessories as described below:

2.3.2.1 Dilution Flow System Description

In monitoring environments with extremely high concentration levels, the excessive particulate contained in the sample can result in excessive tape loading. This will result in frequent tape advances. Rapid depletion of the filter tape and potentially bad data are the most immediate detrimental side effects. Over time, there will be excessive buildup of particulate matter inside the instrument, as well. This will result in additional maintenance being required and greater wear of internal components. To avoid these issues, Met One Instruments offers the Dilution Flow System.

When installed on the back of the BC 1054, a controlled portion of clean air is mixed with the incoming sample air. Using this feature, the incoming sample concentration levels can be diluted between 50% and 80%. This means that because the volume of air is carefully controlled, accurate measurements can be made with a mere 20% of the full particulate concentration in extreme environments.

2.3.2.2 Dilution Flow System Components

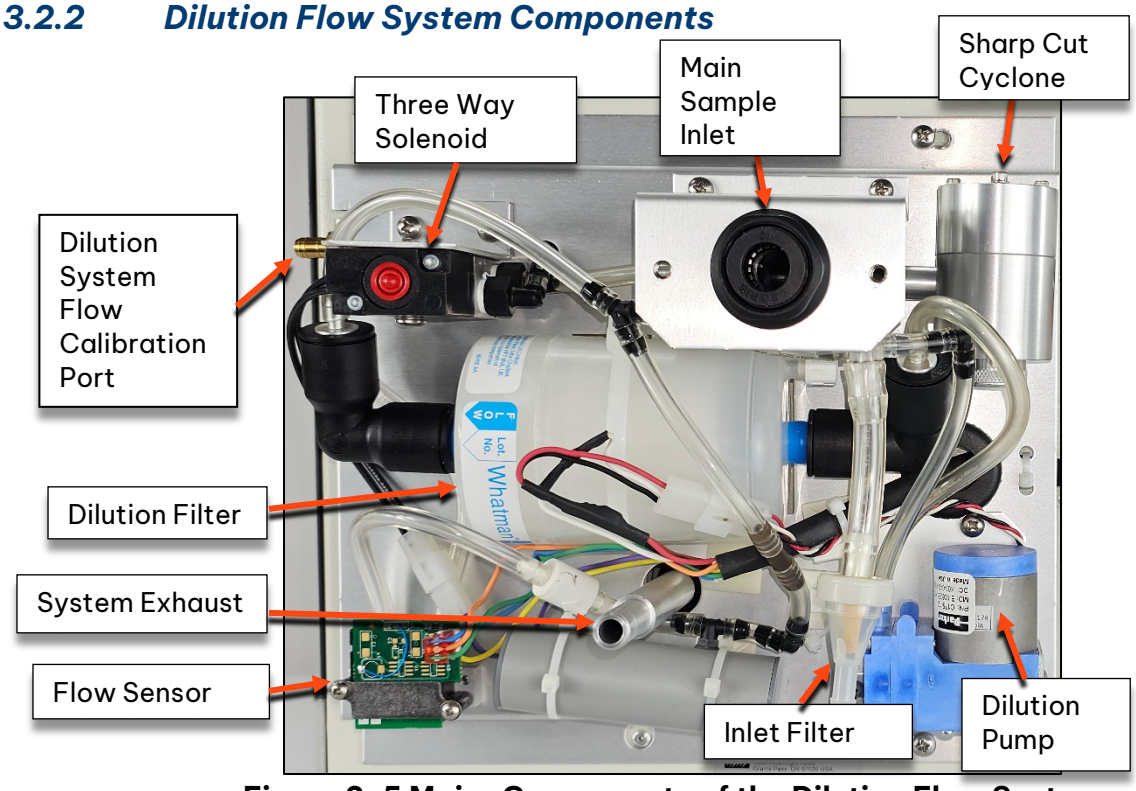


Figure 2-5 Major Components of the Dilution Flow System

2.3.2.3 Dilution Flow Inlet Assembly Installation

1. **Connect the Support Tube to the TSP Inlet**: Install the TSP Inlet on top of the support tube. The Dilution Flow System has an integral PM2.5 SCC. This replaces the SCC mounted to the TSP at the inlet.
2. **Route the Flexible Tubing**: Flexible tubing (pn: 960216) should be routed from the base of the support tube in the sample location and connected to the inlet fitting in Dilution Flow System assembly that will be mounted on the back of the BC 1054. For now, route the tubing to the back of the BC 1054 and lay it aside.
3. **Connect the BX-597A AT/BP/RH Ambient Sensor**: The BC 1054 comes with a BX-597A combination ambient temperature, barometric pressure, and relative humidity sensor. The sensor must be mounted to be able to monitor the ambient conditions of the area being sampled (see **Figure 2-1**).
    a. Route the digital sensor cable (pn: 30010-25) from the corresponding connector on the bottom of the BX-597A sensor to the correct terminals on the back of the BC 1054, as shown in **Table 2-1**.

4. **Mount the Dilution Flow System assembly**: Install the Dilution Flow System assembly on the back of the BC 1054.

a. Remove the two screws holding the cover of the assembly in place and then remove the Dilution Flow System assembly cover shown in **Figure 2-6**.

Figure 2-6 Dilution Flow System Cover Removal

b. Align the sharp-cut cyclone outlet (built into the dilution module) with the flow inlet on the back of the monitor (**Figure 2-7**).

c. Press firmly on the cyclone body, while supporting the system chassis, to insert the inlet into the sharp cut cyclone. When fully inserted, the Dilution Flow System assembly will be flush with the rear housing of the BC 1054.

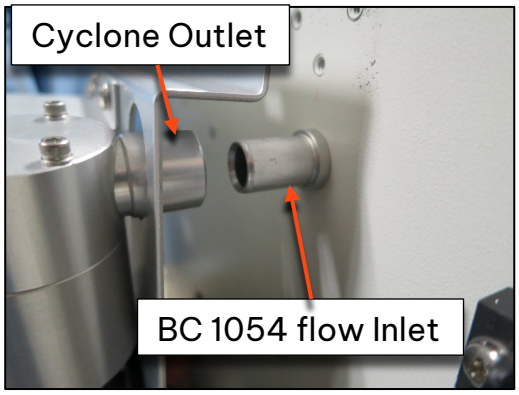


Figure 2-7 Dilution Flow System Cycolne Alignment

d. Align the mounting holes and install the three mounting screws (**Figure 2-8**) to secure the assembly to the main body of the monitor.

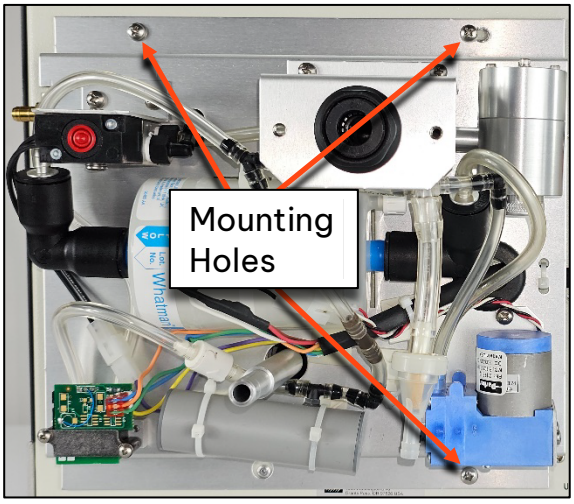


Figure 2-8 Dilution Flow System Mounting Screw Locations

e. Connect the communication cable to the port in the upper right corner on the back of the BC 1054.

f. Insert the 82793 Exhaust Adapter tube into the exhaust (**Figure 2-9**).

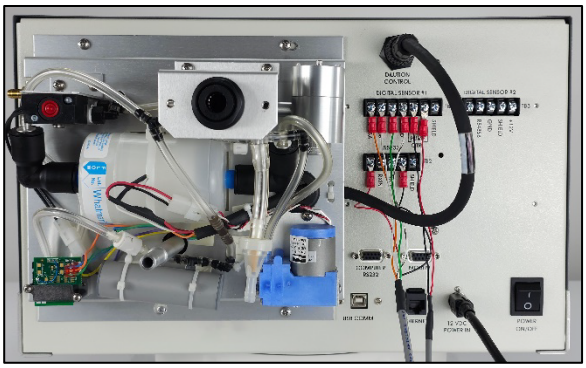


Figure 2-9 Dilution Flow System Exhaust Adapter

g. Install the Dilution Flow System assembly cover and secure it in place with the two screws removed in step **a**. Use caution to avoid pinching the communication cable and internal tubing.

h. Attach the push-to-connect adapter to the exhaust adapter tube.

Figure 2-10 Dilution Flow System Installed

5. **Connect the inlet tubing.** Route the flexible inlet tubing (**Figure 2-10**) to the inlet located on the Dilution Flow System and insert it.
6. **Connect the inlet grounding strap** as shown in **Section 2.3**.
7. **Connect the clear, flexible tubing from the pump.** Route the flexible tubing from the pump to the Push-to-Connect adapter on the Exhaust Adapter tube.
8. **Connect the two-conductor** control cable from the pump. Route the control cable from the pump to the BC 1054 back panel, as shown in **Section 2.3**.
9. **Connect the 12V power supply**: Plug the 12V, 8.5A power supply (pn: 510634) into the four-pin power connector on the back panel of the BC 1054. The power supply has a universal AC voltage input. The included US-type modular power cord (pn: 400100) can be changed to another type if needed.
10. **Configure the BC 1054 Sample Settings**: Determine the appropriate settings for the sample environment and required particulate size cutoff.

NOTE: Disregard the step below if filter tape is already installed.

11. **Install the filter tape:** Install a roll of filter tape (pn: 460211). See **Section 2.4** for filter tape installation instructions.

2.3.3 BX-597A Ambient Sensor Installation

Connect the BX-597A AT/BP/RH Ambient Sensor: The BC 1054 comes with a BX-597A combination ambient temperature, barometric pressure, and relative humidity sensor. The sensor must be connected and mounted to be able to monitor the ambient conditions of the area being sampled (see **Figure 2-1**).
Route the digital sensor cable (pn: 30010-25) from the corresponding connector on the bottom of the BX-597A sensor to the correct terminals on the back of the BC 1054 as shown in **Table 2-1**. **NOTE: Either 12V terminal may be used and can be shared.**

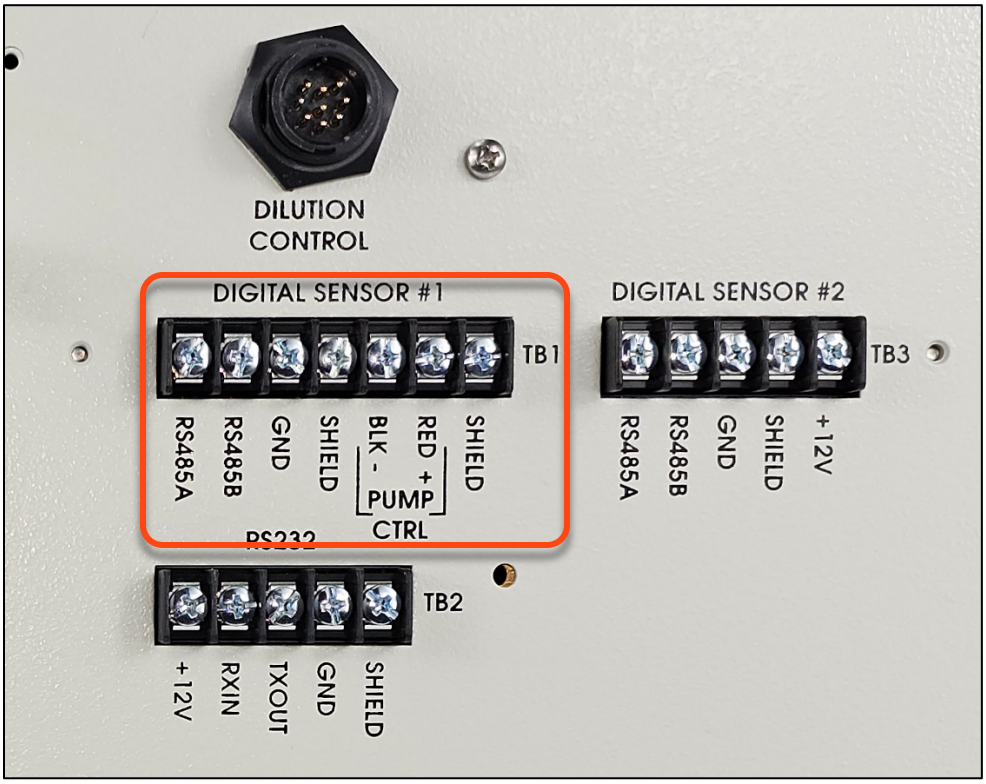


Figure 2-11 Main Digital Sensor Terminal

Table 2-1 BX-597A Sensor to BC 1054

BX-597A WIRE	BC 1054 TERMINAL
Red	12V DC PWR
Orange or Yellow	RS485A
White	RS485B
Black	GND TB-2
Green	GND TB-1
White/Brown	SHIELD TB-1

Terminal Wiring Connections

NOTE: See Section 4.2.5 Digital Sensor Configuration to set up and confirm the digital sensor connection.

2.3.4 AC Pump Box Installation

Position the pump box near the BC 1054. The best location for the vacuum pump is often on the floor under the rack or bench, but it may be located up to twenty feet away if desired. It may be preferable to locate the pump further away so noise is minimized if the BC 1054 is in an area where personnel are present.

NOTE: The pump is not weatherproof and should always be indoors.

Route the clear 10mm air tubing from the pump to the back of the BC 1054 and insert it firmly into the Quick-Connect fittings on both ends.

The pump box is supplied with a captive two-conductor signal cable used by the BC 1054 to turn the pump on and off.
Connect the red wire to the "PUMP CTRL + RED" terminal and the black wire to "PUMP CTRL – BLK."

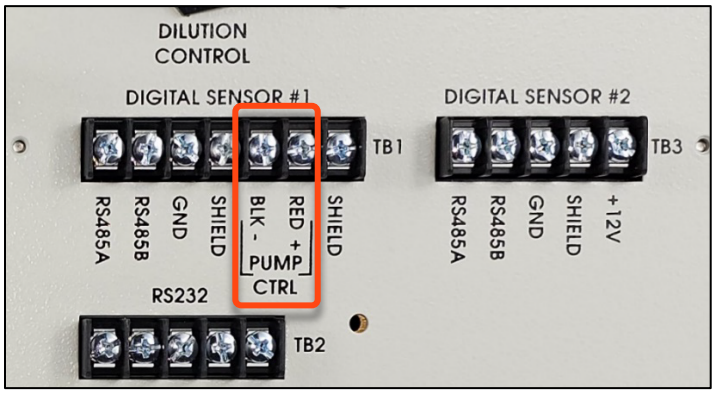


Figure 2-12 AC Pump Box Connection

Install the AC power connector into the fitting on the pump box. Plug the other end into the appropriate AC power source. The included US-type modular power cord (pn: 400100) can be changed to match the local AC connection type, if needed.

2.3.5 Connect the 12V Power Supply

NOTE: It is recommended to keep the power switch at the back of the unit in the OFF position until all accessories are installed.

Plug the 12V, 8.5A power supply (pn: 510634) into the four-pin, keyed power connector on the back panel of the BC 1054. If the power connected does not fully seat, check the key alignment and gently re-seat the connector.

The power supply has a universal AC voltage input. The included US-type modular power cord (pn: 400100) can be changed to match the local AC connection type, if needed.

2.4 *Filter Tape Installation*

Section 4.2.4 Tape System Configuration will provide filter tape installation instructions.

3. USER INTERFACE and MENU SYSTEM

This section describes the BC 1054 menu hierarchy, menu navigation, user interface touch-screen functions, and menu descriptions.

3.1 *Menu Hierarchy*

The BC 1054 menu structure is outlined in the following table.

Table 3-1 BC 1054 Menu Hierarchy

Menu	Sub Menu Options	Overview
SETTINGS	Sample	Modify the location ID and Sample Rate
	Tape	Modify the Tape settings
	Flow	Modify the Sample and Dilution flow settings
	Heater	Modify the Flow and Box Heater settings
	General	Modify general system settings
	Admin	Administrator level controls and settings
CALIBRATION	AT	Calibrate the ambient temperature sensor or restore default settings
	BP	Calibrate the ambient pressure sensor or restore default settings
	Sample Flow	Calibrate the Sample Flow sensor or restore default settings
	K-Factors	Calibrate the BC Channels
	LEDs	Adjust the LEDs to reduce detector alarms
	Verify Cal	Verify the instrument calibration
	Dilution flow	Calibrate the dilution flow system (when connected)
INSTRUMENT TESTS	Load Tape	Assist in loading a new roll of tape
	Self Test	Automatic test of the BC 1054 subsystems
	Tape Test	Manually advance the filter tape
	Leak Test	Assist in checking for leaks around the filter tape interface
	Lamp Test	Tests the individual LEDs and photodiode detectors
	Digital Link	Test and configure external digital sensors
	Box Heater	Verify the box heater is working properly
EXPORT DATA	No submenu	Export data to a USB flash drive
ALARM LOG	No submenu	View alarms and system flags
ABOUT	No submenu	Details the model and serial number, location ID, software version, firmware version, ethernet address, and calibration date

3.2 *Initial Startup Sequence*

When the back panel power switch is set to the ON position, the BC 1054 will begin the boot process. The screen will remain dark for approximately thirty seconds, after which the splash screen will appear, identifying the instrument Model and boot process status.

Figure 3-1 Boot Screen

NOTE: When the monitor has been configured to local monitoring requirements, press the green START button or allow the countdown to finish for the sample start sequence to commence.

See Section 5.2 on how to start and stop a sample after the instrument is configured.

When the boot process is complete, a prompt will appear stating that "Sampling will begin in 60 seconds" (**Figure 3-2**). Press the PAUSE button to stop the sample start sequence.

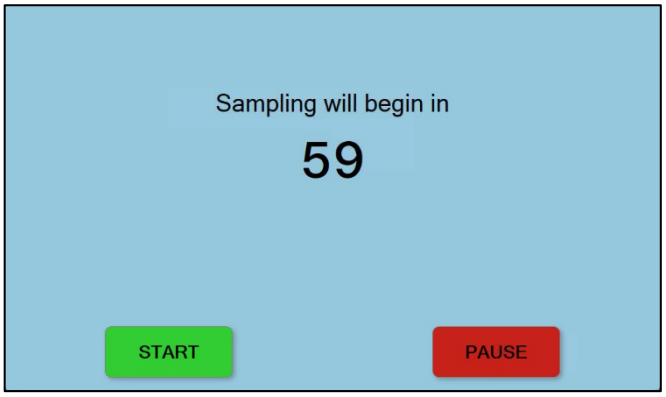


Figure 3-2 Sample Countdown

NOTE: The instrument should be configured to the local monitoring requirements and systems audited before sampling.

3.3 *User Interface and Touch-Screen Display Functions*

The BC 1054 user interface consists of a color touch-screen display used to control almost all the features and functionality of the sampler. The Image (**Figure 3-3**) below indicates the Home screen buttons for operation and navigation along with data read-outs such as ambient conditions and current sample values. The section below provides an in-depth overview of the Home screen.

3.3.1 Touch Screen Manipulation

The BC 1054 color touchscreen display provides easy menu navigation and field editing. Action buttons are indicated by arrows from blue text boxes. When pressed, action buttons will lead to different menus, toggle data views, or start and stop samples. The arrows and circles will toggle the Home screen data view from numerical values to a bar graph view for quick reference. See **Section 3.3.2** for more details.

NOTE: The blue text boxes indicate action buttons.

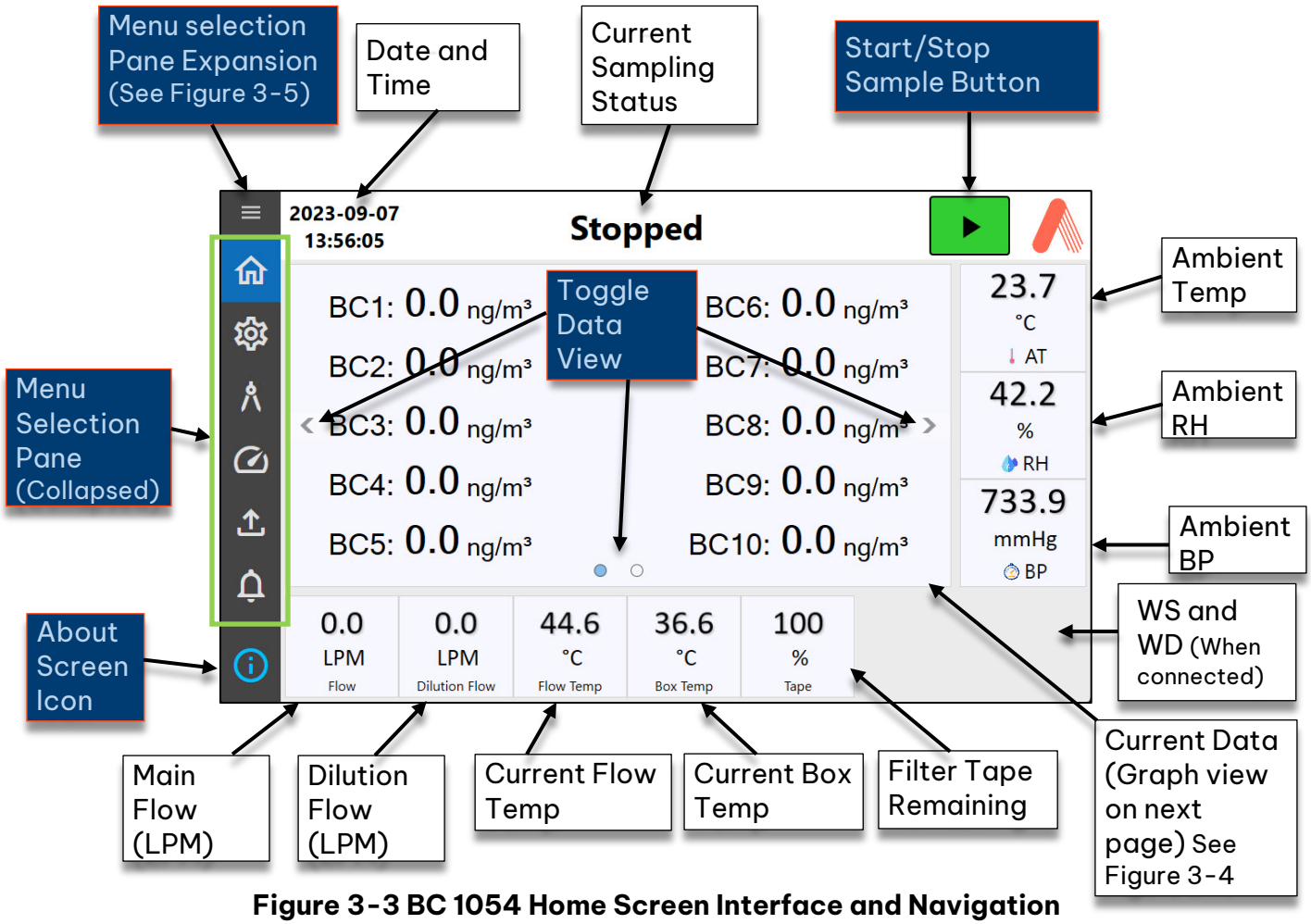


Figure 3-3 BC 1054 Home Screen Interface and Navigation

NOTE: Dilution Flow only appears when the BC 1054 detects a Dilution flow system.

3.3.2 Data View Screens

Current sample data can be viewed two ways: numerical values, as shown by **Figure 3-3**, or in a graph shown in **Figure 3-4**. To toggle the different views, press the arrow buttons on either side of the data view screen or press the small circle buttons at the bottom center of the screen.

The graph view is intended as a quick visual representation of the raw sample data.

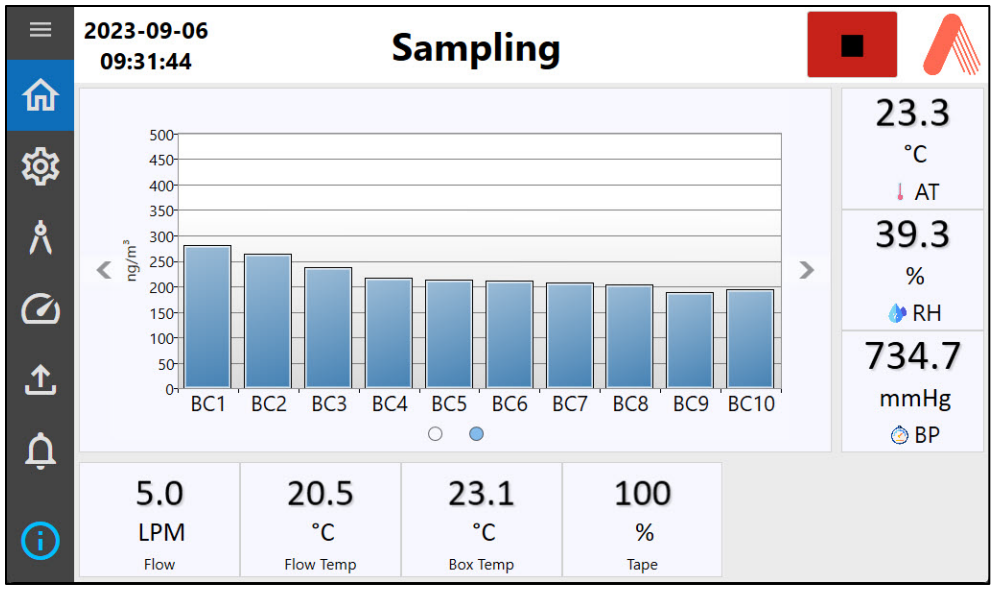


Figure 3-4 Home Screen Data Graph View

3.4 *User Interface Navigation*

This section describes how to access menus, edit input fields, and navigate through the menu hierarchy using the touch-screen display.

3.4.1 Home Screen Menu Selection Pane

The Home screen menu selection pane on the left side of the screen shows a list of icons that navigate to the seven available menus. The side pane can expand to show the icon labels by pressing the button in the upper left corner. See **Figure 3-5** below. To close the menu pane icon labels, press the button again or touch anywhere on the main screen.

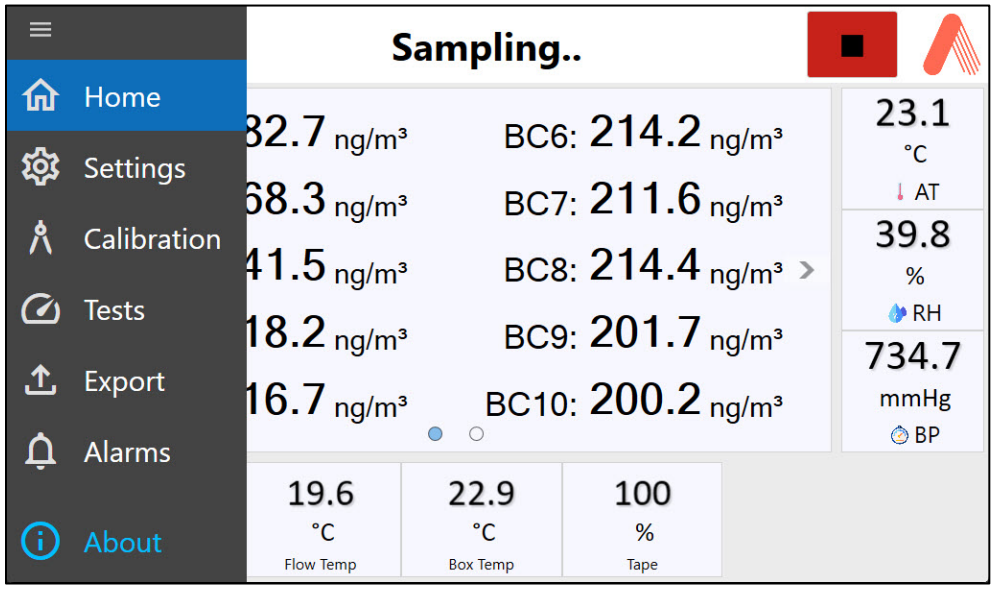


Figure 3-5 Home Screen Side Menu Expanded

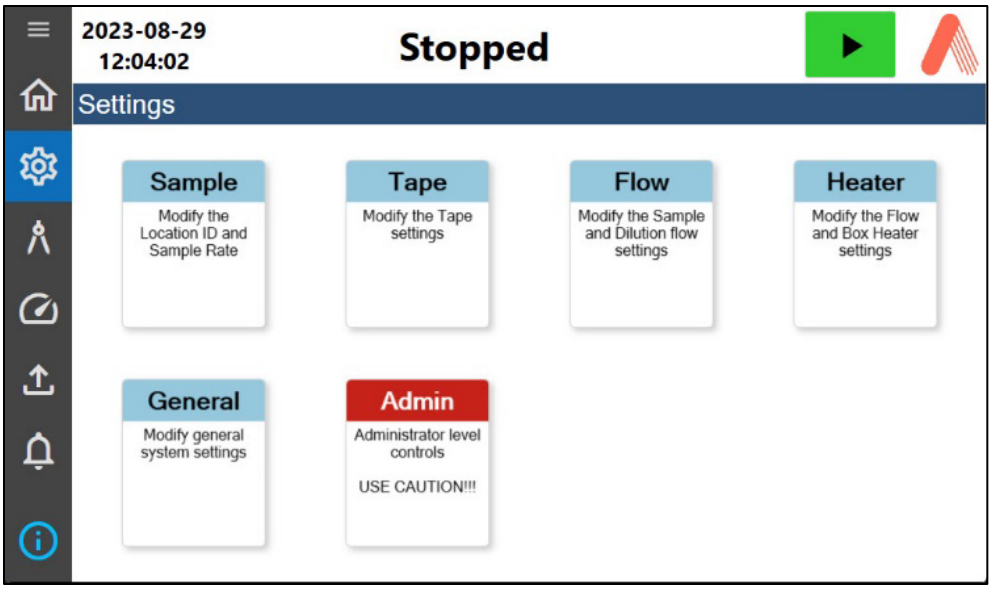


Figure 3-6 Settings Menu Selection

When a menu icon is selected from the menu selection pane, it will be highlighted blue, and sub-menus will appear on the screen, as shown in **Figure 3-6**. The selected main menu label is shown above the sub menus in the blue bar.
Select a sub-menu by pressing on the labeled boxes within the menu screen. **Figure 3-7** is an example of what a sub-menu looks like.
To return to the home screen from any menu, press the icon at the top of the menu selection pane.
When the menu selection pane is present, different menus can be selected at any time.

3.4.2 Sub Menu Navigation

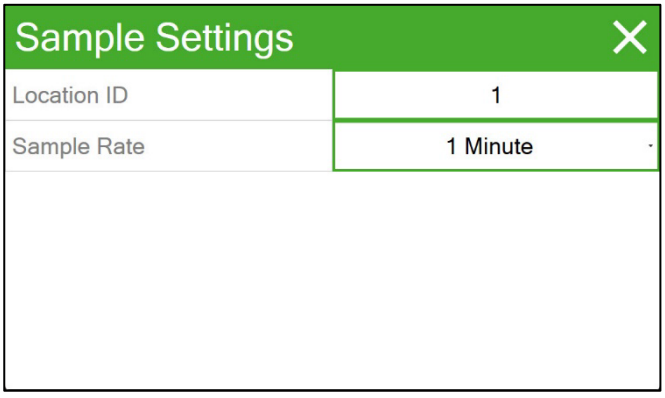


Figure 3-7 Settings Sub Menu Navigation

When a sub-menu is selected, the menu selection pane will disappear. Sub-menus consist of input fields and drop-down menu selections.
"Location ID" in **Figure 3-7** is an example of an input field where values can be customized to user preferences. When the box outlined in green is selected, the screen will change to a keypad where users can input desired values.
"Sample Rate" is an example of a drop-down menu which provides pre-defined selectable settings.

3.4.3 Editing Input Fields

Some parameters, such as the Date and Time settings, require character entry. Boxes with a green outline indicate a changeable field. When that field is selected, either a drop-down menu a numerical or alphanumerical keypad will appear. **Figure 3-8** shows the numerical input keypad for setting the date.

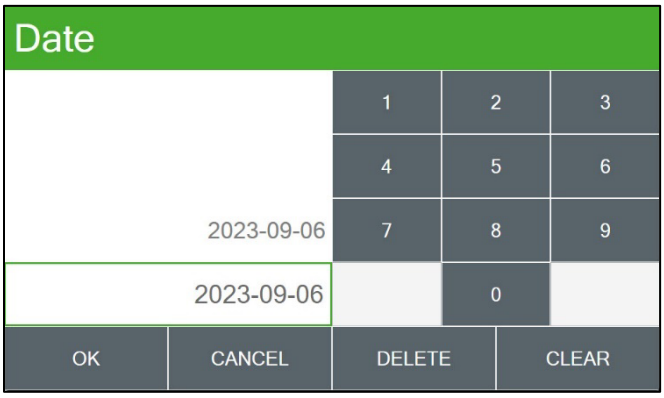


Figure 3-8 Numeric Keypad

- To edit this field, press the CLEAR button to remove the current date.
- Using the numerical keypad, key in the desired date.
- Pressing the Delete button will remove one character at a time, like the backspace key on a keyboard.
- The cancel button will return to the sub-menu without saving changes.
- Pressing OK will save the changes and go back to the previous screen.

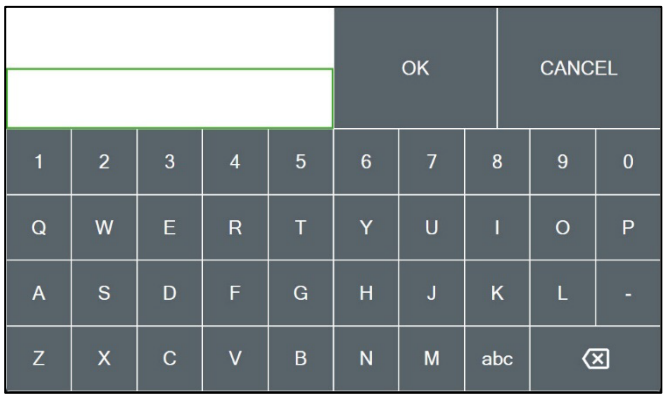


Figure 3-9 Alphanumeric Keypad

Figure 3-9 is an example of an alphanumeric keypad. This specific keypad will appear when setting up a password for Remote Access settings.

The keypad functions similarly to a standard keyboard. The letter keys are capitalized by default.

- To edit this field, input any combination of eight characters by pressing the desired keys. The characters will appear in the green outlined box.
- Select the abc button to change the keypad to lowercase letters and symbols if desired. This key acts similarly to the Shift key on a standard keyboard.
- The ⌫ button will delete a single character with each press.
- The CANCEL button will return to the previous menu without saving changes.
- When the desired password is confirmed, press the OK button to save the password and go back to the previous menu.

3.5 *Menus*

The following sections describe the six main menus and the functions of the sub-menus within. The sub-menus have specific functions to change settings for proper configuration, operation, and calibration of BC 1054 systems.

This section is broken up by the main menus and sub-menus with individual explanations. The 3.X.X level shows the main menu screens, and the 3.X.X.X sections show and explain the submenus and their individual entries.

3.5.1 Home Screen

The BC 1054 main sampling/operation screen or Home Screen is shown below in **Figure 3-10**. The current date and time are always fixed at the top line of the display on this screen. The menu selection pane is on the left side of the main screen, as mentioned in **Section 3.4.1**. All ten sample concentrations are reported in units of ng/m^3, and the logged concentration values update at the end of every minute.

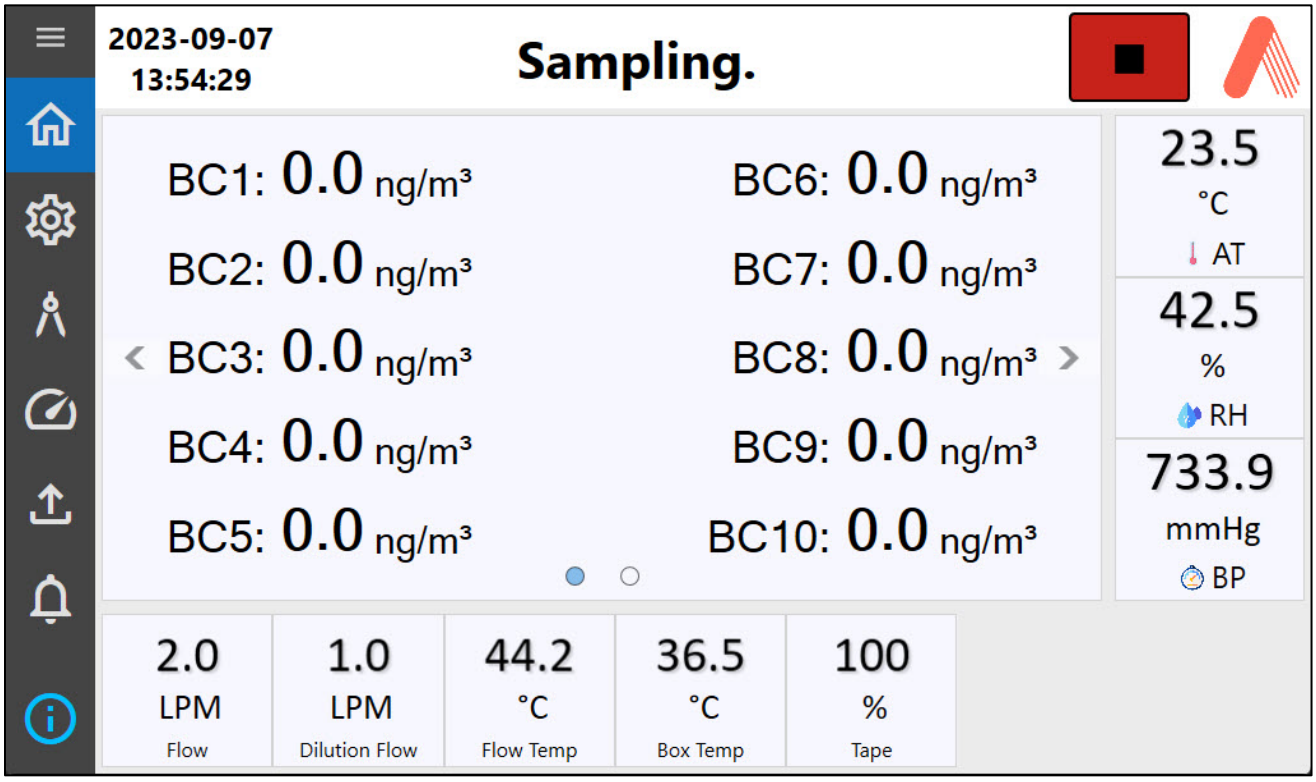


Figure 3-10 Home Screen with Dilution Flow

The list below defines each of the internal sensor readings and ambient sensor readings.

These values are updated once every second.

- **FLOW:** This value is the actual sample flow rate (through the sample filter) in liters per minute.
- **DILUTION Flow:** The flow rate of the Dilution Flow System (this will only be displayed if the Dilution Flow System is detected by the BC 1054).

- **AT:** The value for ambient temperature (°C).
- **BP:** The value for ambient barometric pressure (mmHg).
- **RH:** The value for ambient relative humidity (%).

The AT, BP, and RH values all require that the BX-597A ambient combination sensor be connected properly and are required for instrument operation. These parameters are updated on the display once every second.

- **WS** and **WD:** (not shown in **Figure 3-10**) WS is the measured wind speed, and WD is the measured wind direction. Both WS and WD require an optional external WS/WD sensor (part number AIO 2). Contact Met One Instruments for details at sales.moi@acoem.com.
- **FLOW TEMP:** The temperature of the air flow measured just after the optical measurement head whereas the BOX TEMP is the temperature of the inside of the BC 1054 enclosure.
- **TAPE**: The remaining amount of filter tape is estimated in a percentage.

3.5.2 Settings Menu

This section describes the Settings menu, its sub-menus, and their functions. The Settings menu provides basic settings for usability and standard operation that should be modified to suit the specific needs of local monitoring programs as needed.

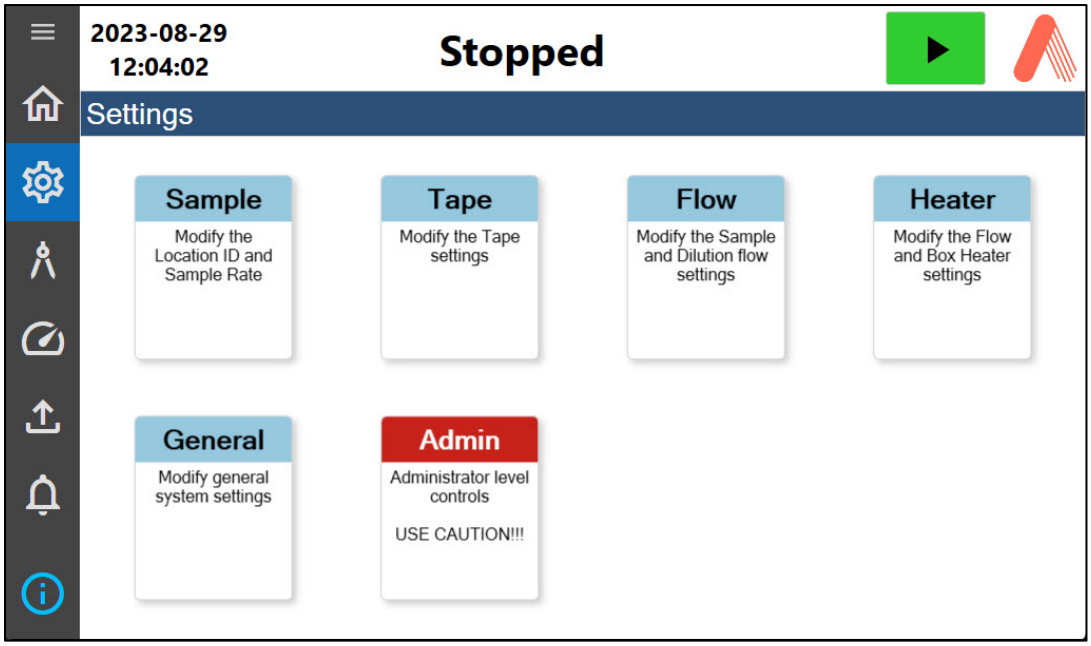


Figure 3-11 Settings Menu

3.5.2.1 Sample Settings Screen

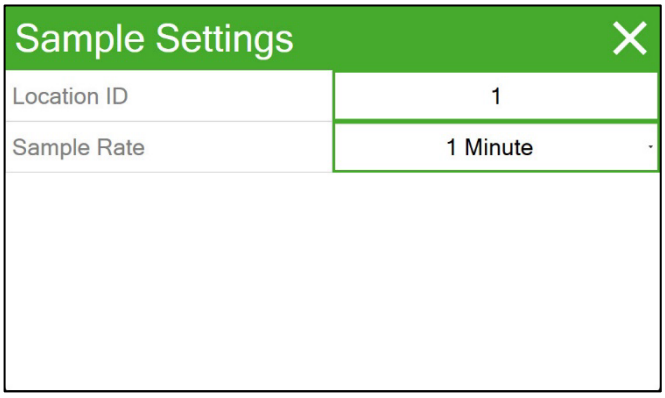


Figure 3-12 Sample Settings Screen

The SAMPLE settings screen allows users to set the Sample Rate and the Location ID of the unit. The location ID is a simple ID number that will appear in the data files. It can be used as a Unit ID number in a network of multiple BC 1054 monitors. The range is 1 to 999. The Sample Rate is the rate at which the data is sent to the user report. Setting this value to one hour will return hourly data, whereas setting it to one minute will report one-minute sample periods.

3.5.2.2 Tape Settings Screen

The TAPE SETTINGS menu contains settings that determine how and when the filter tape is advanced to a fresh spot. Some of these settings may need to be established based on measured or likely ambient BC concentrations.

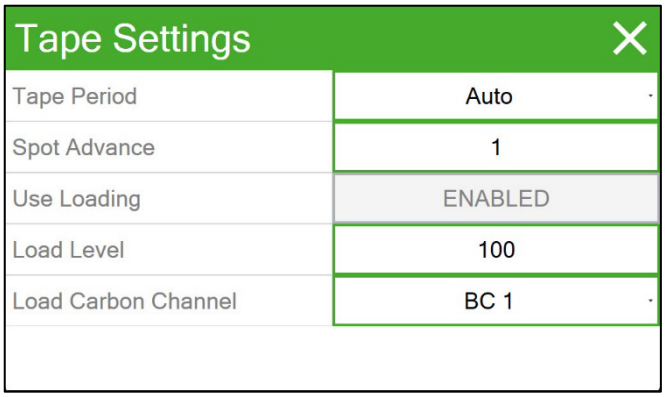


Figure 3-13 Tape Settings Screen

3.5.2.3 Flow Settings Screen

The FLOW SETTINGS screen is shown below. **Figure 3-14** Flow settings screen shows the BC 1054 base configuration without a dilution flow system connected. **Figure 3-15** Flow settings screen shows the BC 1054 with a dilution flow system connected. The BC 1054 is designed to automatically detect a dilution flow system when connected.

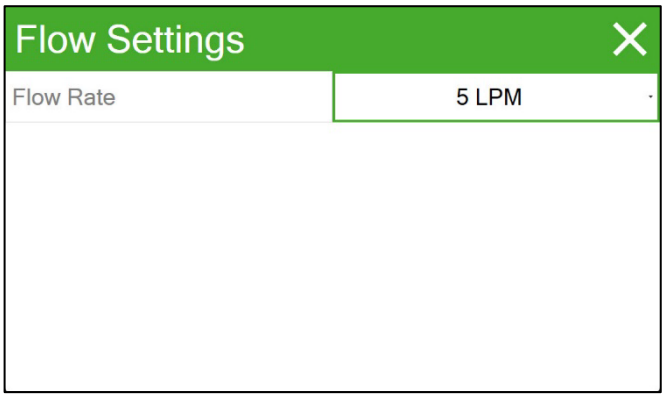


Figure 3-14 Flow Settings Screen

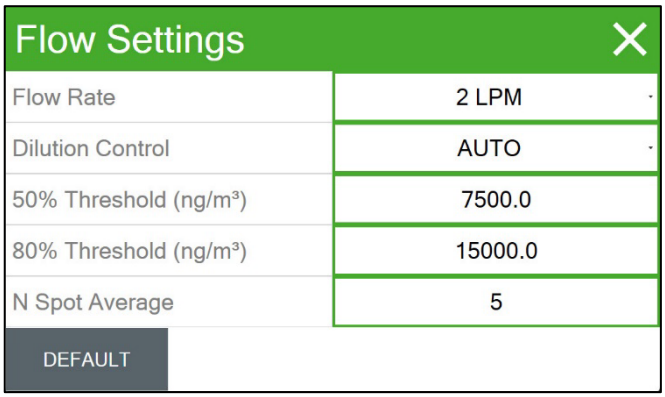


Figure 3-15 Flow Settings Screen with Dilution System

NOTE: If a dilution system is not connected to the BC 1054, the dilution flow value is not shown in the home screen.

3.5.2.4 Heater Settings Screen

The HEATER SETTINGS screen provides a means of adjusting the set points of the internal box heater and the inlet heater.

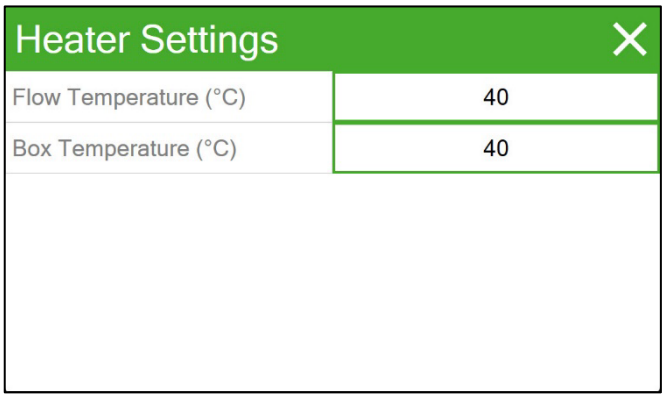


Figure 3-16 Heater Settings Screen

3.5.2.5 General Settings Screen

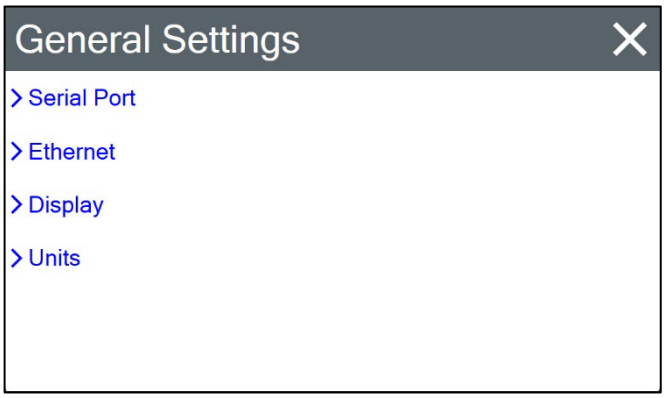


Figure 3-17 General Settings

The GENERAL SETTINGS screen is where remote connection/data transfer and accessibility settings can be configured.

3.5.2.6 Admin Settings Screen

The ADMINISTRATOR SETTINGS Screen consists of vital settings designated for owners and authorized operators. The System clock and Passwords can be set, memory cleared, and more in this menu.

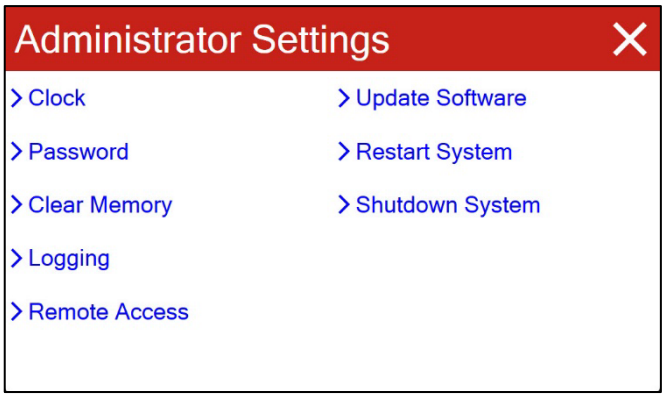


Figure 3-18 Admin. Settings Screen

NOTE: When a password is set, all menus will be locked and can only be accessed by putting in the current password when prompted.

CLOCK: The CLOCK setup screen is used to set the instrument date and time.

PASSWORD: The PASSWORD setup screen is used to change the 4-digit numeric password used to limit access to certain features in the menu system, including the setup menu.

CLEAR MEMORY: The MEMORY screen is used to clear/erase data and clear alarms stored in the BC 1054 memory.

CAUTION: This menu function will permanently delete the selected files from the instrument memory!

LOGGING: The LOGGING screen is used to configure diagnostic data logging for troubleshooting purposes. This should only be accessed at the request of Met One Instruments Service personnel and should be disabled when not in use. Trace Logging Level provides all information available, whereas Debug Logging provides less information. The Logging can be downloaded by inserting a USB flash drive into the USB port above the tape take-up spool on the right and pressing the EXPORT button.

REMOTE ACCESS: The REMOTE ACCESS screen is used to configure the remote connection password and remote access condition after startup.

UPDATE SOFTWARE: The UPDATE SOFTWARE screen is used to install current software provided by Met One upon request.

RESTART SYSTEM: This option is used to do a soft reboot when any major software changes are made.

SHUTDOWN: This option will initiate a soft shutdown. The power switch on the back of the unit will remain in the "ON" position until physically toggled. If SHUTDOWN is used, the power switch will need to be toggled to turn the instrument back on.

3.5.3 Calibration Menu

This section describes the Calibration menu, its sub-menus, and their functions. The Calibration menu provides the means to audit and calibrate individual measurement sensors that are vital to the operation of the BC 1054 and to verify those calibrations as a system. Also available on this screen are the K-Factor calibration, LED adjustment, and calibration verification.

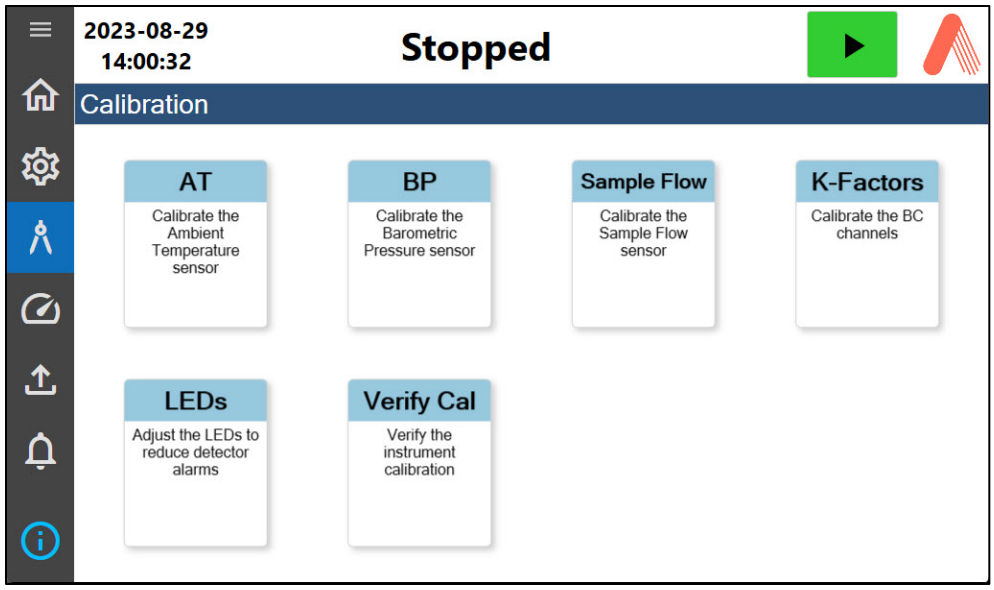


Figure 3-19 Calibration Menu

3.5.3.1 Ambient Temperature Calibration Screen

The AT CALIBRATION screen is used for field audits or calibrations of the ambient temperature sensor connected to the BC 1054.

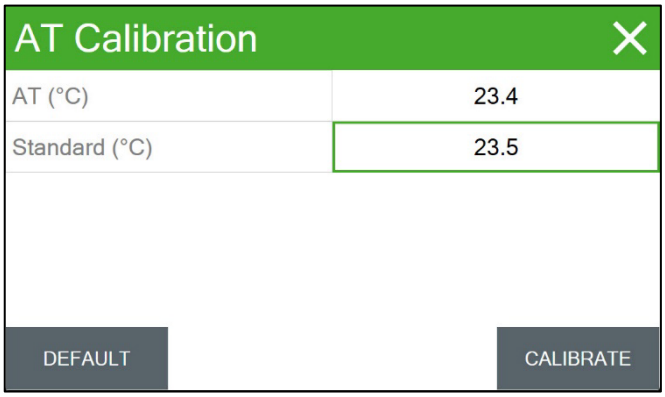


Figure 3-20 Ambient Temp. Cal. Screen

3.5.3.2 Barometric Pressure Calibration Screen

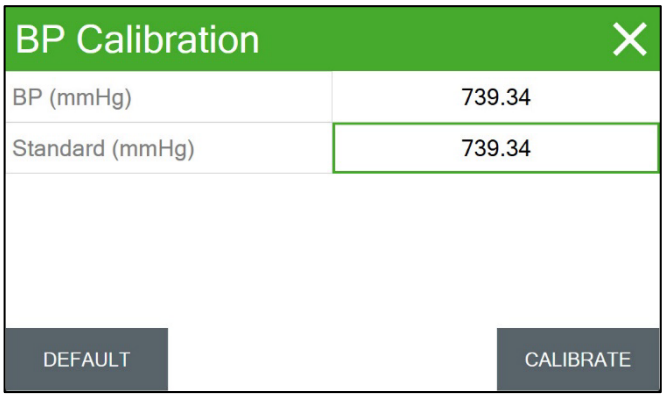


Figure 3-21 Barometric Pressure Cal. Screen

The BP CALIBRATION screen is used for field audits or calibrations of the ambient barometric pressure sensor connected to the BC 1054. Note that the pressure will be calibrated using the current set units for pressure (mbar or mmHg).

3.5.3.3 Sample Flow Screen

The SAMPLE FLOW screen is used for field audits or calibrations of the sample flow measurement of the BC 1054. The temperature, pressure, and leak status must be checked before performing a flow calibration.

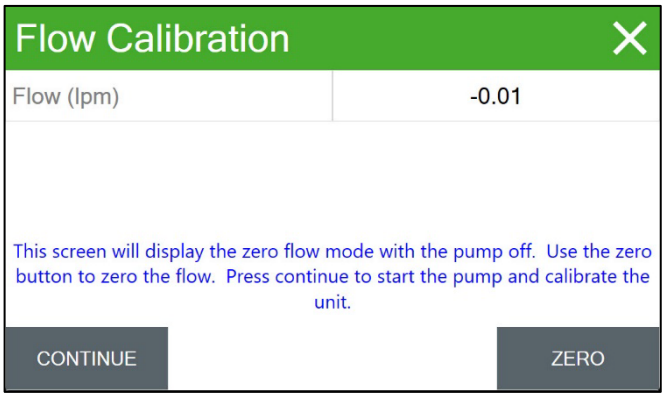


Figure 3-22 Flow Zero Cal. Screen.

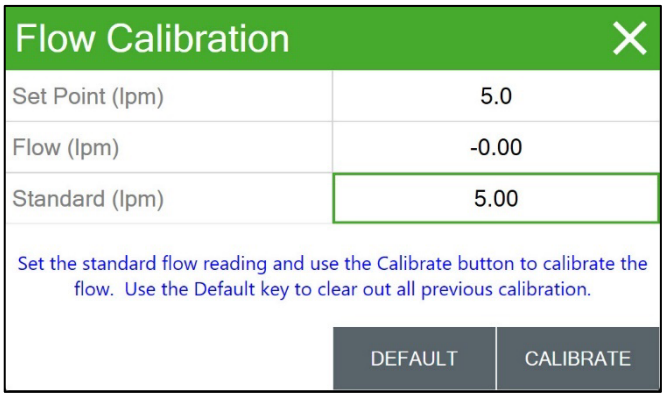


Figure 3-23 Flow Cal Main Screen

3.5.3.4 Dilution Flow Screen

The DILUTION FLOW screen is used for field audits or calibrations of the dilution flow measurement of the BC 1054 Dilution Flow System.

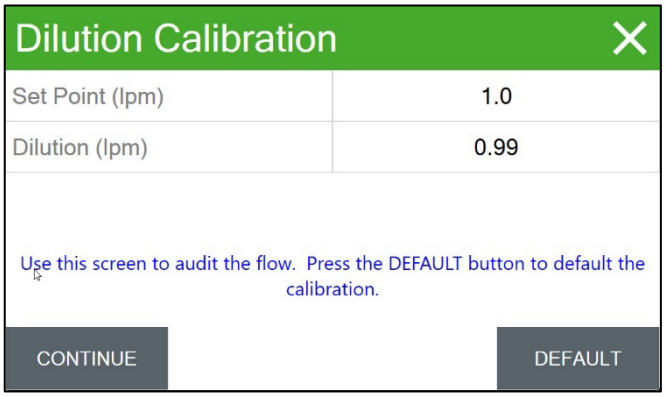


Figure 3-24 Dilution Flow Audit Screen

3.5.3.5 K Factor Calibration Screen

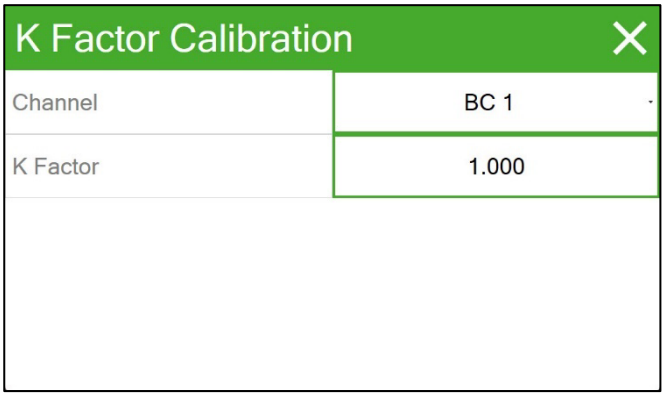


Figure 3-25 K Factor Cal. Screen

Each BC 1054 monitor leaves the factory with a calibration certificate containing the K-factors used to adjust the referenced BC 1054 monitor to a factory standard. In certain sampling situations, it may be desirable to adjust the output readings of one or more channels to match a reference instrument more closely under local conditions. The K-FACTORS screen in the CALIBRATE MENU may be used to do this.

3.5.3.6 LED Calibration Screen

LEDs are used in line with the detection system. If detector alarms are present, the LEDs can be individually adjusted or "Calibrated" on this screen to potentially remedy the problem. If the problem persists, contact the Met One service department for assistance.

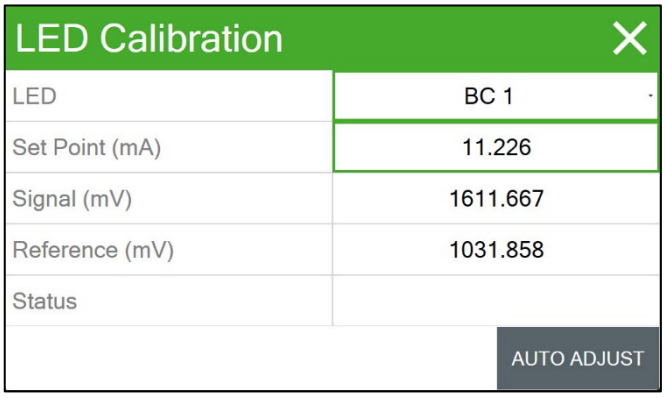


Figure 3-26 LED Cal. Screen

3.5.3.7 Verify Calibration Screen

The VERIFY CALIBRATION screen is used to perform the optical span calibration verification test on the instrument using a neutral density filter.

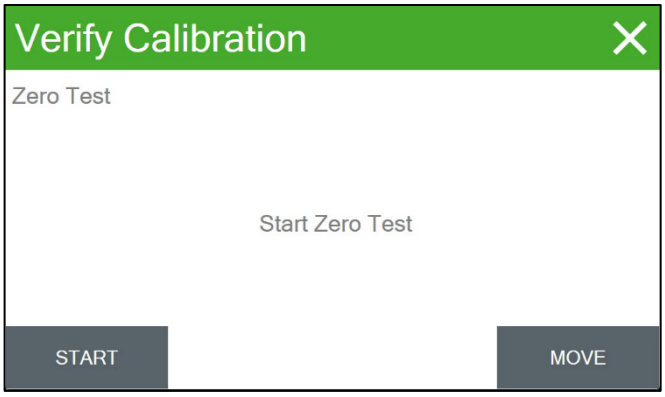


Figure 3-27 Verify Cal. Zero Screen

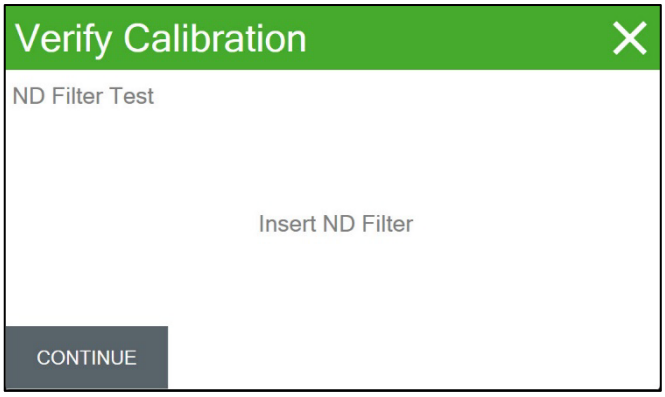


Figure 3-28 Verify Cal Insert ND Filter Screen

3.5.4 Test Menu

The BC 1054 TESTS or INSTRUMENT TESTS menu contains a system of screens that can be used to test the electrical and mechanical subsystems for troubleshooting purposes.

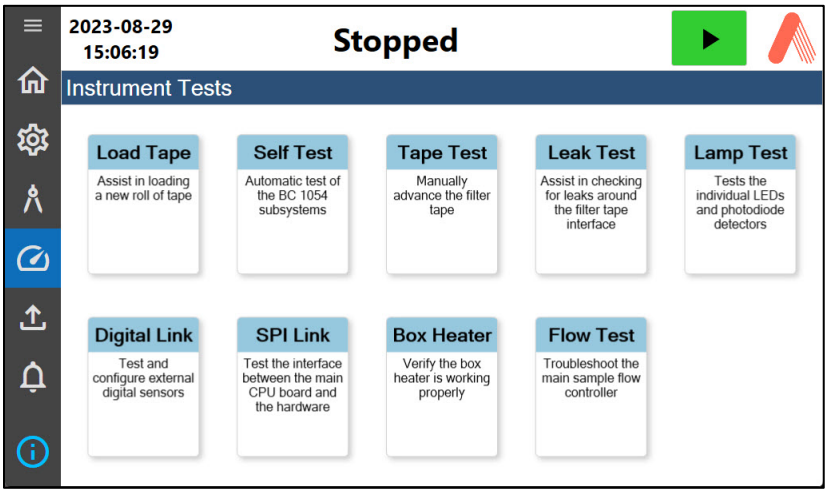


Figure 3-29 Test Menu

3.5.4.1 Load Tape Screen

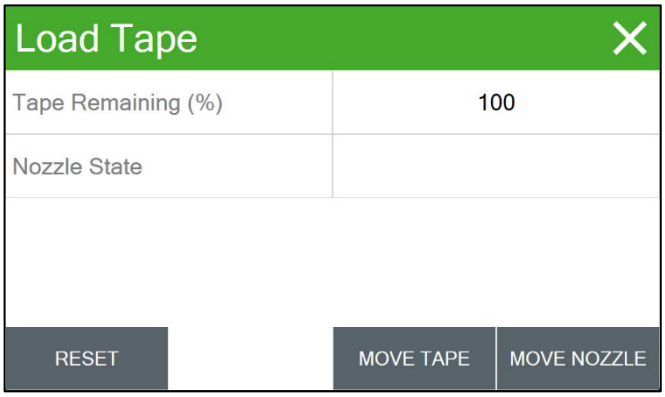


Figure 3-30 Load Tape Screen

The LOAD TAPE screen is used to raise or lower the optical measurement head to install a new roll of filter tape. The screen shows the remaining filter tape percent and nozzle position. The tape and nozzle can be moved using this screen for testing and maintenance. When the filter tape is replaced, the remaining percent can be reset to 100 from this screen.

3.5.4.2 Self Test Screen

The SELF TEST screen is used to test the main components of the measurement system with an "OK" status for correct operation or "Error!!" if a system did not pass.

- Tape movement check
- Nozzle movement check
- Flow system operation
- Dilution system operation
- Detector operation

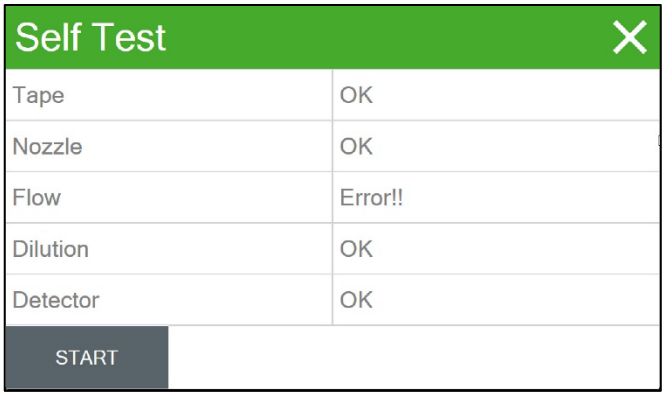


Figure 3-31 Completed Self Test Screen

3.5.4.3 Tape Test Screen

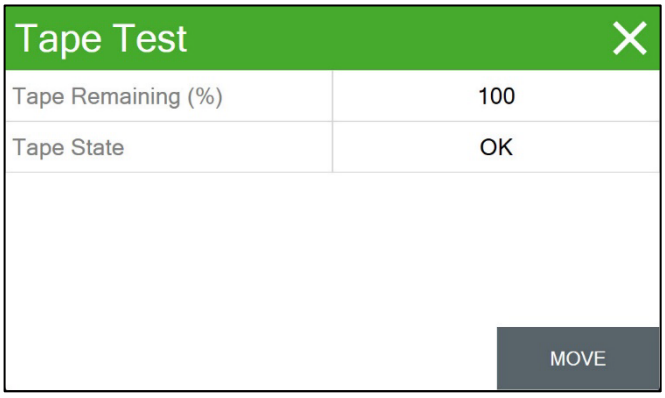


Figure 3-32 Tape Test Screen

The TAPE TEST screen is used to manually advance the filter tape to spool up the end of a new roll of tape, or to test the tape motor and encoder. Press the MOVE button at the bottom right corner of the screen to start the tape advance. The amount of remaining tape travel is measured by the encoder and displayed on the screen.

3.5.4.4 Leak Test Screen

The LEAK TEST screen is used to check the flow system for significant leaks that can affect performance and accuracy.

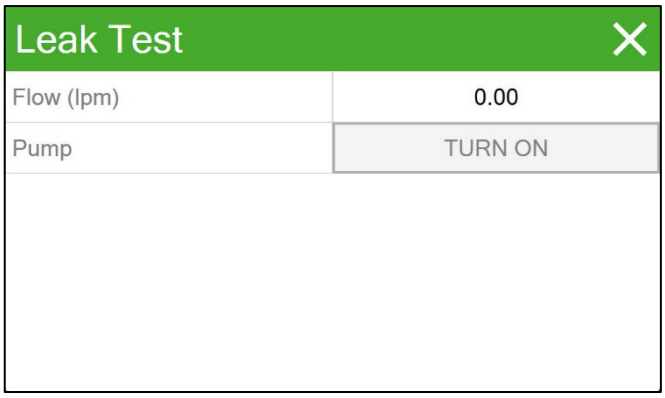


Figure 3-33 Leak Test Screen

3.5.4.5 Lamp Test Screen

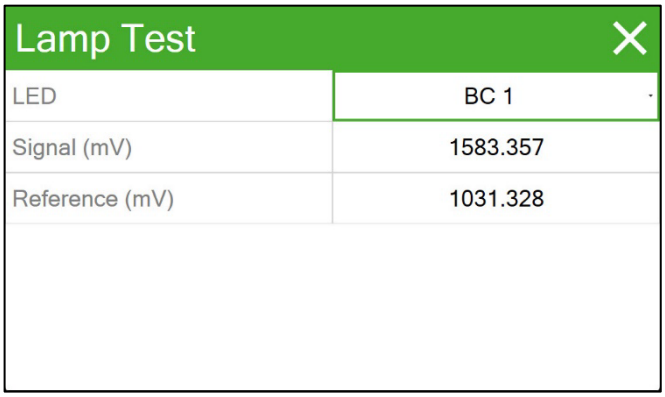


Figure 3-34 Lamp Test Screen

The LAMP TEST screen is used to test the individual LEDs and photodiode detectors for proper functionality, especially if optical system alarms are generated.

3.5.4.6 *Digital Link Test*

The DIGITAL LINK screen is used to configure and test the link between the BC 1054 and ambient digital sensors. Sensor 1 and Sensor 2 indicate the identification of connected sensors. Figure 3-35 Sensor 1 shows a BX-597A is connected and working.

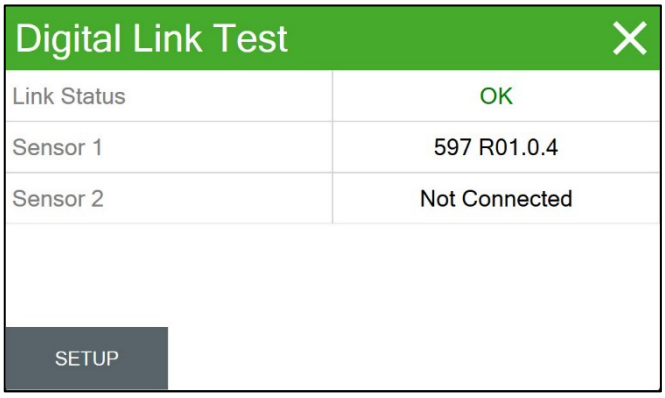


Figure 3-35 Digital Link Test Screen

3.5.4.7 *Box Heater Test Screen*

The box heater is composed of two large power resistors mounted on a plate with a continuously running circulation fan. The instrument firmware uses a proportional control output to regulate the heater and the temperature inside the enclosure based on the detector board temperature. The default setting for the Box Temp is set to 30 °C. To change this setting, see **Section 4.2.7**.

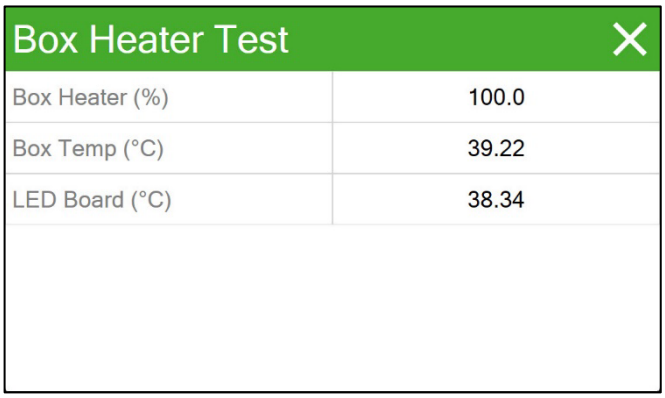


Figure 3-36 Box Heater Test Screen

The BOX HEATER TEST screen is used to view the current Box Heater power and temperature and the LED circuit board temperature.
The BC 1054 has a 40-watt heater located inside the flow system enclosure in order to elevate the temperature inside the enclosure for stability purposes. The current heater power being used is displayed as a percentage in the BOX HEATER field.

3.5.5 Export Menu

The BC 1054 can copy data files to a user-supplied USB flash drive. The flash drive USB plug must be inserted into the BC 1054 USB port. The BC 1054 USB port is approximately four inches above the filter tape take-up spool, on the right side of the detector housing, inside the main door.

NOTE: The flash drive needs to be formatted to FAT-32 or NTFS for compatibility.

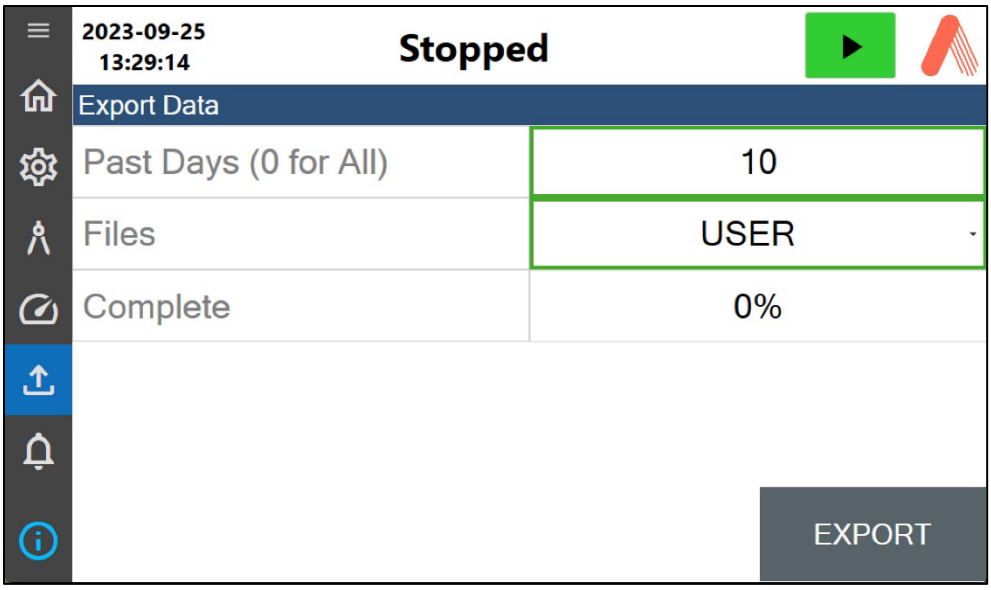


Figure 3-37 Export Data Screen

3.5.6 Alarms or Alarm Log

The ALARM LOG Screen allows operators to quickly view alarms and error log entries in the BC 1054. The screen displays the type of error and the time and date when the error occurred.
Some alarms, such as FLOW FAILURE, shown in **Figure 3-38 Alarm Log**, below, will provide specific information about that alarm to aid in troubleshooting.

To see older alarms, drag the scroll bar or use the up and down arrows on the right side of the screen to scroll through the alarms.

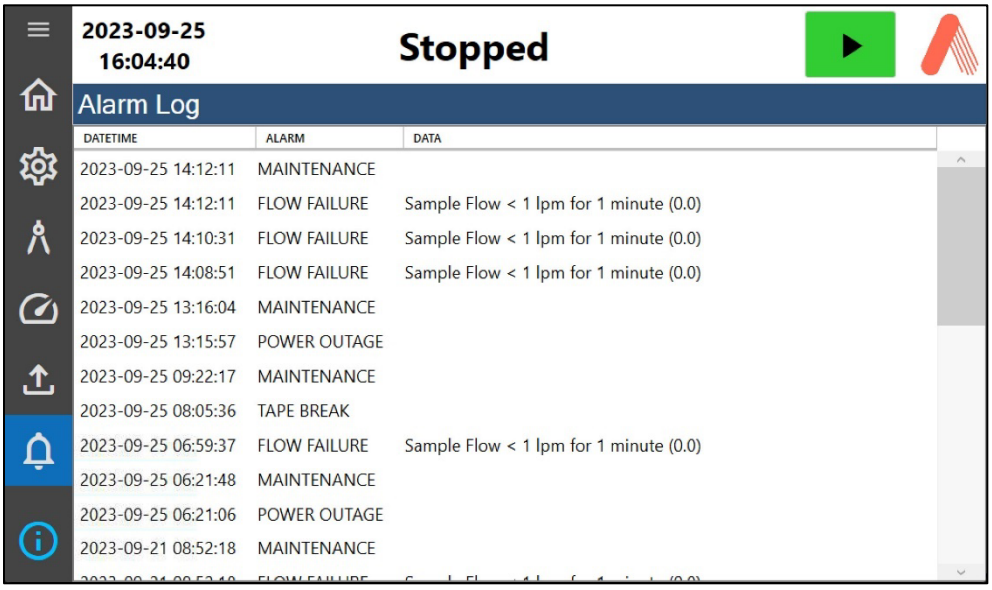


Figure 3-38 Alarm Log

3.5.7 About Screen

The ABOUT screen provides important identification data specific to each BC 1054, which includes the following: Model, Serial number, Location ID, software and firmware versions, IP address, and factory calibration date. At the bottom of the About screen, the phone number, email address, and support web page for Met One are provided.

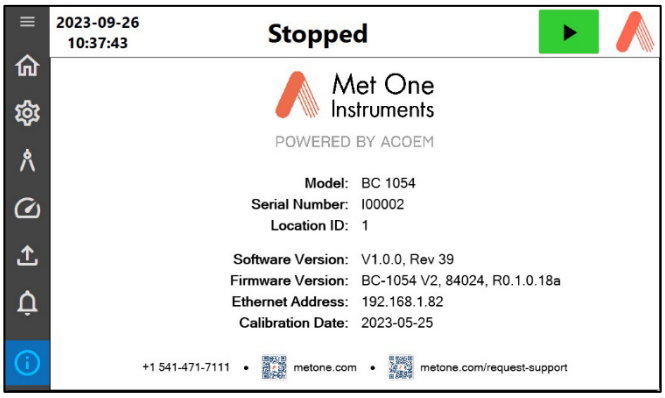


Figure 3-39 About Screen

4. BC 1054 Configuration and Setup

The sections below explain the process of configuring the BC 1054 for operation. The factory settings provide a baseline for standard sampling conditions, but it is recommended to check local sampling requirements and adjust the BC 1054 settings accordingly.

4.1 *Administrator Settings*

The ADMINISTRATOR SETTINGS menu consists of vital settings designated for owners and authorized operators, as stated in **Section 3.5.2.6**. The Administrator Settings menu can be found in the SETTINGS menu, which is accessed in the side menu pane from the home screen.

NOTE: It is recommended to set a password to protect settings from being altered by unauthorized personnel. Setting the system password is explained below in Section 4.1.2.

4.1.1 Setting the Clock

The SET CLOCK Screen is used to set the internal BC 1054 clock. The cock is used to match data points with other collocated instruments for accuracy.

Set Clock screen location: Side Menu Pane>Settings>Admin Settings>Clock (see **Section 3.1 Menu Hierarchy**).

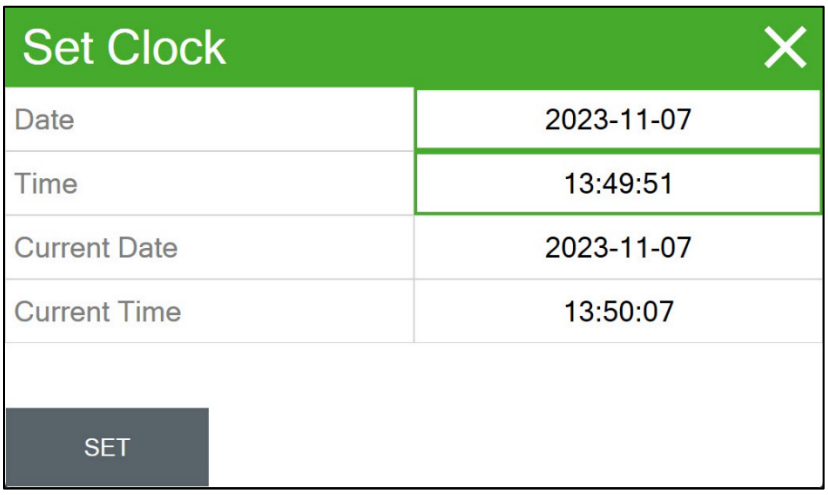


Figure 4-1 Set Clock Main Screen

4.1.1.1 Setting the Date

Press on the green outlined box next to "Date" from the clock main screen shown in **Figure 4-1 Set Clock Main Screen**.

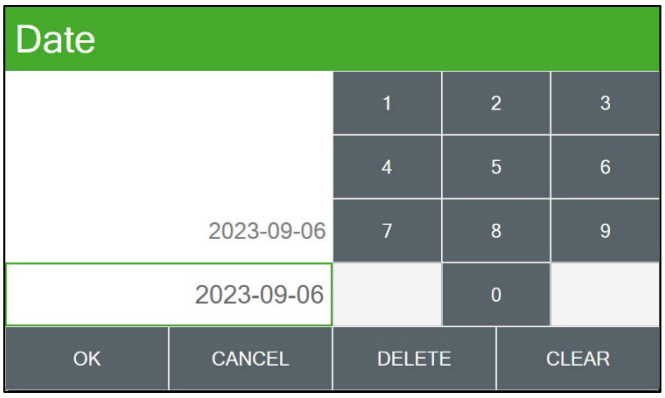


Figure 4-2 Date Input Screen

In this screen, the date is set using the keypad.

Press the CLEAR button at the bottom right corner of the screen to remove the current date.

Type in the new current date, YYYY-MM-DD, using the keypad.

If digits need to be removed, use the DELETE key to remove one digit at a time from right to left.

If all the digits need to be removed, press the CLEAR button.

To save the new date, press the OK button.

4.1.1.2 Setting Time

To set the time, press on the green outlined box next to "Time" from the Clock Main Screen seen in **Figure 4-1 Set Clock Main Screen**.

In this screen, the Time is set using the keypad.

Press the CLEAR button at the bottom right corner of the screen to remove the current time. Type in the current Time, HH:MM:SS, using the keypad.

If digits need to be removed, use the DELETE key to remove one digit at a time from right to left.

If all the digits need to be removed, press the CLEAR button.

To save the new date, press the OK button.

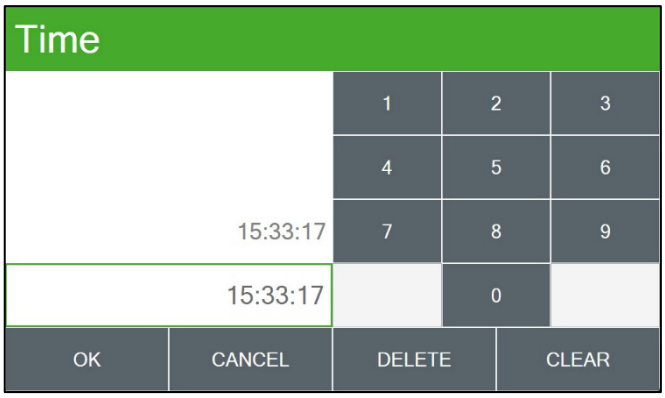


Figure 4-3 Time Input Screen

The following rules apply to setting the clock from the front panel screen and via the serial communication ports.

- Setting the clock while the instrument is sampling allows for adjustments of less than ten minutes.
- Adjusting the clock by more than ten minutes requires that the instrument is NOT sampling.

If the clock is adjusted while the instrument is NOT sampling, the time is adjusted immediately. The BC 1054 will prompt a system reboot.

If the clock is adjusted while the instrument is sampling, adjustments to the real-time clock are made in two-second increments each minute until the correction is complete.

- A time correction of one minute would take 30 minutes to complete.
- A time correction of ten minutes would take 300 minutes to complete.

4.1.2 System Password

The SET PASSWORD screen is used to change the four-digit numeric password used for limiting access to most features in the menu system, including the setup menu.

Set Password screen location: Side Menu Pane>Settings>Admin Settings>Password.

The default password is **0** (zero). This disables the password and allows full access to all the password-controlled functions. If the password is changed to any value between 1 and 9999, it will subsequently be required for access to these screens.

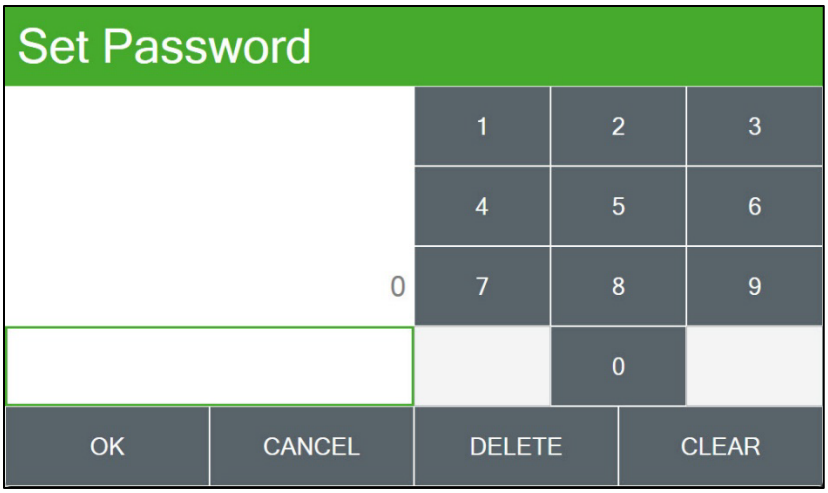


Figure 4-4 Set Password Entry Screen

4.1.2.1 Password Recovery

Should the password ever be lost or forgotten, the Met One Instruments service department can assist in password recovery. Establish serial communications with a terminal program such as Comet Software or HyperTerminal. When a connection is established, send the "RPW" command to the unit. The BC 1054 will provide an encrypted response, which should then be emailed (see **Figure 3-39 About Screen** for email) to the Met One Instruments service department for decoding.

4.1.3 Clear Memory

The BC 1054 memory stores sample data and alarms, which can be cleared individually. It is recommended, but not required, to clear data and alarms when moving an instrument to a different site or after major services have been performed.
Data should be downloaded and saved before clearing memory. As seen in **Figure 4-5 Clear Memory Screen**, when memory is cleared, it will be permanently deleted from the instrument's memory.

CLEAR MEMORY menu location: Side Menu Pane>Settings>Admin Settings>Clear Memory (see **Section 3.1 Menu Hierarchy**).

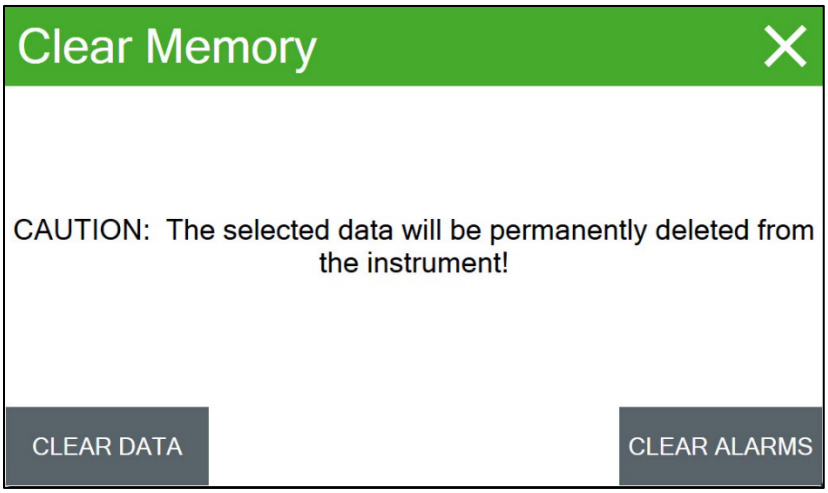


Figure 4-5 Clear Memory Screen

To permanently clear sample data, press the CLEAR DATA button.

To permanently clear alarms, press the CLEAR ALARMS button.

A prompt will appear after pressing clear to confirm that data will be permanently deleted.

4.1.4 Logging

The LOGGING screen allows the user to select the extent of diagnostics data that will be included in exported data.

Logging screen location: Side Menu Pane>Settings>Admin Settings>Logging (see **Section 3.1** Menu Hierarchy).

Figure 4-6 Logging Level

This screen is used for diagnostic purposes and should remain off unless requested by Met One Instruments service personnel.

4.1.5 Remote Access Config (Not supported at this time)

This section provides steps to set up the remote access behavior after powering on the instrument and how to set a password for remote access. The Remote Access Config Screen can be accessed using the following menu path: Side Menu Pane>Settings>Admin Settings> Remote Config (see **Section 3.1 Menu Hierarchy**).

To set Remote Access, press on the box outlined in green next to "Remote Access" to change the remote access state. When the box is pressed, the status will change between the following options.

Enable: Remote access is available for use at any time.

Disable: Remote access is turned off. This setting can be used to close a remote session or block access for new remote sessions.

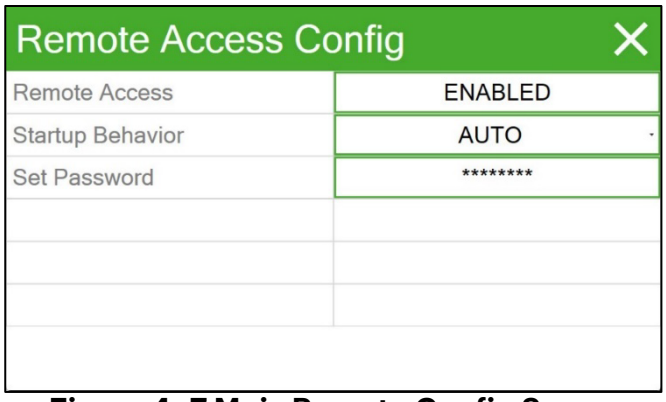


Figure 4-7 Main Remote Config Screen

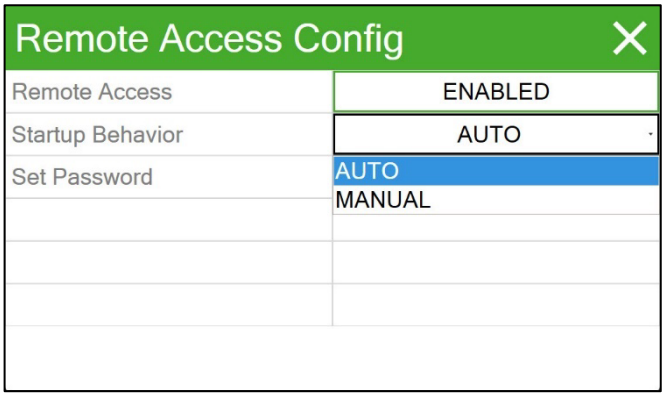


Figure 4-8 Remote Access Startup Behavior

To set the Remote Access Password, press on the green outlined box with "********" in it. The input screen with an alpha and numeric keyboard will appear. Select any combination of letters and numbers, up to eight characters. Press OK to set the password.

To set the Startup behavior, press on the box outlined in green next to "Startup Behavior" to view the dropdown list of options. The options available are shown below.

AUTO: Remote access will be available when the instrument is powered on.

MANUAL: Remote access will be disabled when the instrument is powered on.

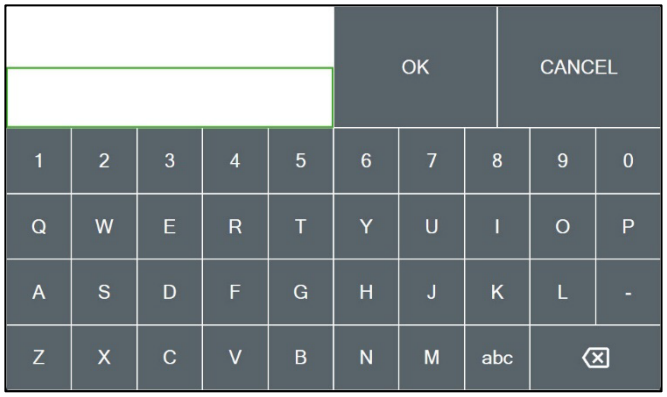


Figure 4-9 Remote Access Password Input Screen

4.1.6 Update Software

The UPDATE SOFTWARE screen is used to upgrade the internal software for the BC 1054. Software updates are available by request through the Met One Service department. Please have the instrument serial number and software version when software requests are made. Load the provided software upgrade onto a USB flash drive.

Upgrade Software screen location: Side Menu Pane>Settings Menu>Admin Settings>Update Software (see **Section 3.1 Menu Hierarchy**).

Plug the USB flash drive into the USB port above the filter tape take-up spool.

Go to the Update Software screen. If proper software is loaded onto the USB flash drive, the screen will show the software name and version.

Press the UPGRADE button on the lower left corner of the screen.

When the process is finished, unplug the USB device. The system will automatically restart.

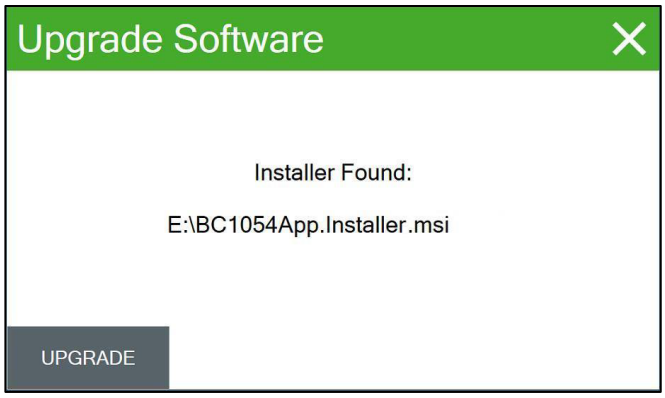


Figure 4-10 Upgrade Software

4.2 *Basic Settings*

This section describes each settings menu in detail and how to configure the BC 1054. Sampling requirements will vary; these instructions are guidelines and should be crosschecked with local sampling requirements.

4.2.1 Display Configuration

The SETUP DISPLAY screen is used to adjust the display brightness to accommodate local conditions.

Setup Display screen location: Side Menu Pane>Settings>General Settings>Display (see **Section 3.1 Menu Hierarchy**)

Figure 4-11 Display Configuration

To change the screen brightness, press on the green perpendicular brightness indicator and drag it across the horizontal track Bar.

Press in the general position of the track bar to quickly change brightness.

The brightness percent will be displayed on the right of the brightness track bar.

4.2.2 Units of Measurement Configuration

Currently, the only unit settable is the pressure units with the option of mbar or mmHg. Future settable units will be listed here.

Setup Units screen location: Side Menu Pane>Settings>General Settings>Units.

To change the pressure units, press the green outlined box to the right of "Pressure" to activate the dropdown options list.

Select "**mbar**" for Millibar reporting.

Select "**mmHg**" for Millimeters of mercury reporting.

When a selection is made, the primary screen pressure value and downloadable data will reflect the change.

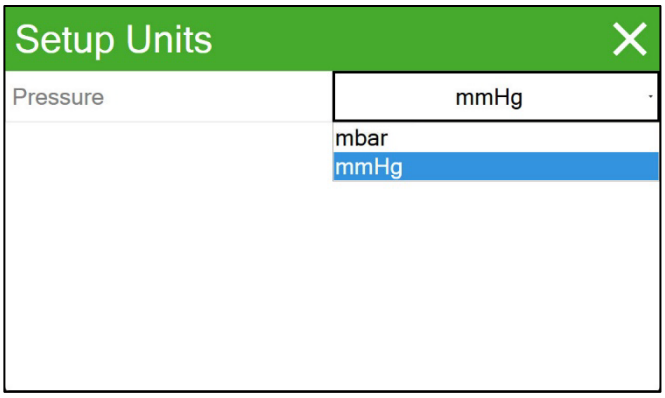


Figure 4-12 Setup Units Configuration

4.2.3 Location ID and Sample Rate Configuration

The BC 1054 Location ID and Sample Rate can be configured to owner preferences and local monitoring requirements in the SAMPLE SETTINGS screen. The Location ID is a convenient way to identify data set locations when comparing multiple sample site data reports. This is an optional setting that does not affect operation.

Sample Settings screen location: Side Menu Pane>Settings>Sample

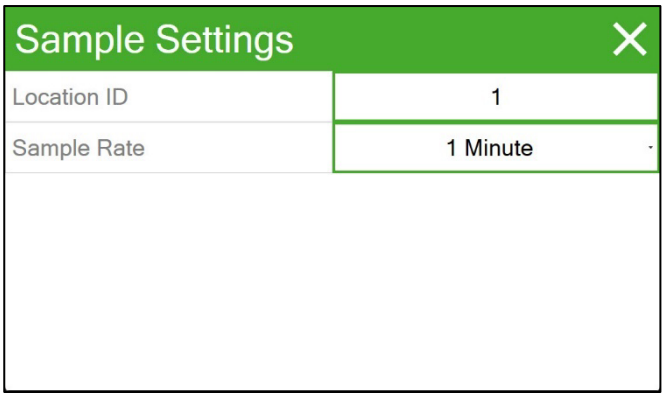


Figure 4-13 Sample Settings Configuration

To set the Location ID, Press the box outlined in green to the right of "Location ID." See **Section 4.2.3.1** below for further instructions.

To set the Sample Rate, press on the box outlined in green next to "Sample Rate". See **Section 4.2.3.2** below for further instructions.

4.2.3.1 Location ID Configuration

After the green box next to "Location ID" is pressed, the Location ID input screen will appear with a numerical keypad. Press any combination of numbers from 1 to 999. Press OK to save the new ID.

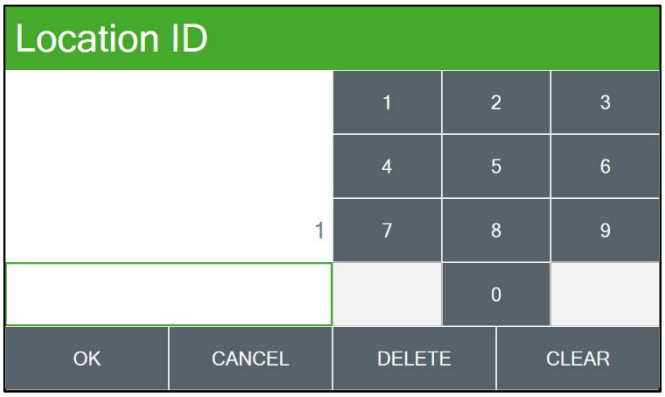


Figure 4-14 Location ID Input Screen

4.2.3.2 Sample Rate Configuration

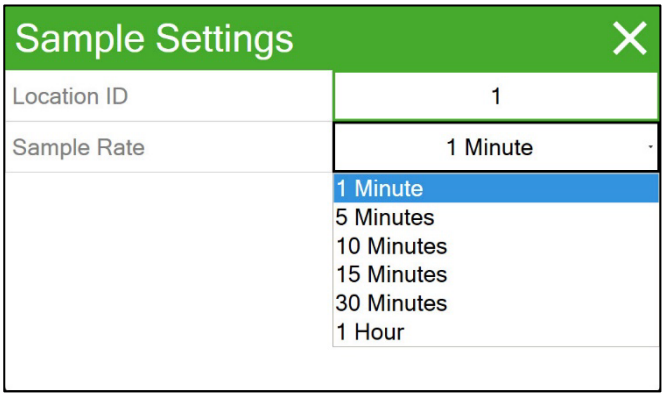


Figure 4-15 Sample Rate Drop Down List

After the green outlined box next to Sample Rate is selected, a drop-down options list will appear.

Select the preferred sample rate from the drop-down list by pressing on that option. The selected option will automatically be saved.

4.2.4 Tape System Configuration and Setup

This section provides instructions for setting the Tape Period, Spot Advance, Use Loading, Load Level and Load Carbon Channel in the TAPE SETTINGS screen.

Tape Settings screen location: Side Menu Pane>Settings>Tape.

The TAPE PERIOD setting is the time interval at which the filter tape automatically advances to a fresh spot.

When set to AUTO, the unit will advance the tape spot based only on the filter loading threshold. The default operational mode is AUTO tape advance on the UV filter loading threshold.

The interval can be set to 1, 2, 3, 4, 6, 8, 12, or 24 hours (independent of filter loading). With a fixed time interval, the tape will advance at the top of the respective hour demarcation.

Example: If Tape Period set to six-hour tape advances, tape moves will occur at 0:00, 06:00, 12:00, and 18:00.

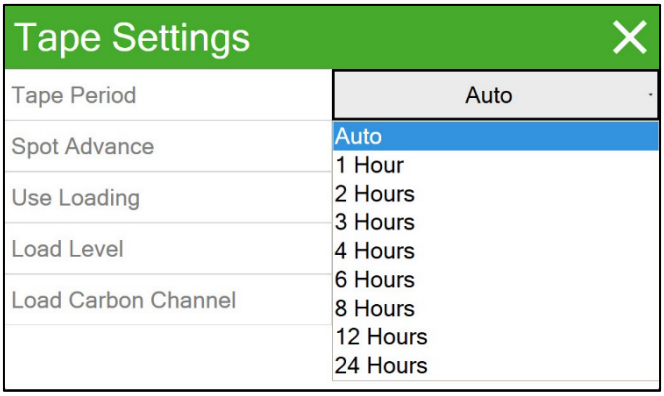


Figure 4-16 Tape Settings Screen

There may be additional tape advances if the loading threshold is reached before the timed tape advance time is reached. In such cases, the timed tape advance will still occur at the scheduled time interval. If frequent tape advancements occur due to particulate loading on the filter tape, it is recommended to set the flow rate to 2 LPM or use a Dilution Flow System.

NOTE: The appropriately designated cyclone must be used to match the set flow rate for flow characteristics.

NOTE: The BC 1054 Tape Period should be set to "AUTO" for normal operation. Data may be invalid or only used for testing purposes if the Tape Period is set to anything other than "AUTO."

The SPOT ADVANCE setting is used to determine how many filter spots are advanced when the tape moves. The default setting is "1", and the resulting dirty filter spots will be closely spaced. When the setting is set to "2", the unit will leave an extra blank spot between the used spots. This setting should be left at "1" unless the local monitoring requirements mandate wider spacing.

NOTE: USE LOADING, LOAD LEVEL AND LOAD CARBON CHANNEL should be left at the default settings for standard operations.

4.2.4.1 Filter Tape Installation

NOTE: If this section is being referenced to replace a used roll of filter tape with a new roll, ensure that sampling is stopped, and the nozzle is in the up position.

1. Turn the instrument ON. Press the STOP button to prevent the instrument from entering SAMPLE mode. The optical measurement head will raise automatically. To re-set the Tape Remaining Counter, enter the TEST MENU/LOAD TAPE menu (see **Section 3.5.4.1**). If necessary, the optical measurement head can be manually raised and lowered from this same menu.
2. Flip down the tape load access door. Loosen and remove the two tape reel knobs and remove the clear reel covers.

Instructions for removing used filter tape and installing a new roll of filter tape.

   a. Remove the cardboard core from the supply reel and discard it.
   b. Remove the full core from the take-up reel.
   c. Remove the used filter tape from the current plastic core tube and discard. replace the empty core tube back on the take-up reel.

3. Install the new filter tape roll onto the supply reel on the left, with the tape feeding off the left side of the roll.

NOTE: A gray plastic core is installed on the take-up reel from the factory on new units and can be used for collecting used filter tape. This core can be reused by removing used filter tape. Install the core back on the take-up reel to use again.

4. Route the filter tape exactly as shown in **Figure 4-17**.
   a. Route the tape under the black idler roller
   b. Through the slot in the measurement head cover
   c. Under the other black idler
   d. Up over the knurled encoder drum
   e. Down to the take-up reel on the right side.

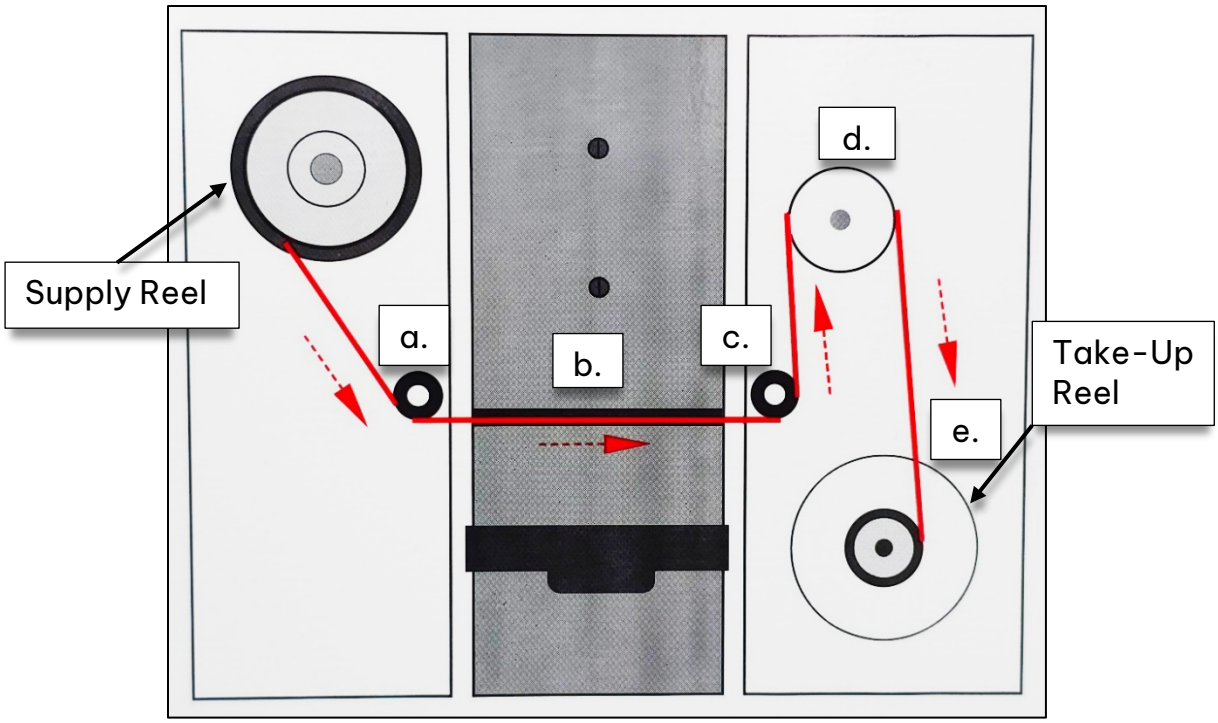


Figure 4-17 Filter Tape Routing

5. Center the Filter tape on the take-up reel and fasten the loose end of the filter tape to the right side of the empty core tube on the take-up reel with cellophane tape. **Make sure that the softer side is facing UP** and the textured side is facing **DOWN**.
6. Take up the filter tape slack by turning the left (Supply) reel. Reinstall the reel covers and flip up the Tape Load Access Door.
7. Enter the TEST MENU/TAPE TEST screen.
8. Press the MOVE button at the bottom right corner of the screen. Verify that the tape spools correctly.
9. Advance at least one turn of filter tape over the take-up core and return to the home screen.

4.2.5 Digital Sensor Configuration

This section describes how to use the DIGITAL LINK TEST Screen. The BC 1054 must have a BX-597A sensor connected and properly configured for operation. If the sensor is not present, the unit will not begin sampling.

This section describes the process for configuring the BC 1054 to receive data from digital sensors.

Digital Link Test screen location: Side Menu Pane>Tests>Digital Link.

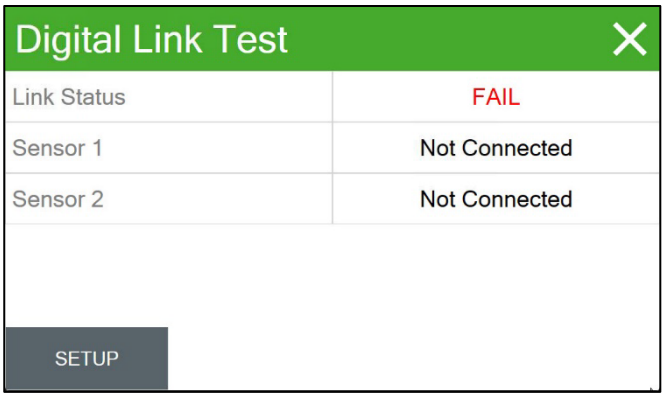


Figure 4-18 Digital Link Test FAIL

When the Digital Link Test screen opens, "Link Status" may show "FAIL" but should change to "OK" within about two seconds if the sensor connection leads are secured in the correct terminal location.

See Chapter **6 MAINTENANCE and TROUBLESHOOTING** if Link Status continues to show FAIL.

Press the SETUP button in the lower left corner of the screen to access the DIGITAL LINK TEST screen.

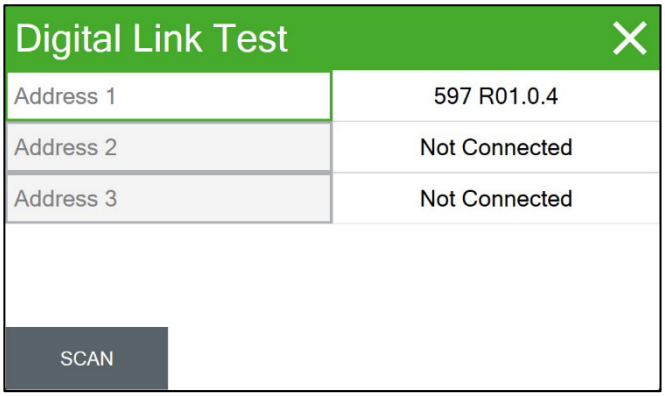


Figure 4-19 Digital Link Test Setup Screen

The Digital Link Test screen displays sensor address, sensor type, and sensor firmware.

This screen is used to confirm all connected digital sensors are responding and reporting to the BC 1054.

This screen is also used to scan for aditional sensors that do not automatically populate; and to assign an addresses to each additonal sensor, if needed.

Address 1 is the master sensor.

Address 2 is the reference sensors.

WARNING: If the reference sensor is displayed in Address 2 for a moment and then shows "Not Connected", it may be set to Address 1 and is conflicting with the master sensor. Disconnect the master sensor or disconnect the sensor power wire from the back of the instrument. If the reference sensor is now displayed in Address 1. Press on the Address 1 box outlined in green to change the address.

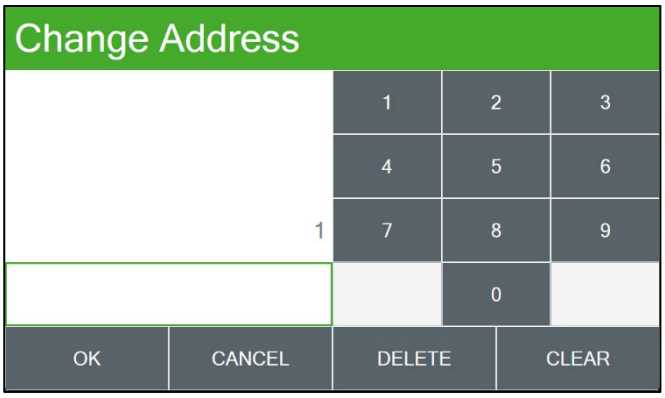


Figure 4-20 Change Sensor Adress Screen

Set to Address 2 by pressing on the 2 Key and press OK.

The reference sensor should now be displaying in the Address 2 Field.

Plug the master sensor back in (or re-apply power) and confirm that the master is now displayed as Address 1 and the reference sensor is displayed as Address 2.

Press the X at the top right corner to go back to the main Digital Link Test screen to confirm all connections (See **Figure 4-22**)

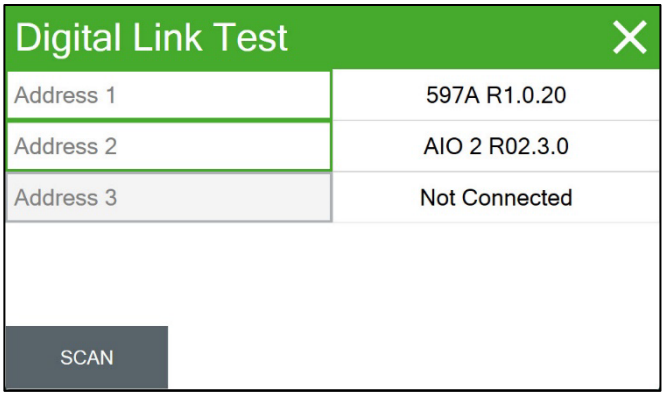


Figure 4-21 Digital Link Setup, Two Sensors

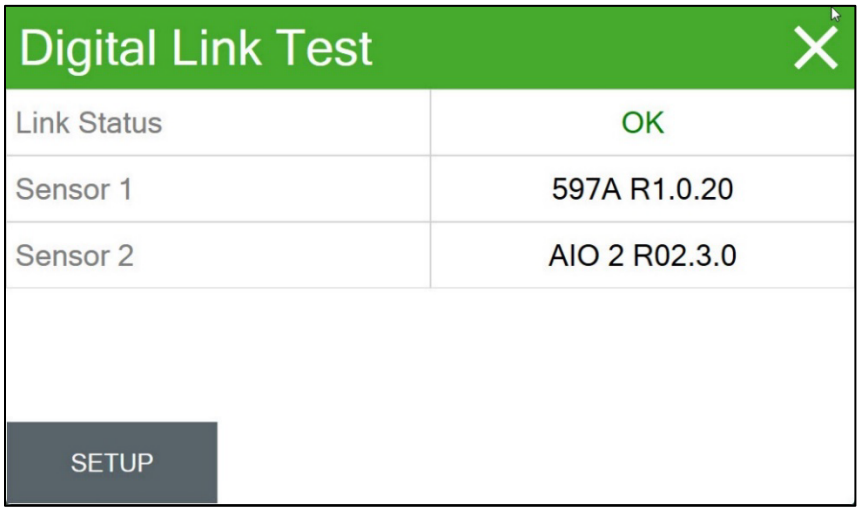


Figure 4-22 Digital Link Test Confirmation

4.2.6 Flow Configuration

The BC 1054 can be configured with the standard flow system or accompanied by a dilution flow system for higher-concentration environments. The sections below describe how to configure both types of flow systems.

The FLOW menu location: Side Menu Selection Pane>Settings>Flow.

4.2.6.1 Standard Flow System Configuration

The flow rate may be set to either 2 or 5 LPM and **must** match the flow rate required by the attached $PM_{2.5}$ or PM_1 cyclone. The factory default is 2 LPM for areas with heavy concentrations to reduce tape movement frequency due to filter loading. When switching between 5 lpm and 2 lpm, the flow must be re-calibrated.

As stated above, the BC 1054 standard flow configuration is set to 2 LPM for high-concentration environments.

Set to 5 LPM by pressing on the green outlined box next to “Flow Rate”, a list of options will drop down.
Select 5 LPM, the list will close, and the setting will be saved automatically.

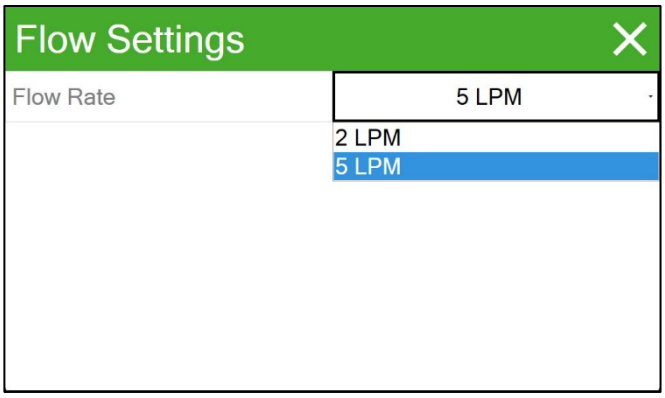


Figure 4-23 Flow Settings Dropdown Options

4.2.6.2 Dilution Flow System Configuration

BC 1054 units sampling extremely high concentrations should utilize a dilution flow system. When installed, the flow system is activated automatically. When a dilution flow system is installed and connected to the BC 1054, the flow rate is automatically set to 2 LPM. **A 2 LPM cyclone is built into the dilution flow system.**

NOTE: If a cyclone is connected to the sample inlet, remove it before connecting the dilution flow system.

NOTE: The dilution flow system needs to be calibrated after installation.

The dilution flow system can be set with three different control options.

To select the desired dilution control setting, press on the green outlined box next to “Dilution Control.”

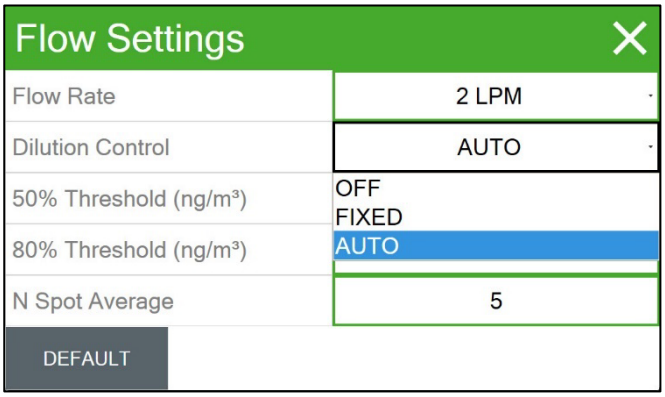


Figure 4-24 Flow Settings Dilution Control Options

A dropdown list will appear with the following options:

OFF: The dilution flow system is off, and the flow rate is set to 2 LPM.

FIXED: See **Figure 4-25** description.

AUTO: See **Figure 4-26** description.

Select an option from the dropdown list by pressing on that option. When pressed, the list will disappear. The selection will automatically be saved.

Selecting "FIXED" control will provide a dropdown list of user-selectable fixed dilution flow percentages.

To make a selection, press on the green outlined box next to "Dilution Percent"; a dropdown list will appear with available options.

Press on the preferred option in the dropdown list. When selected, the list will close, saving the selected option.

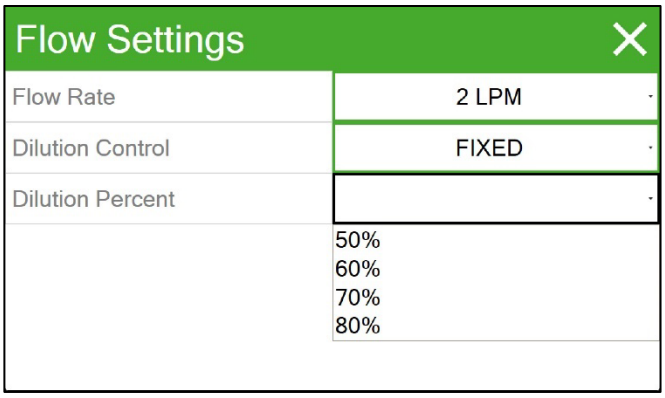


Figure 4-25 Fixed Dilution Flow Control

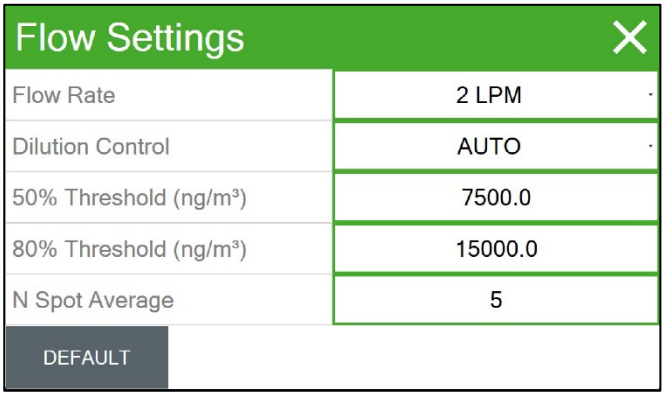


Figure 4-26 Auto Dilution Flow Control

Selecting "AUTO" control provides three customizable settings for when the dilution flow system is activated during high-concentration events.

50% Threshold: Set the concentration level for the system to activate at 50% dilution.
80% Threshold: Set the concentration level for the system to activate at 80% dilution.

N Spot Average: The number of Spots with an average concentration at, or above, the user-specified threshold to activate the dilution system.

To set the threshold options and N Spot Average, Press on the green outlined box next to the setting label. A numerical input pad will appear; set the desired concentration threshold and press OK to save. The same operation can be performed to set the N Spot Average.

4.2.7 Heater Configuration

The HEATER SETTINGS screen provides a means of adjusting the set points of the sample inlet heater and internal box heater.

The FLOW TEMPERATURE and BOX TEMPERATURE range is between 25 °C and 40 °C.

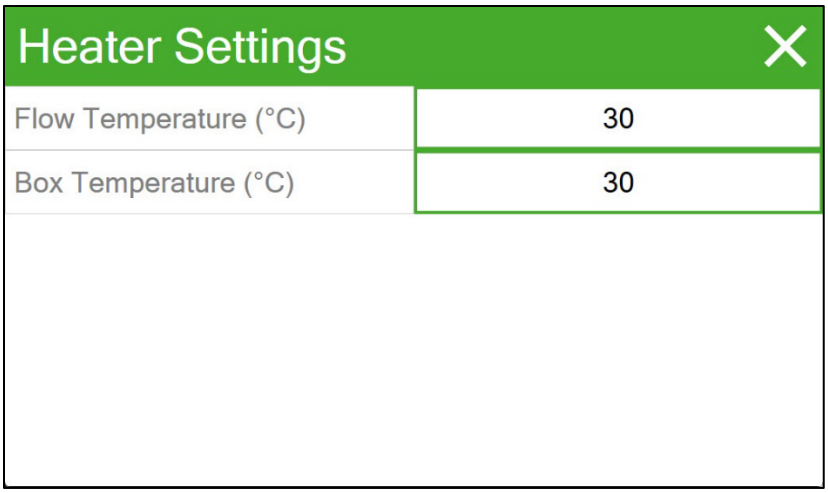


Figure 4-27 Heater Settings Main

FLOW TEMP: The temperature of the sample air after it has passed through the inlet heater and the optical measurement head.

- This temperature should be set to ~10 °C above the maximum ambient temperature in high RH conditions. It should be noted that raising the temperature of 100% RH air 10 °C will reduce the RH saturation to approximately 60% RH.

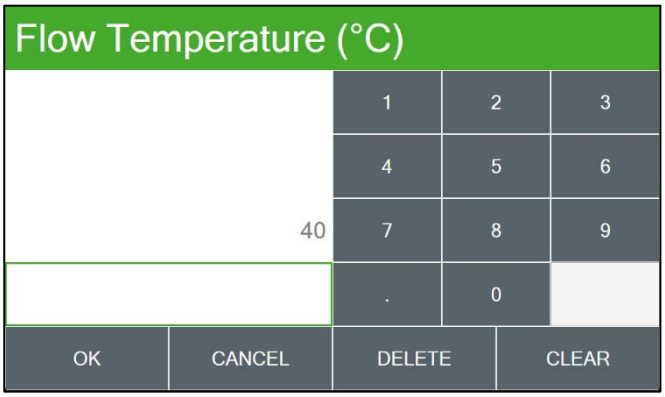


Figure 4-28 Flow Temperature Input Screen

Set the Flow Heater activation temperature by pressing on the green outlined box next to "Flow Temperature," shown in **Figure 4-27**.

Use the numerical keypad to input the required value and press OK to save.

BOX TEMP: The target set point for the internal temperature of the box.

- This is a heat-only temperature control, so the temperature inside the box cannot be cooled below ambient temperatures. The default value for BOX TEMP is 30 °C.

Set the Box Heater activation temperature by pressing on the green outlined box next to "Box Temperature," shown in **Figure 4-27**.

Use the numerical keypad to input the required value and press OK to save.

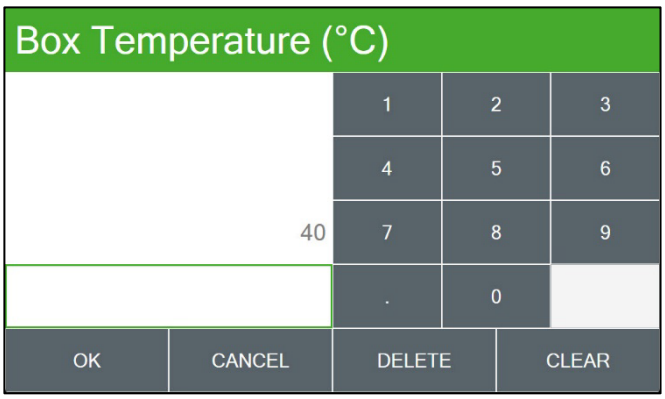


Figure 4-29 Box Temperature Input Screen

4.3 *Communication Settings*

The BC 1054 can be configured to have its data polled over a network connection if available at the sample site. This section describes the procedures for setting serial port and ethernet communication settings.

4.3.1 USB Communications

BC 1054 monitors include a USB COMM (Type B) port located at the back panel, indicated by the orange outline, below in **Figure 4-30**.

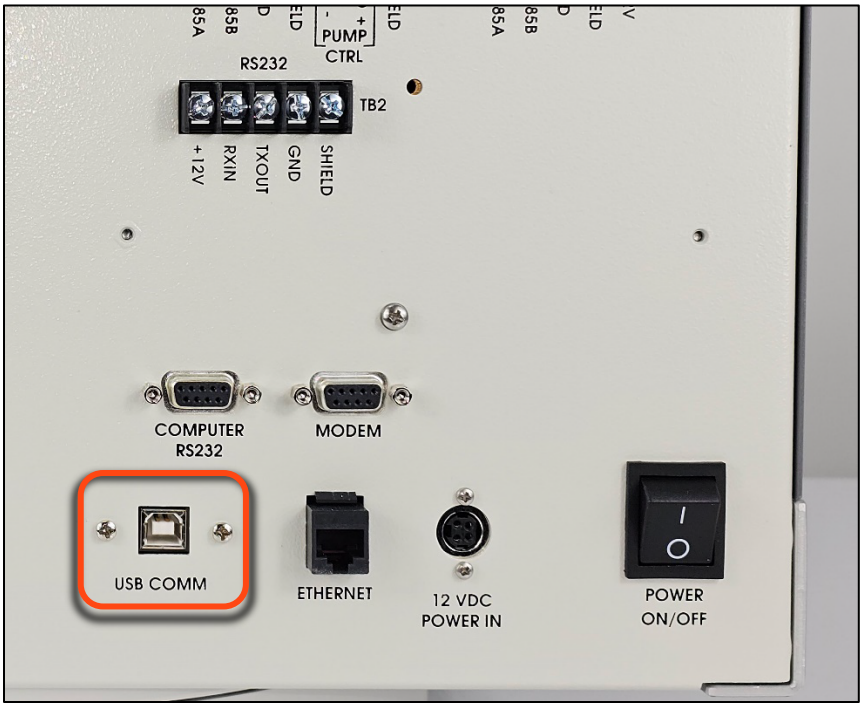


Figure 4-30 USB Type B Port (Rear Pannel)

WARNING: The USB COMM port requires the Silicon Labs CP210x Driver to be installed on the computer, intended to be connected to the BC 1054, before use.

Driver download weblink: https://www.silabs.com/products/development-tools/software/usb-to-uartbridge-vcp-drivers

4.3.2 Serial Port Configuration

The SERIAL PORT SETTINGS screen is shown below, in **Figure 4-31**. These settings affect the configuration for the "COMPUTER RS232."

Serial Port Settings screen location: Side Menu Pane>Settings>General Settings>Serial Port.

The default settings are 9600 (Baud Rate) and NONE (Flow Control).

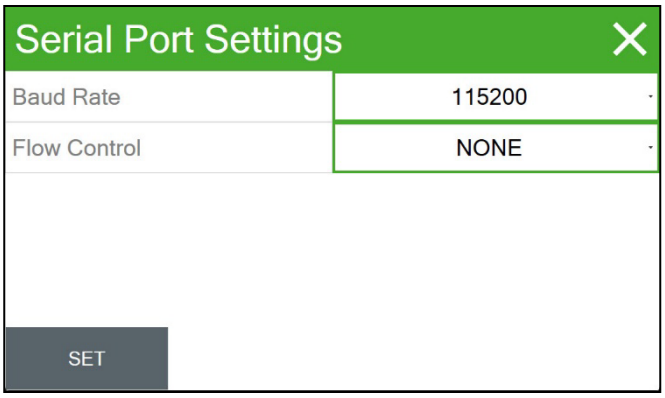


Figure 4-31 Serial Port Settings Screen, Main

The BAUD RATE setting is the data transfer rate for the serial data output. Downloading large data files will take longer at low baud rates, so set it to the fastest rate supported by the data collection system.

The FLOW CONTROL setting is set to NONE for most standard RS-232 serial port applications.

To set the Baud Rate, press on the green outlined box next to "Baud Rate." A dropdown options list will provide all the Baud Rate setting options.
Press on one of the numerical options to make a selection. The dropdown list will close, and the chosen setting will be displayed.

The value can be set to 300,600 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 baud.

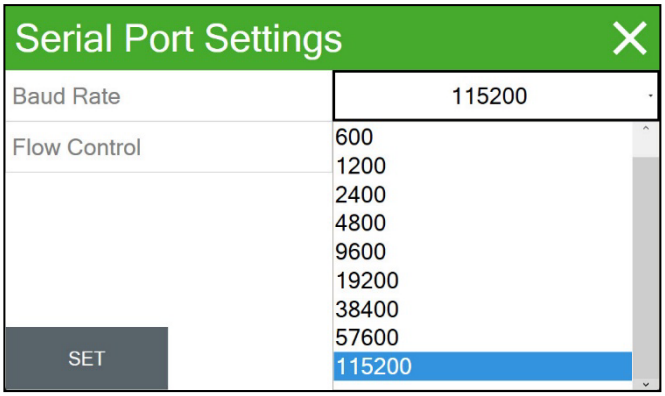


Figure 4-32 Baud Rate Dropdown List.

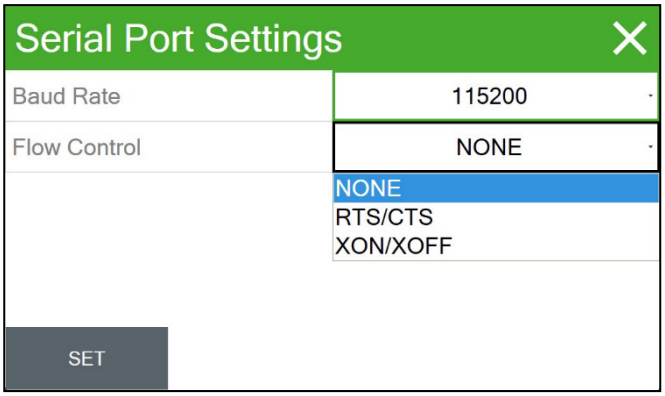


Figure 4-33 Flow Control Dropdown List

The Flow Control setting should be left at NONE except for special circumstances specified by the owner's IT department.

4.3.3 Ethernet Configuration

Ethernet Configuration is used to set the IP Address, Subnet Mask, and Gateway to allow the BC 1054 to communicate on a local area network using a standard Ethernet cable connection to a switch or router. It is recommended to set the IP address config to **STATIC.** The static IP address needs to be provided by the instrument owner's IT department.

Ethernet Config screen location: Side Menu Pane>Settings>General Settings>Ethernet.

4.3.3.1 Ethernet Cable Connection

Figure 4-34 Ethernet Connection Port shows the location of the ethernet port at the back of the BC 1054. This is where the ethernet cable needs to be connected to use the instrument's networking capabilities.

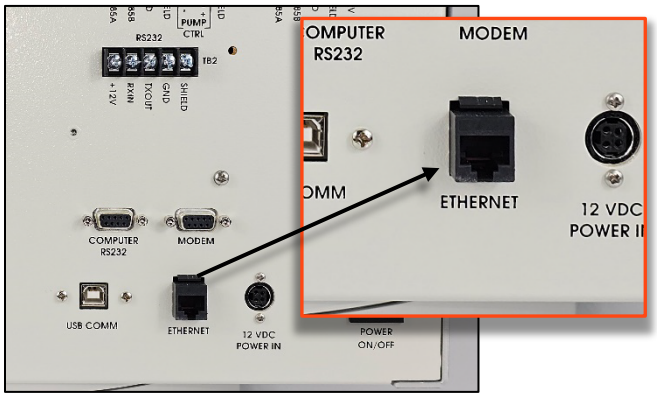


Figure 4-34 Ethernet Connection Port

4.3.3.2 Auto IP Configuration.

To set the IP address Config, press on the green outlined box next to IP Address Config. to activate the dropdown options list. There are two options in the list, AUTO and STATIC. Select one by pressing on an option. The dropdown list will close, and the selection will now show in the box.

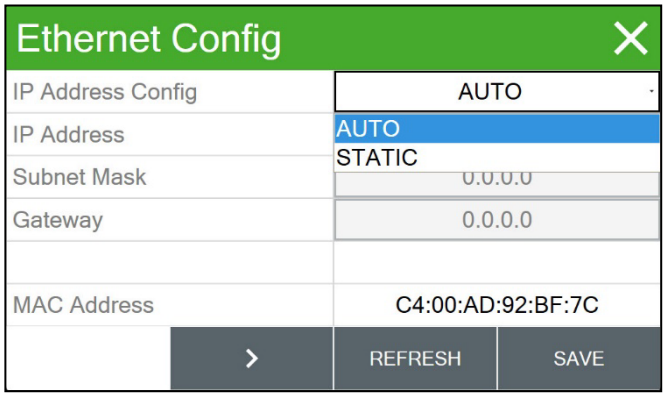


Figure 4-35 IP Config Dropdown

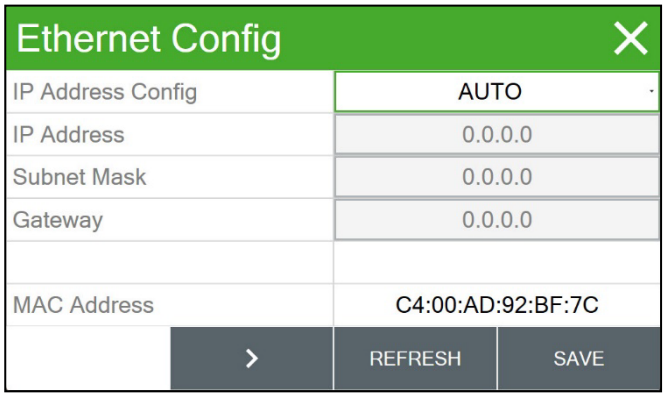


Figure 4-36 IP Config Auto

The AUTO selection will cause the instrument to be assigned a dynamic IP address, provided by the network. The IP Address Subnet Mask, and Gateway will automatically populate.

The AUTO setting is not recommended for long-term remote use.

To populate the IP address, Subnet Mask, and Gateway, press the REFRESH button at the bottom of the screen. The ethernet config. information will populate and automatically save.

4.3.3.3 Static IP Configuration

This selection allows the user to manually set a STATIC IP address, Subnet Mask, and Gateway. This information needs to be provided by the network administrator or authorized IT department personnel.

The STATIC setting is recommended for long-term remote use.

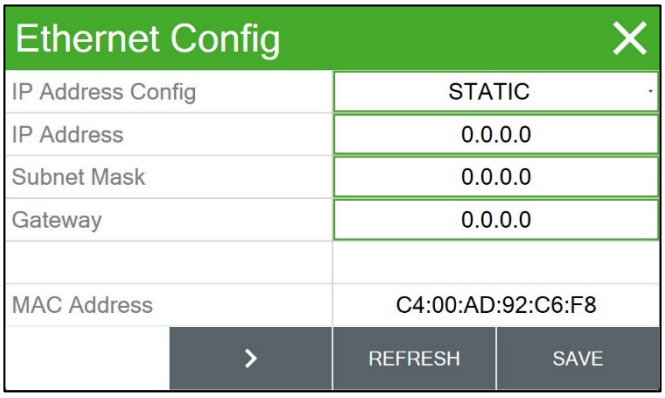


Figure 4-37 Static IP Config Screen

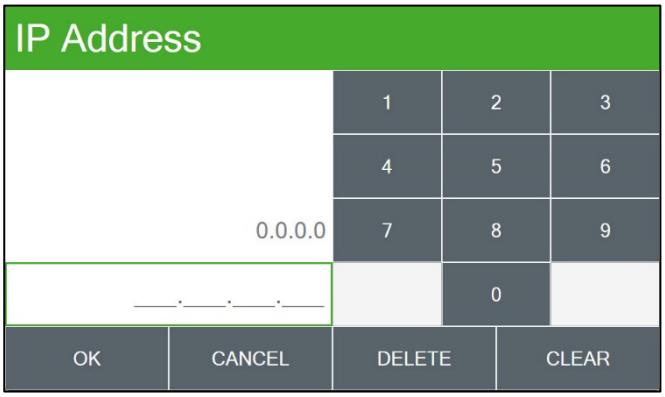


Figure 4-38 Static IP Input Screen

Press the green box next to the IP Address to access the IP input screen.

Use the numerical Keypad to type in the static IP address.

Press OK to save the entry.

Repeat the steps above to set the Subnet Mask and Gateway.

When the Static IP address, Subnet Mask and Gateway are set, press the save button at the bottom right corner of the Ethernet Config screen as shown by **Figure 4-37 Static IP Config Screen**.

4.3.3.4 DNS Configuration

The DNS Config screen is for advanced networking purposes only and should be configured by an experienced networking professional.

If these settings need to be changed, contact the local IT department.

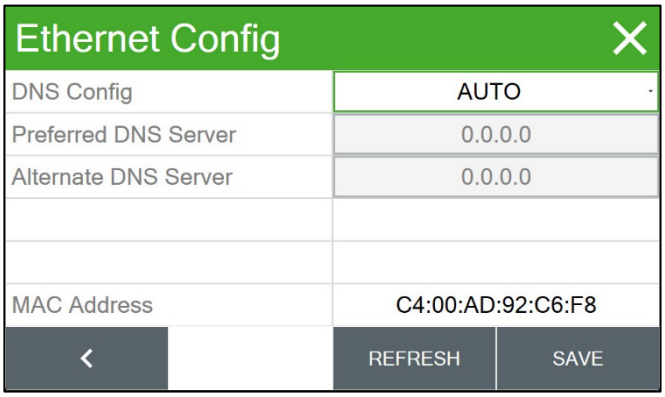


Figure 4-39 DNS Config Screen

5. BC 1054 OPERATING PROCEDURES

This section explains the initial startup procedures, how to start and stop samples and the system warmup procedure.

IMPORTANT: The BC 1054 is sold calibrated, but it is recommended to calibrate the ambient (BX-597A) sensor and flow sensor (see Section 6.5) before deployment.

5.1 *Initial Startup*

The steps in this section should be performed for the initial startup or after moving the BC 1054 to a different sample site location.

5.1.1 System Verification

It is vital to perform a system verification check before operating the BC 1054 to ensure that all major systems function properly.

5.1.1.1 Self Test

As stated in **Section 3.5.4.2 Self Test Screen**, the Self Test function is used to activate an automatic test of most of the BC 1054 subsystems in order to verify that the instrument is in operational condition.

If all four function tests pass, continue to the sections below.

If any of the function tests fail, see the appropriate section in **Chapter 6 MAINTENANCE and TROUBLESHOOTING** to diagnose and correct the issue.

5.1.1.2 Ambient Sensor Calibration

See **Section 6.5.1 BX-597A Digital Ambient Sensor Field Calibration** for this procedure.

5.1.1.3 Flow System Test and Calibration

See **Section 6.4.3 BC 1054 Flow System** for the flow audit procedure.

5.1.1.4 Flow Calibration

See **Section 6.5.2 Sample Flow Sensor Field Calibration** for the flow calibration procedure.

5.2 *Starting and Stopping a Sample*

This section explains the process for starting a sample run, the warmup period and stopping or pausing a sample.

When the back panel power switch is turned on, the BC 1054 will boot up and display a splash screen identifying the instrument.

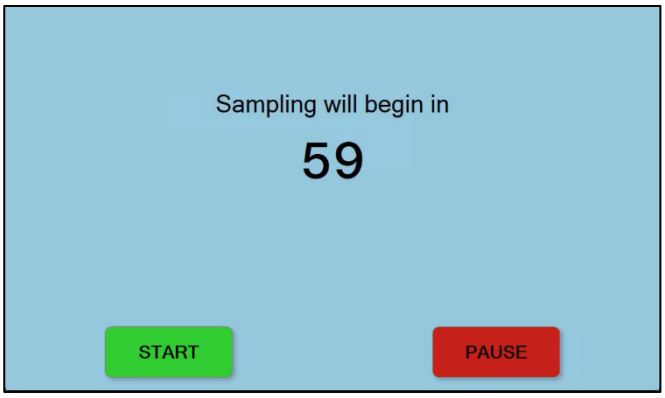


Figure 5-1 Start Sample Count Down Screen

After three seconds, a timer will display indicating that sampling will begin in sixty seconds. The timer counts down from sixty seconds in one second intervals.

5.2.1 Starting a Sample

The BC 1054 will automatically start sampling approximately two minutes after being turned on. To start sampling immediately after powering on the instrument, press the green START button (bottom left) during the sixty second count down. To temporarily cancel the initiation sequence and enter the Main Menu, press the PAUSE button (bottom right) on the screen before the sixty second countdown expires. After 30 minutes of inactivity, the unit will automatically resume sampling.

If sampling has been stopped and needs to be started, press the green ▶ START button in the upper right corner of the home screen. When pressed, the sample initiation process will begin. Sampling will start at the top of the next minute.

This button will turn red and become the STOP sample button during sampling.

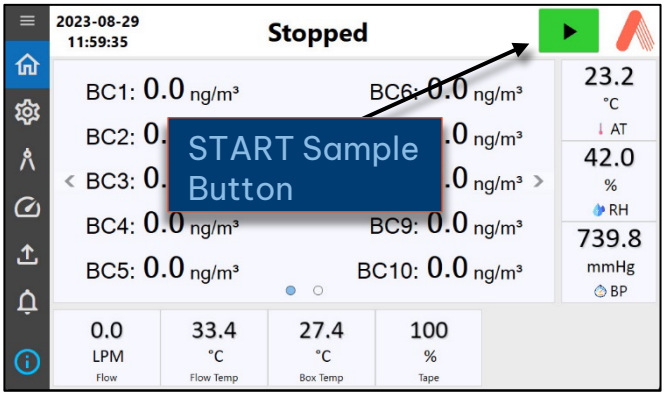


Figure 5-2 Start Sample, Home Screen.

5.2.2 Warmup Period

After powering up and sampling has begun, the BC 1054 takes three to five hours to warm up and equilibrate before optimal measurement stability is achieved. The BC 1054 carbon monitor is factory configured with an array of default settings that the operator may consider changing before deployment.

WARNING: It is essential for the instrument to fully warm up and systems equilibrate before performing any audits, calibrations, or sampling.

5.2.3 Stopping a Sample

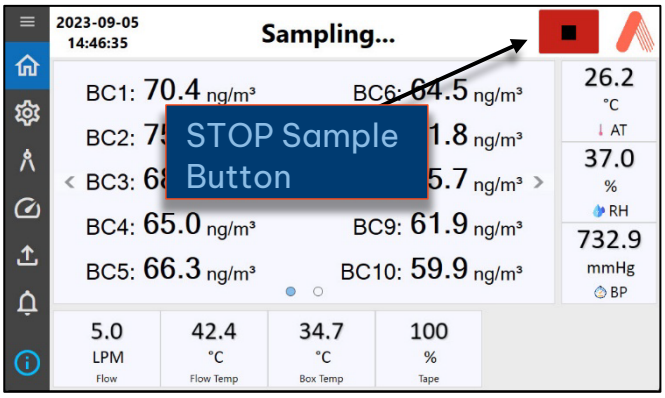


Figure 5-3 Stop Sample, Home Screen

The BC 1054 is a continuous measurement instrument. To stop the BC 1054's current sample, press on the red ■ STOP Sample button in the upper right corner of the Home screen.

When the STOP sample option in the Home screen is selected, the BC 1054 will ask the user to confirm if the sample should be stopped. If confirmed, the BC 1054 will continue its last sample. Once the sample has finished the BC 1054 will then move the tape to a clean spot. After moving the tape to the next clean spot, the BC 1054 will continue measuring for another 11 samples. These 11 records allow the BC 1054 to apply the correction algorithm to the previous data so that the measurement readings are reported with corrected concentrations.

6. MAINTENANCE and TROUBLESHOOTING

This section provides information about routine maintenance of the BC 1054, and for performing more detailed diagnostic tests if a problem is encountered. The instrument generates error messages on the display or in the data log if a failure or other problem is detected. Many times, there is a simple solution. Persistent errors often signify a failure that will require investigation.

6.1 *Recommended Periodic Maintenance*

Table 6-1 BC 1054 Maintenance Schedule shows the Met One Instruments recommended periods for routine maintenance items. Some of these items will need to be performed more often depending on local conditions. Local monitoring program administrators may need to review these items and establish SOPs appropriate for local applications.

Table 6-1 BC 1054 Maintenance Schedule

Maintenance Item	Minimum Period
Replace filter tape	As Required (2-12 Months Typical)
Temperature, pressure, and flow audits	2 Months
Span check	2 Months
Clean inlet particle traps (cyclone)	2 Months
Disassemble and clean cyclone assembly	3 Months
Replace cyclone O-rings	As Required
Leak test	2 Months
Flow, temperature, and pressure full calibrations	As Required
Clean the debris filter	1 Year
Replace dilution system cartridge filter	3 Years
Rebuild external pump	As Required
Replace dilution system pump	As Required
Replace dilution system flow sensor	As Required
Factory service	As Required

6.1.1 Factory Service

Factory service primarily consists of optical system cleaning, optics/detector checks, and a calibration check (and recalibration if needed) against a factory standard. As-found calibration checks can also be requested. Contact the Met One technical service department to schedule service. A Return Authorization number must be obtained before the unit is returned. See **Section 1.2** for Met One contact details.

6.2 *BC 1054 Error and Alarm Event Descriptions*

The BC 1054 contains a system of error and alarm codes that are used to alert the operator to any problems with the unit. The errors appear on the display and are stored in the digital alarm log with the time and type of the error. Corresponding alarm codes are stored in the data array.

The Alarm field is reported in data files by a numeric code. If multiple alarms are generated for a single data record, the reported alarm value is the sum of the alarm codes. The general alarm events are described in **Table 6-2**. Certain alarm events may not be posted to the data array if an alarm condition terminates operation before the end of a sample. Please consult the Alarm Log for more detailed information when an error is encountered.

WARNING: Before performing any services that require disassembly of the BC 1054, turn off and unplug the instrument from power.

Table 6-2 Alarm Codes

Code	Description	Causes	Corrective action
0	**No Alarm**	System fully functional	None
1	**Power Failure**	Caused by a power cycle or a microprocessor reset.	Power off/on event logged. Ensure unit is provided with stable power.
2	**Digital Sensor Link Failure**	Digital sensor link failure after 10 seconds of no communication with the BX-597A sensor.	1. Ensure the BX-597A sensor connection on back of BC 1054 is correct. 2. Ensure the BX-597A sensor connector is plugged in securely on bottom of BX-597A. 3. Possible bad BX-597A. Obtain factory replacement.
4	**Tape Move Failure**	1. Filter Tape roll is spent. 2. Filter Tape break. 3. Filter Tape loose, not turning encoder. 4. Encoder wheel turns, but not measuring filter tape movement.	1. Install new roll of filter tape. 2. Re-attach tape to take-up spool. 3. Raise nozzle, tighten tape so it's in contact with encoder wheel. 4. Optical encoder fault. Refer to qualified service technician.
8	**Maintenance**	Stop for maintenance during normal operation.	"Stop Sample" logged. Not an error condition.

16	**Flow Failure**	Failure when the flow is less than 1.0 LPM for greater than one minute, when the flow is 10% out of regulation for more than one minute, or when the flow is 5% out of regulation for more than five minutes. 1. Flow controller out of position. 2. Inlet hose kinked or other blockage on inlet. 3. Debris filter clogged. 4. Bad/failed pump. 5. Bad flow sensor or flow controller.	1. Perform flow audit and allow flow controller to regulate flow. 2. Un-kink hose or remove blockage, clean cyclone, clean TSP head, replace inlet tubing. 3. Clean or replace debris filter. 4. Replace pump and re-calibrate flow. 5. Replace flow system (82322-1) and re-calibrate flow.
32	**Automatic Tape Advance**	The tape was advanced because of tape loading. Scheduled tape advances do not generate this notice.	Automatic tape advance logged. Not an error condition.
64	**Detector Failure**	1. Incorrect Filter tape install. 2. Blocked Reference or Sample port. 3. Light leak. 4. Hardware Failure.	1. Verify tape is installed correctly. 2. Clear obstructions in the port below the tape (Sample detector window) or Reference port. 3. Ensure door is closed and light shield is properly installed. 4. Refer to qualified service technician.
128	**N/A**	**N/A**	**N/A**
256	**Sensor Range**	A sensor is outside its designated limits. Check error log for abbreviation WS, WD, AT, RH, BP, FLOW, DFLOW, LED T, or DET T.	1. Default and re-calibrate sensors. 2. AIO equipped: if WS, WD, AT, RH or BP, replace AIO. 3. BX-597A equipped: if AT, RH or BP, replace BX-597A. 4. If FLOW, DFLOW, LED T, DET T refer to qualified service technician.

512	**Nozzle Move Failure**	Set when nozzle failed to move up or down.	1. Lift motor not turning: Verify connection in cable. 2. Lift motor turning, lift arm not moving: Lift bearing slipping on shaft, or shaft broken. Refer to qualified service technician. 3. Lift motor turning, lift arm moving, nozzle not moving: lift bearing broken. Refer to qualified service technician. 4. "UP" and/or "DOWN" opto not functioning. Refer to qualified service technician.
2048	**Calibration Audit**	A user Calibration Audit was being performed.	Calibration Audit activity logged. Not an error condition.
65536	**Tape Move**	System advances the filter tape.	Tape advance logged. Not an error condition.

Detector Alarm Events: The detector alarm events are detailed in **Table 6-3**. Any detector failure event will stop machine operation, force a tape advance, and then attempt to resume normal sampling. Detector *warnings* will be logged, but will not interrupt operation. The IR and UV detector ranges are 0.0 to 2500 mV. The limits are as follows:

Saturation Limit = 2450 Detector Limit = 100 Zero Limit = 20 mV

Table 6-3 Detector Failure Alarms

Description	Causes
LED Failure	While an LED is ON, the signal and reference detector readings are below the Detector Limit.
Signal Detector Failure	While LED 1 is ON, the signal detector reading is below the Detector Limit and reference detector reading is above the Detector Limit.
Reference Detector Failure	While LED 1 is ON, the signal detector reading is above the Detector Limit and reference detector reading is below the Detector Limit.
Signal Zero Warning	When the signal zero is above the Zero Limit.
Reference Zero Warning	When the reference zero is above the Zero Limit.
Signal High Failure	When any of the LED Signal readings is above the Saturation Limit.
Reference High Failure	When any of the LED Reference reading is above the Saturation Limit.

See **Section 6.5.5** for more information about calibrating the LEDs.

Sensor Outside Range Alarm Events: This alarm occurs if one of the BX-597A sensor parameters registers a value outside of its measurement range, indicating a possible sensor failure. It is intended to filter out and catch full scale readings which can occur from the ambient sensors.

Table 6-4 Sensor Out of Range Alarms

Sensor	Minimum	Maximum
AT Sensor	-60.0 C	80.0 C
BP Sensor	400 mbar	1200 mbar

6.3 *Basic Problem Causes/Solutions*

The following table contains information on some of the more common BC 1054 problems that may be encountered, and some steps to identify and remedy the problems. Met One Instruments welcomes user suggestions for new items to include in this section of future manual revisions.

Table 6-5 Common Problems and Solutions

Problem:	**The instrument doesn't appear to be turning on or starting.**
Cause/Solution:	• Confirm the power supply and power cord are properly connected to a good electrical outlet. • Confirm the power switch on the back panel is in the ON position. • If the instrument is ON, the hum of the internal heater circulation fan should be audible. • The touch-screen display should come on any time power is applied, and power switch is in the ON position. • The BC 1054 should start sampling within two minute after power-up. • After using the STOP SAMPLE function, sampling will resume after 30 minutes. • The display will go dark after 30 min of inactivity. Touch the screen to activate the display.

Problem:	**Flow failures or low flow.**
Cause/Solution:	• Make sure the pump exhaust is not blocked. • Make sure that the tape is properly advancing the dirty spots. • DEFAULT the flow sensor calibrations and re-calibrate the flow. If corrupted flow calibration parameters are entered into the flow calibration, it may appear that the flow system is not working. • Verify the AT and BP sensor function. Failed ambient sensors will affect the flow. • Check the internal debris filter. If it is clogged, remove and clean (or replace) the filter element. • The sample pump itself will eventually wear out and need to be rebuilt or replaced. It should last at least two years under normal conditions.

Problem:	Leak check failures
Cause/Solution:	• There is always a small amount of leakage at the filter tape interface. • Make sure the upper and lower nozzles are completely clean. • Check the push-to-connect tubing fittings inside the instrument. • The filter tape can be replaced with a small rubber sheet with a small hole positioned under the nozzle. This will eliminate the tape as the leak point to help isolate the leak source. Note: nothing down-stream of the flow sensor is leak tested during the standard leak test procedure.

Problem:	Optical system alarms and failures
Cause/Solution:	• A Detector Failure will occur if no filter tape is installed in the measurement head. • Detector Failure will occur if an LED has failed, if either the Reference or Signal Detectors have failed or if there is a ZERO failure (high background). First, ensure filter tape is properly installed and covers are correctly installed. • Check for obstruction in the port below the tape above the detector window.

Problem:	Calibration Audit failures
Cause/Solution:	• A Calibration Audit Failure can occur if the filter tape is moved during the Calibration Audit procedure. Care should be exercised to not move or damage the tape when performing the calibration audit. • A Calibration Audit Failure can occur if the Calibration Audit Membrane (81947-3) is inserted incorrectly. The Membrane should be fully seated against the back plate with the forks centered in the slot and the open hole on the LEFT. • A Calibration Audit Failure can occur if too much ambient light is allowed to enter the instrument during the process. Ensure the instrument shroud cover is ON and the door is closed during both the zero and ND Filter stages of the audit. • A Calibration Audit Failure can occur if the ND filter membrane in the 81947-3 span check membrane is damaged. A replacement 81947-3 membrane can be purchased from the Met One Instruments Service Department.

6.4 *System Maintenance*

6.4.1 Nozzle Cleaning

The tape interface nozzles in the optical measurement head should be checked and cleaned on a routine basis, to prevent flow leaks at the filter tape interface.

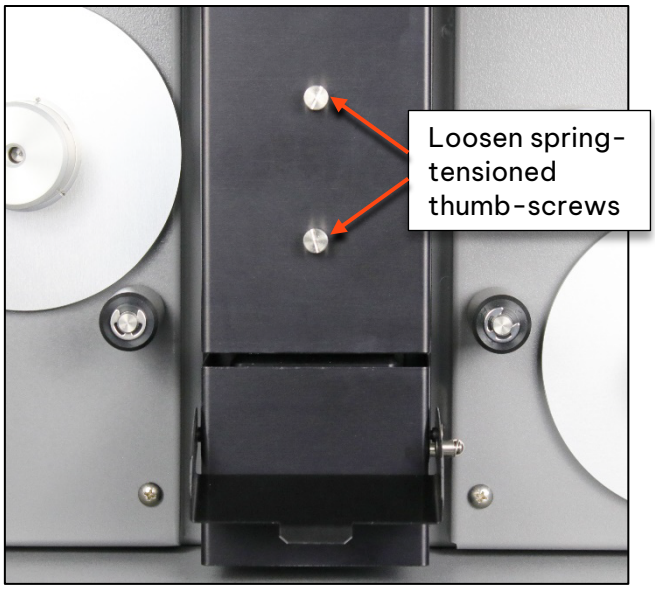


Figure 6-1 Optical Light Shield Removal

This procedure requires removing the optical light shield and removing the filter tape.

With the filter tape removed, unscrew the two thump-screws, and remove the cover by pulling it away, horizontally, from the instrument.

The screws are captive and cannot be fully removed from the cover, for loss prevention reasons.

With the upper head raised, the parts can be inspected and cleaned with a cotton-tipped applicator if needed. Be sure to replace the tape before beginning the leak check.

WARNING: Do not clean optical lenses with any solvents, such as Isopropyl Alcohol or Acetone.

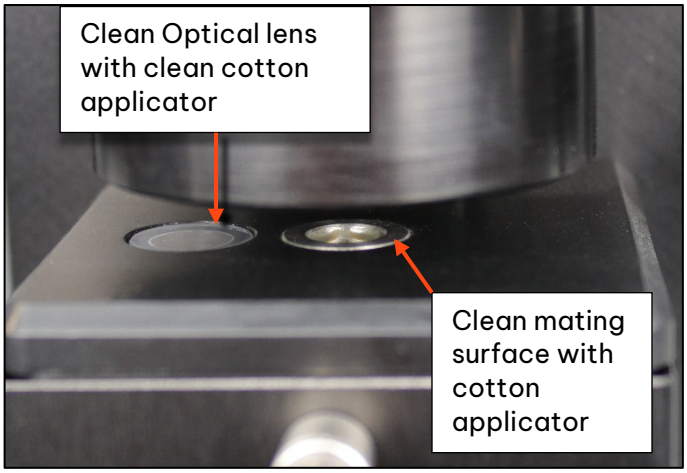


Figure 6-2 Lower Optical Lense and Flow Port

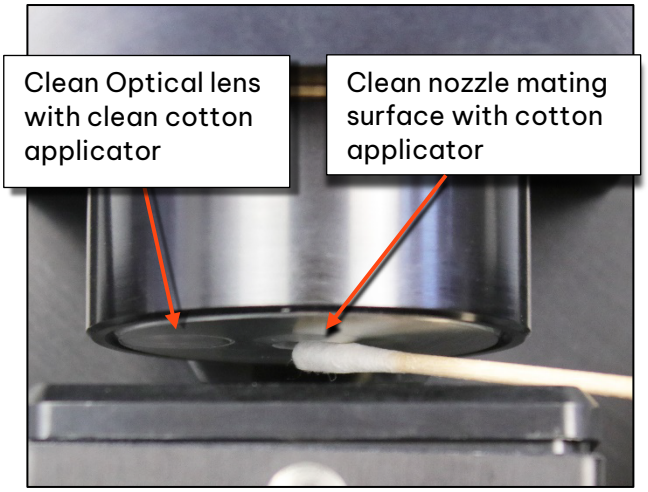


Figure 6-3 Upper Optical Lense and Nozzle

6.4.1.1 Inlet and Cyclone Maintenance

The BC 1054 inlet cyclones all need to be cleaned periodically. Met One recommends cleaning the inlet cyclone particle trap at least once per month in normal conditions. The main cyclone cavity should be disassembled and cleaned every three months during continuous use.

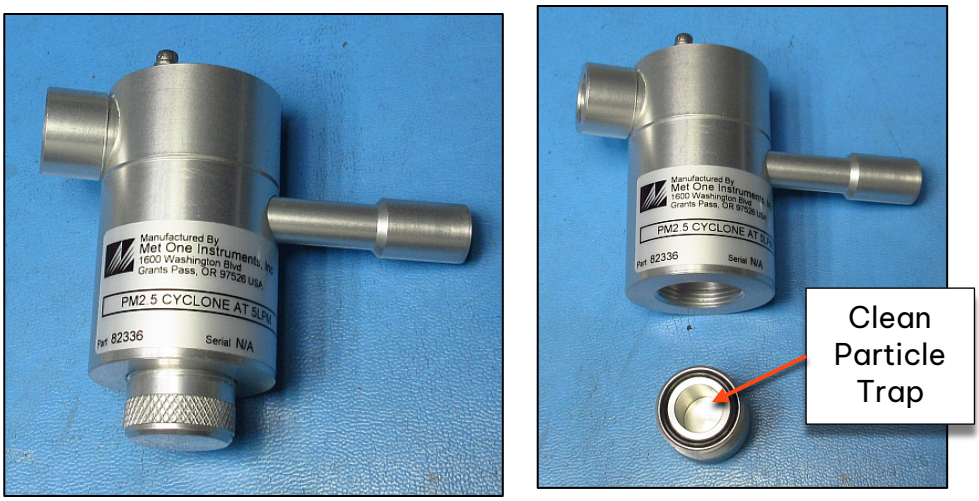


Figure 6-4 Unscrew and Clean Particle Trap

Clean the cyclone particle trap by unscrewing the cap from the cyclone body, then wipe it out with a cloth or blow it clean with compressed air. Check the O-ring and lubricate with silicone grease, if necessary. If the O-ring is damaged, replace it using part number 720079 found in the 8658-2 replacement O-ring kit.

Note: the dilution system cyclone is located behind the exterior cover of the dilution system. The cyclone particle trap can be accessed after removing the outer cover of the dilution system mounted on the back of the BC 1054.

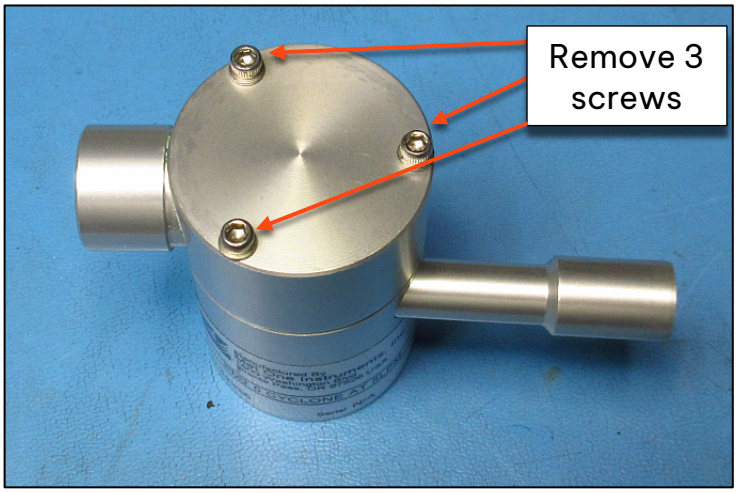


Figure 6-5 Cyclone Disassembly for Full Cleaning

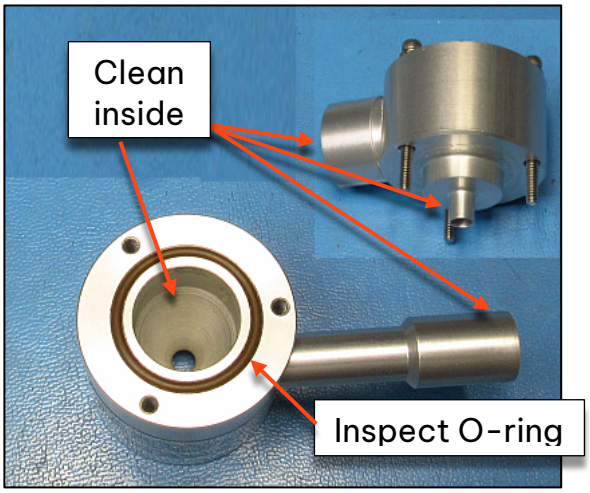


Figure 6-6 Cyclone Internal Cleaning

Full cleaning of the cyclone requires accessing the conical chamber inside. All inside surfaces must be cleaned. Isopropyl alcohol and cotton-tipped applicators work well.

Inspect the O-ring in the top of the cyclone body. Replace if damaged (720081 from 8658-2 O-ring kit).

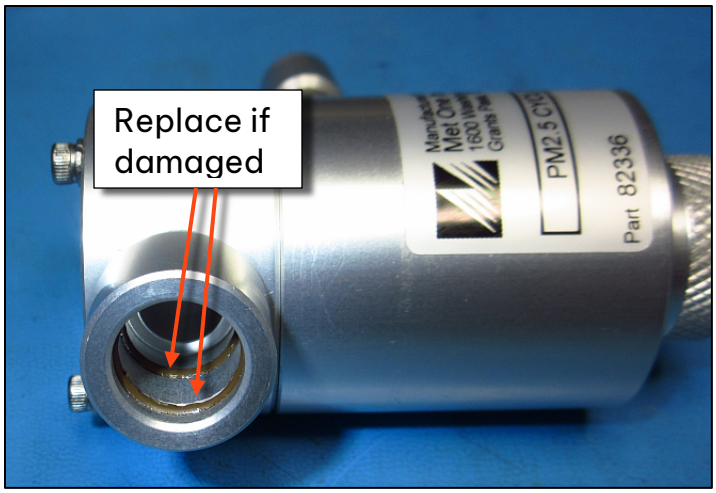


Figure 6-7 Cyclong Inlet O-rings

If damaged, replace (720087 from 8658-2 O-ring kit).

6.4.1.2 Dilution Flow Module Cyclone Cleaning

To remove the cyclone in the dilution system for full cleaning, remove the cover from the dilution system, then remove the two screws that mount the inlet.

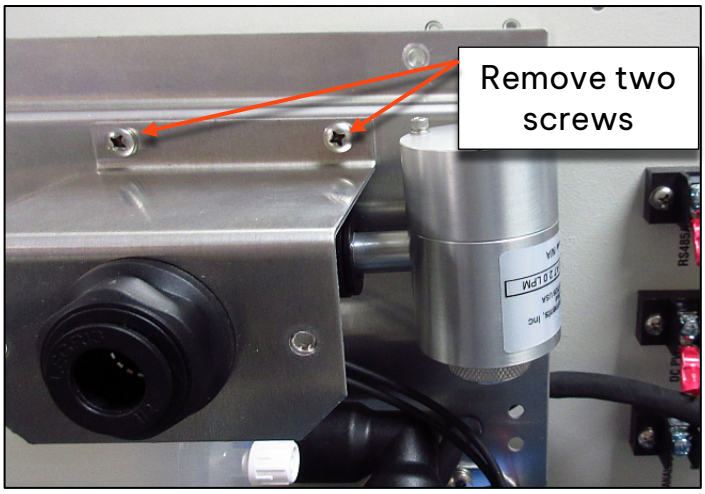


Figure 6-8 Dilution Flow Inlet Mounting Screws

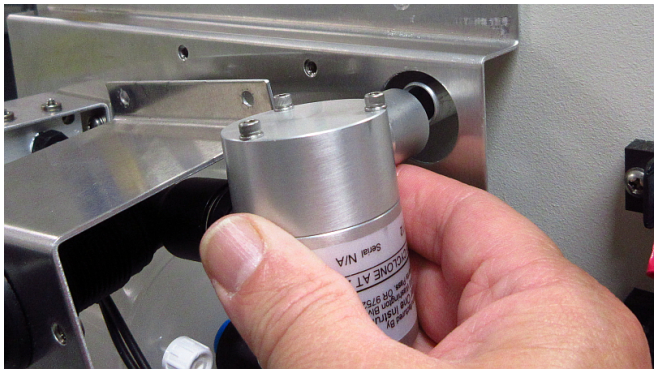


Figure 6-9 Pull Cyclone Away from BC 1054 Inlet Fitting

Pull the cyclone and mounting bracket away from the back of the BC 1054. Disconnect the cyclone from the BC 1054inlet.

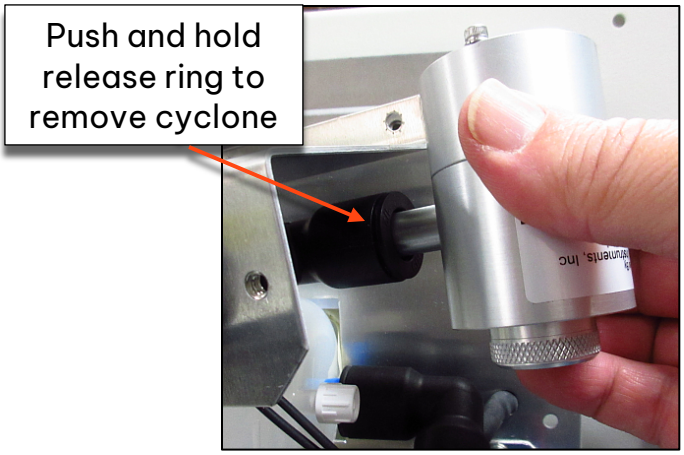


Figure 6-10 Push and Hold Release Ring

Push and hold the release ring on the dilution system inlet "TEE" fitting as the cyclone is pulled out of the "TEE" fitting.

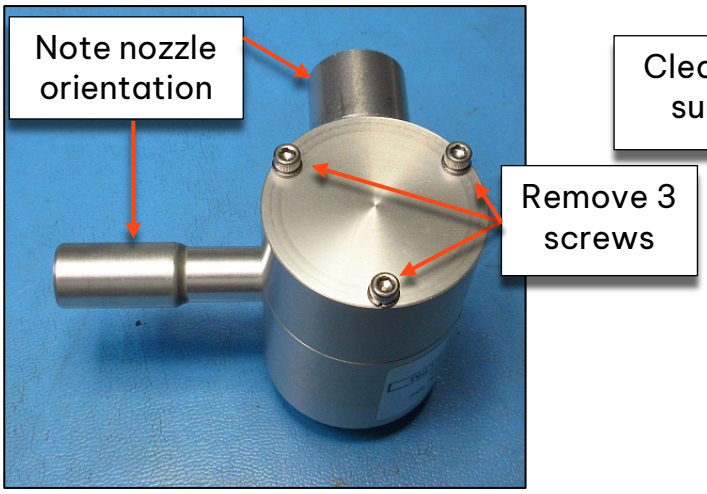


Figure 6-11 Dilution Cyclone Nozzles and Screws

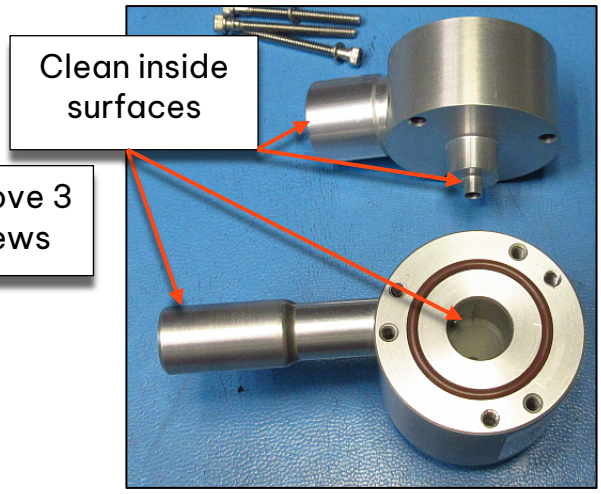


Figure 6-12 Dilution Cyclong Cleaning

Note nozzle orientation of dilution system cyclone.

The dilution flow cyclone nozzles are oriented at 90°. Note two sets of threaded holes on the cyclone body allow re-assembly in both straight and 90° configuration.

Remove the 3 screws in the top of the cyclone to permit access to the interior of the cyclone for full cyclone cleaning.

After cleaning, reassemble in reverse order. For dilution system cyclone, ensure the nozzle orientation is as shown above, **Figure 6-11**.

When service and re-installation is complete on the dilution system cyclone, perform system leak check per **Section 6.4.4**.

6.4.2 Debris Filter Replacement

The BC 1054 contains a filter in the flow system as described in **Section 6.4.3 BC 1054 Flow System**. The filter element part number is 580345, the filter assembly part number

is 580291. These parts can be ordered from the Met One service department. For contact information see **Section 1.2 Technical Service.**

This internal filter (see **Figure 6-13)** keeps filter tape debris from entering the flow sensor. It can be removed for cleaning or to be replaced. See removal and cleaning instructions below. The 580345 filter should be replaced if excessively dirty.

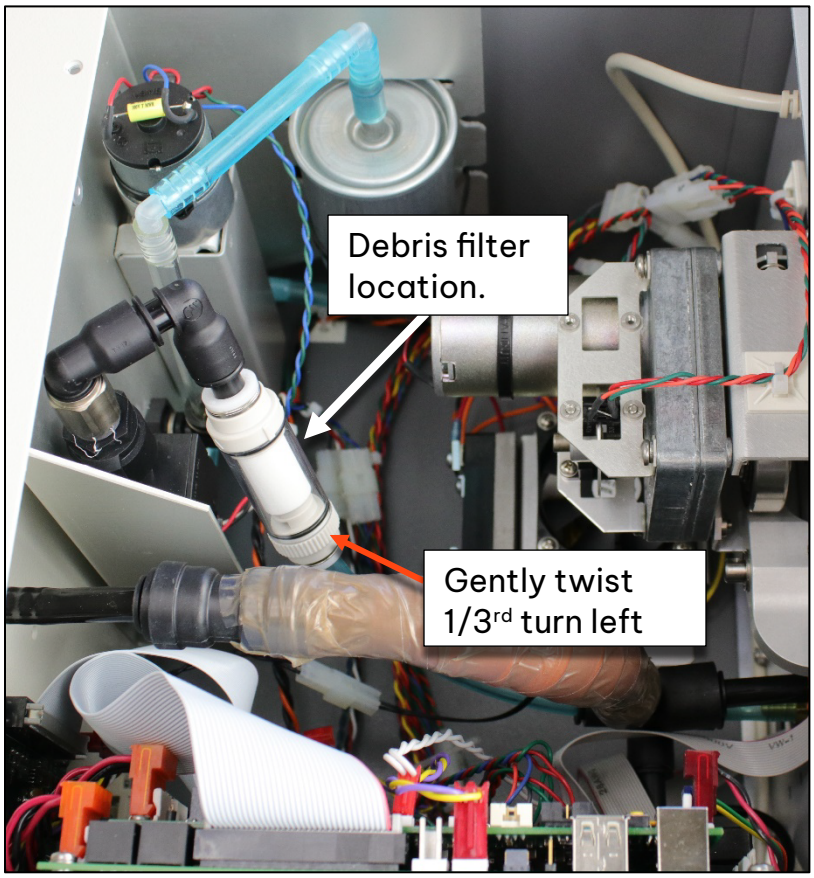


Figure 6-13 Debris Filter Location

Debris filter removal:

1. Hold the clear filter housing with one hand and twist the bottom hose connector about 1/3rd turn to the left.
2. Separate the clear housing from the hose connector by gently pulling up on the clear housing while pulling down on the bottom hose connector.
3. Separate the clear housing from the top hose connector by pulling down on the clear housing and pull up on the upper hose connector.
4. Pull down on the white filter element (580345) to remove from the assembly.

Filter Cleaning:

1. After the filter has been removed, use light blasts of compressed air to blow off any dust or debris.
2. Replace filter if it cannot be cleaned.

6.4.3 BC 1054 Flow System

The flow control system is a critical component of the BC 1054 measurement. A complete functional description is included to assist the user in understanding this system.

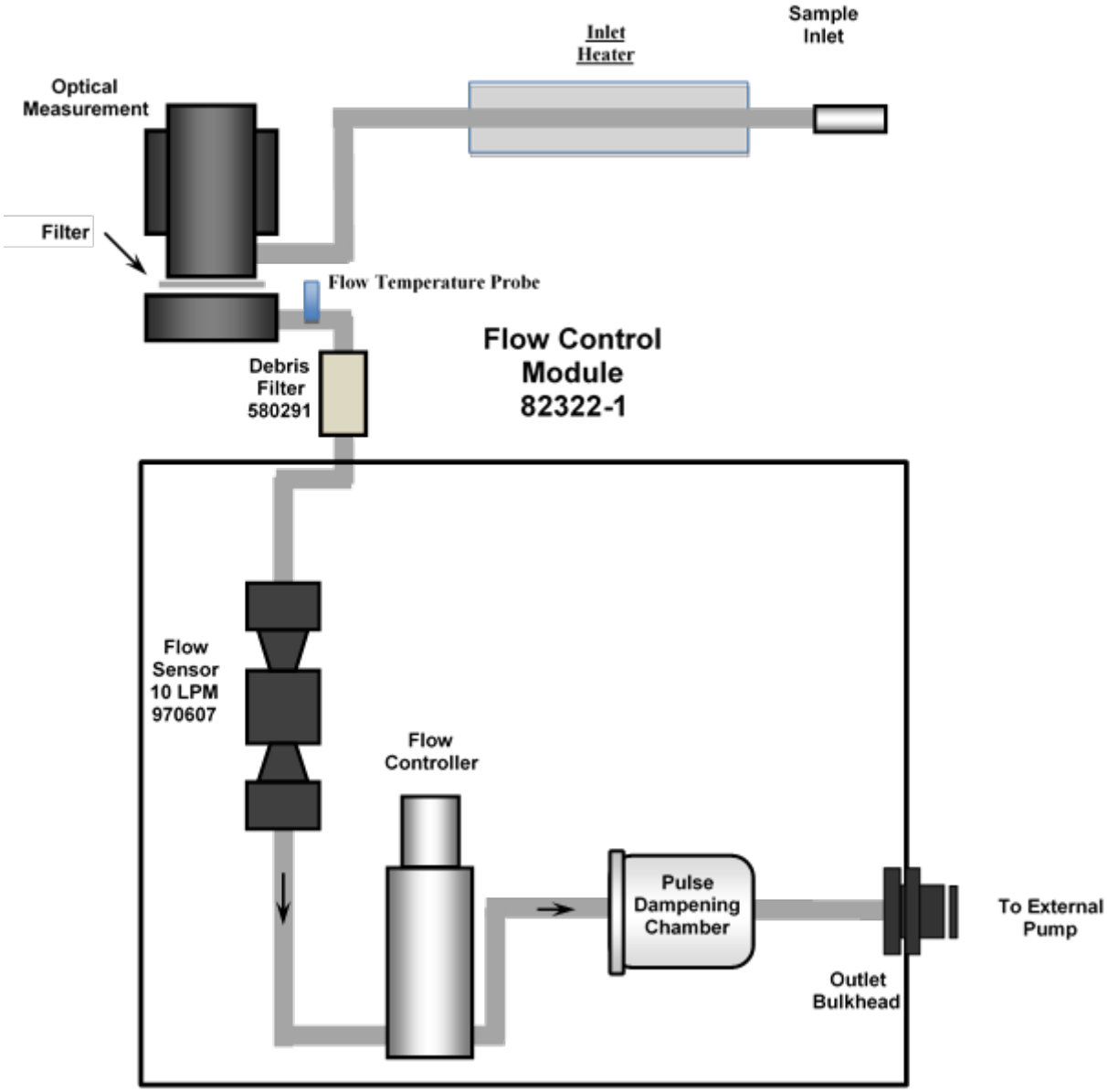


Figure 6-14 BC 1054 Flow System Diagram

The following flow control system descriptions refer to the flow system shown in **Figure 6-14.**

Airflow During Normal Sampling:

1. Ambient air is drawn into the instrument at 2 or 5 LPM through a TSP inlet, then through the $PM_{2.5}$ or PM_1 size fractionator, a stiff support tube (for mounting), and then flexible tubing before entering the back of the BC 1054.
2. The sample air is drawn through the inlet heater into the optical measurement module and through the filter tape where ambient particulate is deposited onto a small

diameter filter spot. The filter spot size is optimized for high sensitivity operation rather than for high concentration operation.

3. The sample air exits the bottom of the measurement module, passes through a small debris filter, and then flows through the mass airflow sensor where the flow rate measurement is made. The CPU converts the mass flow from the sensor into actual volumetric flow based on continuous inputs from the model BX-597A ambient temperature and pressure sensor.
4. Next, the sample air passes through the flow controller (which controls the sample flow rate), through the pulse dampening chamber and out the exhaust bulkhead to the external pump.

Filter Spot Changes:

1. To change the filter tape sample spot, the unit turns off the pump and then raises the measurement head away from the filter tape. The tape take-up motor advances the filter tape to a clean spot. The measurement head is lowered to the closed position on the tape and the pump turns back on. This entire process takes less than 1 minute.
2. After the tape advances, optical carbon reports will resume after 2 minutes.

6.4.3.1 Dilution Flow System Description

In monitoring environments with extremely high concentration levels, the excessive particulate contained in the sample can result in excessive tape loading. This will result in frequent tape advances. Rapid depletion of the filter tape and potentially bad data are the most immediate detrimental side effects. Over time, there will be excessive buildup of particulate matter inside the instrument as well. This will result in additional maintenance being required and greater wear of internal components. To avoid these issues, Met One Instruments offers the 82480 Dilution Flow System.

When installed on the back of the BC 1054, a controlled portion of clean air is mixed with the incoming sample air. Using this feature, the incoming sample concentration levels can be diluted between 50 and 80%. This means that, because the volume of air is carefully controlled, accurate measurements can be made with a mere twenty percent of the full particulate concentration in extreme environments.

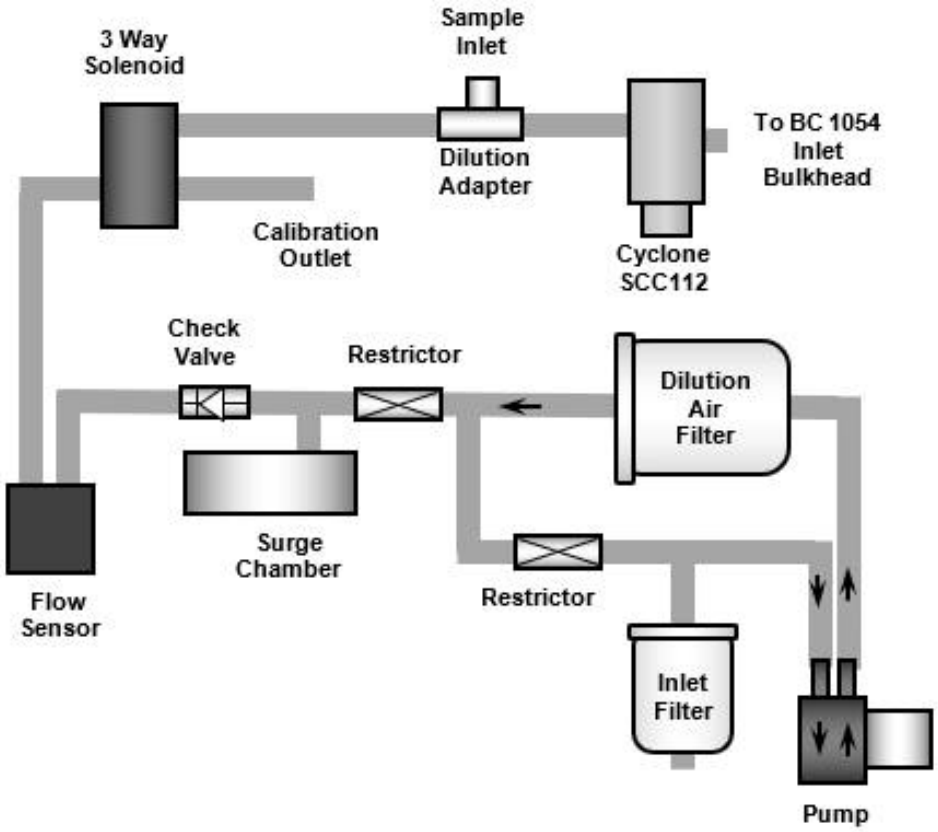


Figure 6-15 BC 1054 Dilution Flow System Diagram

Airflow During Dilution Sampling:

1. Air is drawn through the dilution pump and directed through the dilution filter to ensure the dilution air is clean.
2. It then flows through the flow meter at the target flow rate (between 1.0 and 1.6 LPM). The flow rate is controlled by adjusting the speed of the dilution pump.
3. During normal sampling, after exiting the flow meter, the three-way solenoid valve will direct the clean dilution air into the primary sample air intake path. Here it will mix with the sample air diluting the sample.
    a. The three-way solenoid valve is closed during a leak test of the primary sample flow path to isolate it from the testing path. During this test, the dilution pump will not be running.
    b. The three-way solenoid valve also provides an access point for performing flow verifications and calibrations of the dilution system.

The Dilution Flow System is only useable with a 2 LPM sample flow rate. If the Dilution Flow System is engaged while the BC 1054 is configured for 5 LPM flow, sample flow rate will automatically be changed to 2 LPM and a prompt will appear requiring a flow calibration.

It is important to note that the sharp cut cyclone requires the proper 2 LPM flow rate to perform correctly. When using the Dilution Flow System, the inlet cyclone will not be coupled to the TSP inlet as shown in **Figure 2-1**, but instead is installed directly on the back of the BC 1054 (see **Section 2.3.2**). This is because the sample flow will now include both the air flow from the sample inlet and the dilution air flow paths. Therefore, the 2 LPM flow rate will only be present *after* the dilution air is added to the sample air.

For example, if the dilution flow is set to the maximum value of 80%, the dilution flow rate will be 1.6 LPM. There will be a flow of clean air at 1.6 LPM being injected into the sample air flow path just before the sample air enters the SCC. The sample flow rate must be adding 0.4 LPM to the dilution flow rate to maintain the necessary 2.0 LPM required by the SCC. Therefore, the sample airflow *upstream of the dilution flow system outlet* is only 0.4 LPM. This is the reason the cyclone cannot be deployed in its normal location beneath the TSP inlet.

By contrast, if the dilution flow were set to 50%, both the dilution flow and the sample flow rates would be 1.0 LPM. This relationship should be considered when determining the sample inlet location and routing the sample air flow path inlet tubing. See **Section 4.2.6 Flow Configuration** for engaging the Dilution Flow System and setting the level of dilution.

6.4.4 Leak Check

The BC 1054 flow contains an easy to maintain flow system (see **Section 6.4.3 BC 1054 Flow System**). To perform a leak test, remove the flexible tubing from the back of the monitor and place the vinyl cap (pn: 770025) over the inlet. Navigate to the TEST MENU > LEAK TEST menu. The FLOW value is the output from the internal flow sensor.

If the Dilution Flow System is installed, the vinyl cap cover cannot be used. Instead, insert the nylon sealing plug (pn: 580183) into the tubing inlet. Be sure to fully insert the plug as shown in **Figure 6-16**.

Figure 6-16 Leak Check Sealing Plug Installation

Figure 6-17 Leak Test Main

Press the TURN ON box outlined in green. This will turn on the pump and stop the flow controller valve from attempting to regulate the flow while the vinyl cap is in place. If the Dilution Flow System is detected by the BC 1054, this action will also close the three-way solenoid valve in the dilution flow path to isolate it from the primary sample path.

Once complete, press the TURN OFF box to turn off the pump. **Slowly release the vacuum** in the system (by easing off the vinyl cap) ***before*** exiting this screen. The warning screen shown in **Figure 6-18** will be displayed when exiting the Leak Test screen. Exiting the Leak Test screen before releasing the vacuum will cause the vacuum to be released rapidly. This can damage the tape and suck debris into the sample chamber which may require returning the monitor to the factory for service.

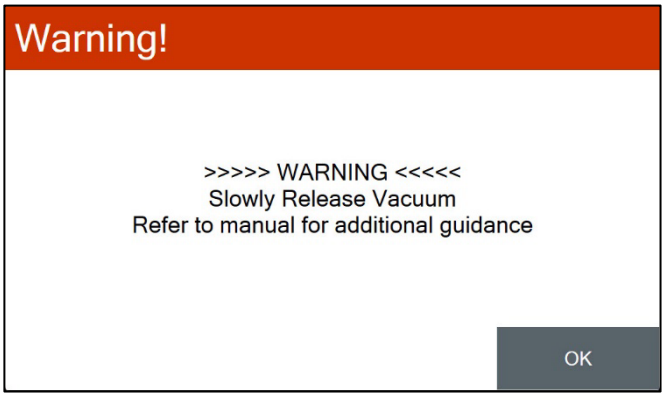


Figure 6-18 Leak Test Warning Screen

Reconnect the flexible tubing on the back of the monitor and resume sampling operations.

6.4.4.1 Flow Verification

To perform a flow verification test, follow the flow calibration steps in **Sections 6.5.2** or **6.5.3** without making any changes to flow settings.

NOTE: Perform a leak check and verify the temperature and pressure sensors before performing a flow verification or calibration, as these systems can affect the flow.

6.5 Calibration Procedures

NOTE: Before performing any calibrations, be sure the instrument has completed the warmup period, see Section 5.2.2 for warmup information.

The BC 1054 has a system of calibration menus which allow the operator to audit or calibrate various system parameters for optimal performance. It is recommended that airflow control parameters (AT, BP, FLOW) be audited monthly and calibrated quarterly

during continuous operation. The exact frequency may vary depending on local conditions and the data validation requirements established by the sampling program administrator.

To perform any calibrations, a standard or reference device such as the SWIFT 25.0 is needed.

The BC 1054 temperature and pressure calibrations should always be checked before any flow calibrations are performed, since the flow calculation is dependent on these parameters. The model BX-597A ambient AT/BP/RH combination sensor must be fully functional and connected properly.

CALIBRATE MENU location: Side Menu Pane.

If the system password is set, it will need to be entered to access the CALIBRATE menu (see **Section 3.5.2.6**).

6.5.1 BX-597A Digital Ambient Sensor Field Calibration

The sub-sections below provide instructions on how to perform a field calibration for the BX-597A digital combo sensor. The BX-597A provides temperature, pressure, and humidity readings. Only temperature and pressure can be field calibrated. The sensor will need to be sent to the Met One service team for humidity calibration and full service.

NOTE: The DEFAULT button should be pressed to clear out all previous field calibrations and restore the factory calibration for the sensor. Use this prior to beginning the calibration process.

6.5.1.1 Temperature Calibration

AT Calibration screen location: Side Menu Pane>Calibration>AT.

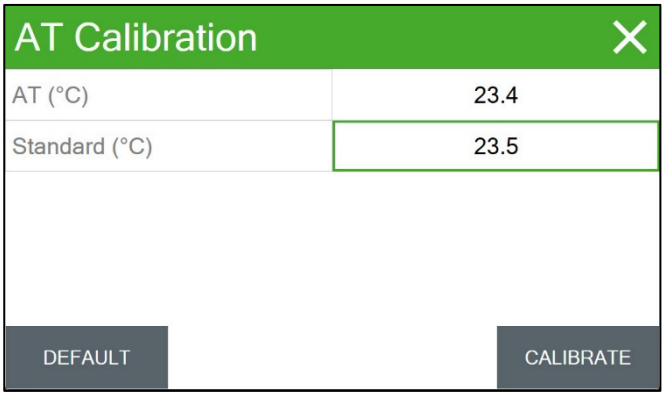


Figure 6-19 AT Calibration Main Screen

The AT parameter is the current reading from the BX-597A temperature sensor. The STANDARD field box, outlined in green, is where the correct value from the traceable temperature standard should be entered, if necessary.

To enter a correction value, press on the green outlined box next to STANDARD.

To correct the AT reading, enter the value shown on the reference sensor using the numeric keypad and then press OK, bringing back the AT Calibration screen (**Figure 6-19**). Press the CALIBRATE button in the bottom right corner. The AT value should change to match the STANDARD value when CALIBRATE is pressed.

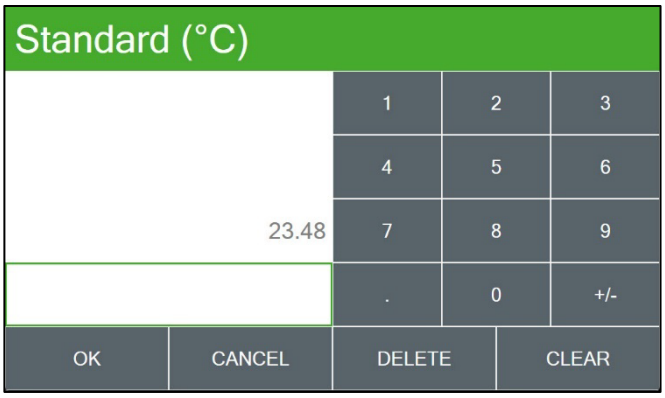


Figure 6-20 AT Standard Input Screen

6.5.1.2 Barometric Pressure Calibration

The BP parameter is the current reading from the BX-597A pressure sensor. The STANDARD field is where the correct value from the traceable pressure standard should be entered, if necessary.

NOTE: The DEFAULT button should be pressed to clear out all previous field calibrations and restore the factory calibration for the sensor. Use this prior to beginning the calibration process.

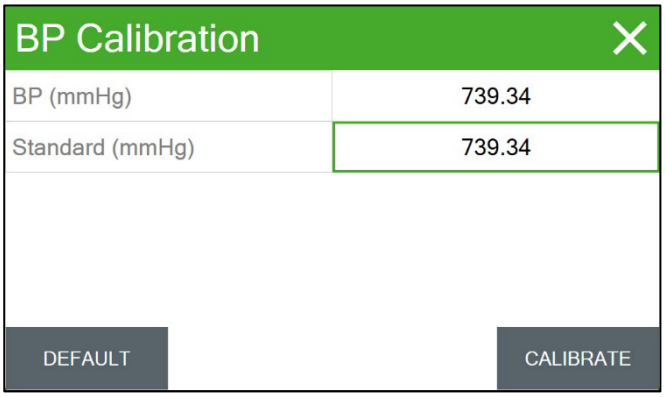


Figure 6-21 BP Calibration Main Screen

The BP parameter is the current reading from the BX-597A pressure sensor. The STANDARD field box, outlined in green, is where the correct value from the traceable temperature standard should be entered, if necessary.

To enter a correction value, press on the green outlined box next to STANDARD.

To correct the BP reading, enter the value shown on the reference sensor using the numeric keypad and then press OK, bringing back the AT Calibration screen (**Figure 6-21**). Press the CALIBRATE button in the bottom right corner. The AT value should change to match the STANDARD value when CALIBRATE is pressed.

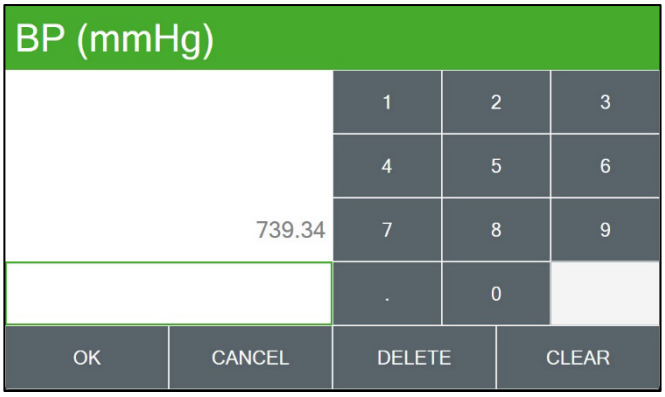


Figure 6-22 BP Standard Input Screen

6.5.2 Sample Flow Sensor Field Calibration

This section provides steps to perform a sample flow audit and single point flow calibration.

NOTE: The BC 1054 temperature and pressure calibrations should always be checked before any flow calibrations are performed, since the flow calculation is dependent on these parameters. The model BX-597A ambient AT/BP/RH combination sensor must be fully functional and connected properly.

The temperature, pressure, and leak status must be checked before performing any flow calibrations. See **Sections 6.5.1**, and **6.4.4** for more details on these prerequisites. **When switching between 5 lpm and 2 lpm the flow sensor MUST be zeroed and re-calibrated since there is only one flow gain and offset.**

*Note: If the Dilution Flow System is installed, the dilution pump will remain OFF when calibrating the sample flow. See **Section 6.5.3** for calibration of the dilution flow sensor.*

Flow calibrations require a traceable flow audit calibration device, and traceable standards for temperature and pressure. The Met One Swift 25.0 and similar particulate sampler flow calibrators work well. Attach the flow meter to the BC 1054 sample inlet.

Sample Flow screen location: Side Menu Pane>Calibration>Sample Flow.

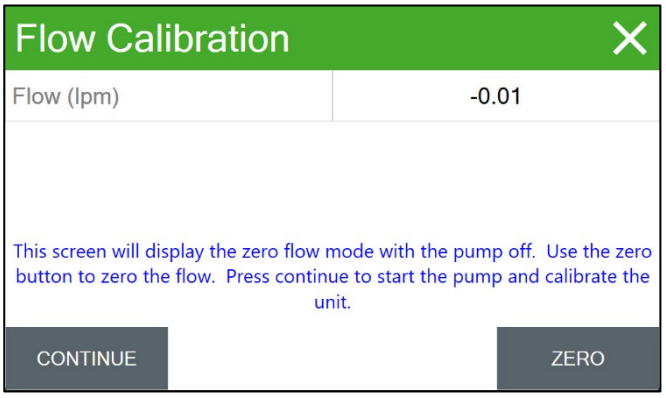


Figure 6-23 Zero Flow Sensor Screen

The zero flow screen will automatically turn the pump OFF if it is running. The measured flow will be displayed in the field to the right of "Flow (lpm)."

Press the ZERO button (bottom right corner) to zero the flow sensor.

Press CONTINUE to open the main Flow Calibration screen.

The pump will automatically start running.

IMPORTANT CALIBRATION NOTES:

When entering the flow calibration screen, allow the flow to stabilize before performing a calibration.

A second calibration standard input value may be necessary if the flow does not match the standard device after one calibration. Be sure to allow at least two minutes for the flow to stabilize after pressing calibrate.

Press the default button to remove any previous calibration offsets before performing a calibration. This will restore the factory calibration settings for the sensor.

This screen provides flow information and the calibration standard input field.

All flow values are in Q_a (actual volumetric conditions).

Press the green outlined box next to Standard (lpm) to input the flow calibration value from the standard device.

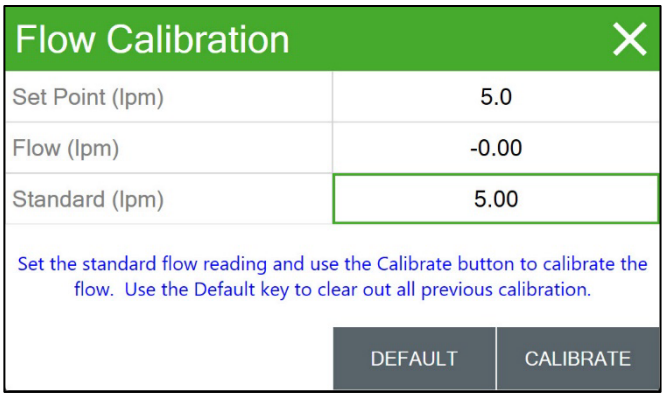


Figure 6-24 Flow Calibration Screen

The STANDARD field is where the correct flow value from the traceable flow meter should be entered if the flow does not match within ± 5% of the traceable standard.

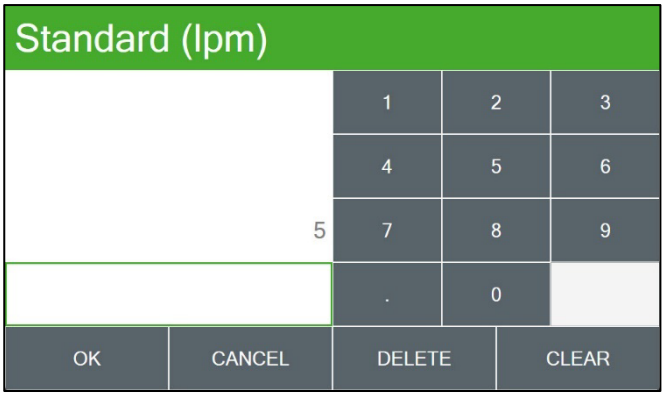


Figure 6-25 Flow Standard Value Input

To correct the FLOW reading, enter the value shown on the reference meter in the STANDARD field and then press OK to go back to the main FLOW CALIBRATION screen.

The FLOW value should change to match the STANDARD value when the CALIBRATE button is pressed.

The monitor will then attempt to regulate the FLOW value to match the SET POINT.

6.5.2.1 Audit-Only Flow Checks

To audit the flow without making any calibration changes, enter the flow calibration menu, record the zero flow value, press the CONTINUE button, allow the flow to stabilize, compare the FLOW (lpm) value to the traceable standard, record the results, and then press the X button. No flow calibrations are changed if the ZERO and CALIBRATE buttons are not pressed.

6.5.3 Sample Flow Rate Field Calibration with Dilution Flow System

NOTE: The BC 1054 temperature and pressure calibrations should always be checked before any flow calibrations are performed, since the flow calculation is dependent on these parameters. The model BX-597A ambient AT/BP/RH combination sensor must be fully functional and connected properly.

The CALIBRATE DILUTION screen is used for field audits or calibrations of the dilution flow measurement of the BC 1054 Dilution Flow System. The sample flow sensor should be calibrated before calibration of the dilution flow sensor.

This flow calibration requires a traceable flow audit calibration device. The standard must be able to accept a pressurized flow rate. A vacuum style of flow measurement will not work for this flow.

The Dilution Flow system is independently regulated and is calibrated separately from the instrument sample flow.

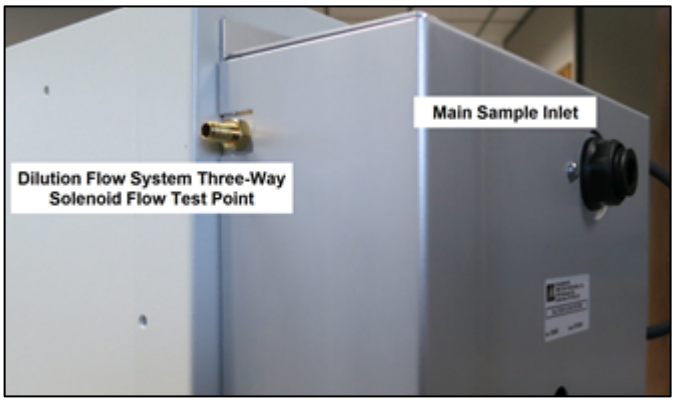


Figure 6-26 Dilution Flow Test Point

Attach the flow meter standard to the three-way solenoid valve located in the Dilution Flow System

See **Section 2.3.2.3 Dilution Flow Inlet Assembly Installation** for standard connection details.

If the dilution flow system is connected to the BC 1054 after the main flow has been calibrated at 5 lpm, **Figure 6-27** warning will appear.

The main sample flow will need to be calibrated at 2 lpm before calibrating the Dilution Flow system.

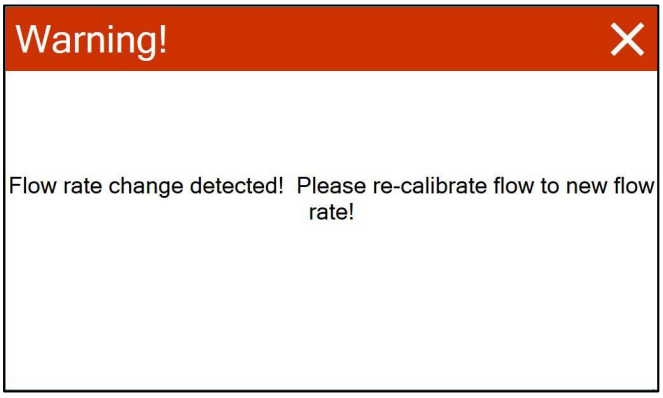


Figure 6-27 Changed Flow Rate Warning

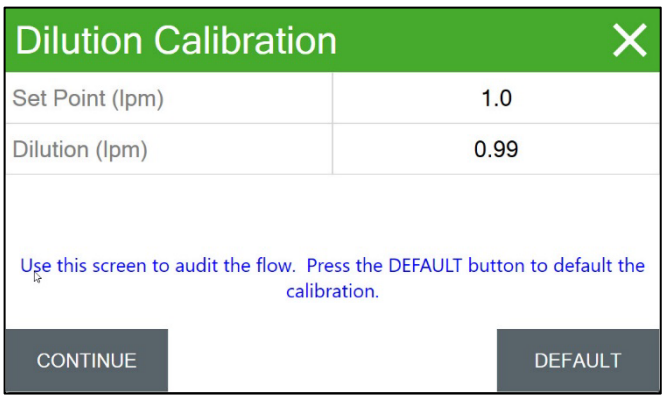


Figure 6-28 Dilution Flow Audit Screen

This screen is used to audit the Dilution Flow. When this screen is accessed, the pump will automatically turn on.

All flow values are in Q_a (actual volumetric conditions).

Allow the flow to stabilize.

Press the CONTINUE button to go to the first flow set point screen for the Dilution Flow system calibration.

The dilution flow calibration is a two-point calibration consisting of the minimum (1.0 LPM) and the maximum (1.6 LPM) flow rates. After pressing CONTINUE, the low flow set point test will be displayed and the pump will be adjusted to the 1.0 LPM flow rate.

The STANDARD field is where the correct flow value from the traceable flow meter should be entered if the flow does not match within ± 5% of the traceable standard.

Before setting the first set point, allow the flow to stabilize.

Press the green outlined box to the right of Standard (lpm) to access the Dilution Flow Standard Input screen to calibrate the low flow set point.

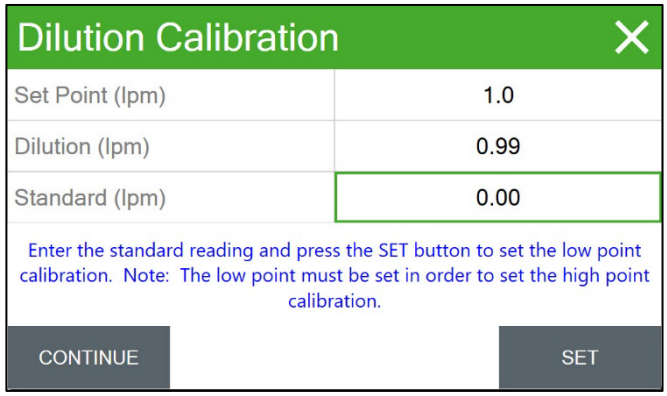


Figure 6-29 Dilution Low Flow Set Point

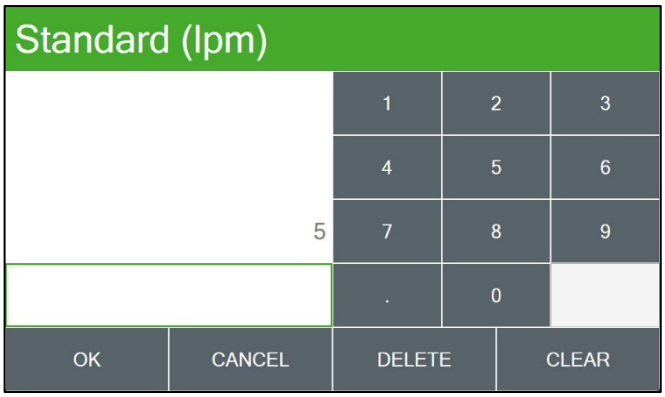


Figure 6-30 Dilution Flow Standard Input

To correct the DILUTION low set point, enter the value shown on the reference meter using the numerical keypad. Press OK to set the value and go back to the flow screen.

Press the SET button to temporarily store the new set point value and to proceed to the high flow set point screen.

Allow the flow to stabilize before proceeding.

When the flow has stabilized, press the green outlined box next to Standard (lpm).

To correct the DILUTION high set point, enter the value shown on the reference meter using the numerical keypad.

Press the CALIBRATE button to complete the calibration process.

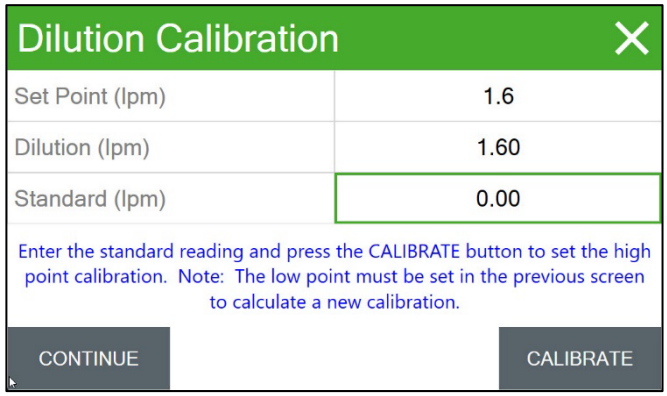


Figure 6-31 Dilution Flow Set Point

NOTE: If the final calibration does not match the flow standard device, repeat the steps above. If the flow still does not calibrate properly, press the DEFAULT button (Figure 6-28 Dilution Flow Audit Screen) and repeat the calibration steps again.

6.5.4 K Factor Calibration

Each BC 1054 monitor leaves the factory with a calibration certificate containing the K-factors used to adjust the referenced BC 1054 monitor to a factory standard. In certain sampling situations, it may be desirable to adjust the output readings of one or more channels to match a reference instrument more closely under local conditions.

The K factors are direct multipliers applied to the concentration measurements. All concentration data stored in the BC 1054 will be affected by these K factors. Only the values reported in the VERIFY CAL menu are not affected by these K factors.

Note: These user accessible K factors do not replace or modify the factory programmed calibration K factors listed on the calibration certificate nor are they applied during the VERIFY CAL process (see **Section 6.5.6**).

K Factor Calibration screen location: Side Menu Pane>Calibration>K-Factors.

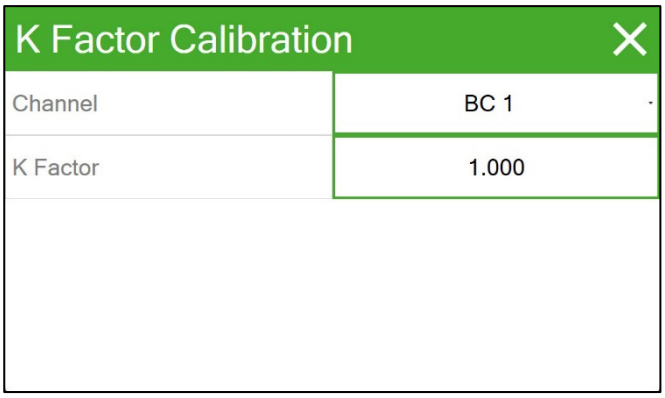


Figure 6-32 K-Factor Calibration Screen

A K Factor can be set for every BC channel. Select a BC channel by pressing on the green outlined box next to Channel.

The dropdown options list will provide the available channels. Press on a channel in the dropdown list to make a selection.

Press the green outlined box next to K Factor to open the K Factor input screen (**Figure 6-33**).

Use the numerical keypad to input a K Factor for the selected BC channel.

The K Factor value should come from a local reference instrument.

K Factor Range: 0.1 – 9.999

Press OK to set the new K Factor.

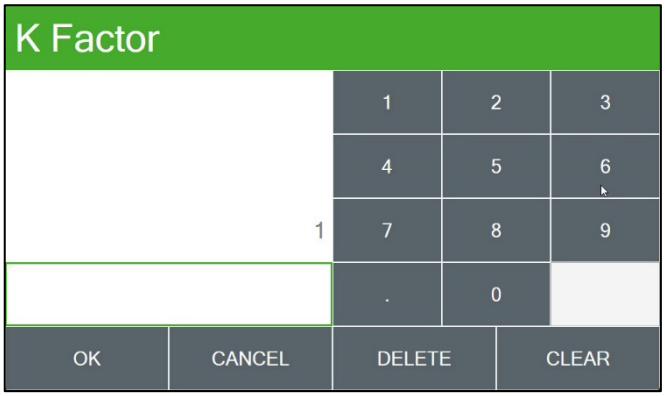


Figure 6-33 K Factor Numerical Input Screen

Repeat the steps above for each channel that requires a K Factor calibration.

6.5.5 LED Adjustment

Each LED has a detector range of 0 to 2500 mV which is calibrated at the factory. Due to detector alarms, it may be necessary for the user to calibrate each LED using the Calibrate LED screen. Confirm that the box temperature is at or close to the preferred operating temperature for optimal LED Calibration outcomes.

LED Calibration screen location: Side Menu Pane>Calibration>LEDs.

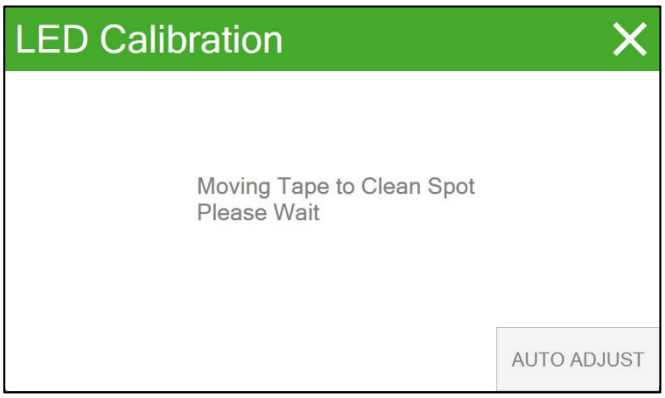


Figure 6-34 LED Calibration Moving Filter Tape

NOTE: Filter Tape is required to calibrate the LEDs and therefore the instrument will check the tape and move it to a clean spot upon entering the screen.

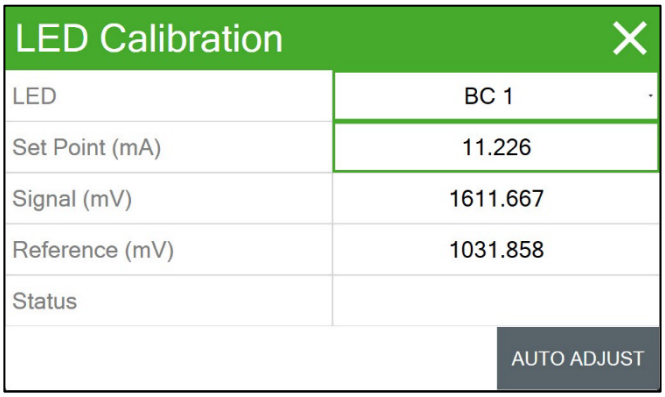


Figure 6-35 LED Calibration Main Screen

Select a BC channel LED to Calibrate by pressing on the green outlined box next to LED.

The dropdown options list will provide the available channels. Press on a channel in the dropdown list to make a selection.

Signal Value: 1600 mV ± 100 mV

Press the AUTO ADJUST button to initiate the BC 1054 automatic calibration process. The selected LED will be set to the best value.

The Status line will show the adjustment status.

When finished, the Set Point field will be updated to the new value.

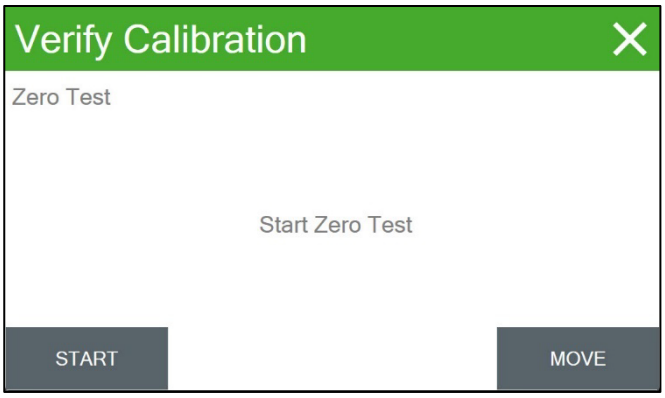
The LED Set Point can be manually set, but it is not recommended to manually adjust these settings.

6.5.6 Verify Calibration (Optical Span Test)

Note: No changes to the instrument calibration are made with this process. This is a span check only.

The VERIFY CAL menu is used to perform the optical span calibration verification test on the instrument using a neutral density filter. This will introduce a known and consistent amount of optical attenuation into the measurement system. The 81947-3 Neutral Density Span Check Filter tool will be needed to perform this test.

Verify Cal menu location: Side Menu Pane>Calibration>Verify Cal



When entering the VERIFY CAL menu, the measurement head will automatically move to the UP position.

Before starting the Zero Test, the measurement head cover will need to be removed. See the instructions below.

Figure 6-36 Verify Calibration Main Screen

Flip down the tape slot access door on the measurement module cover as shown in **Figure 6-37.**

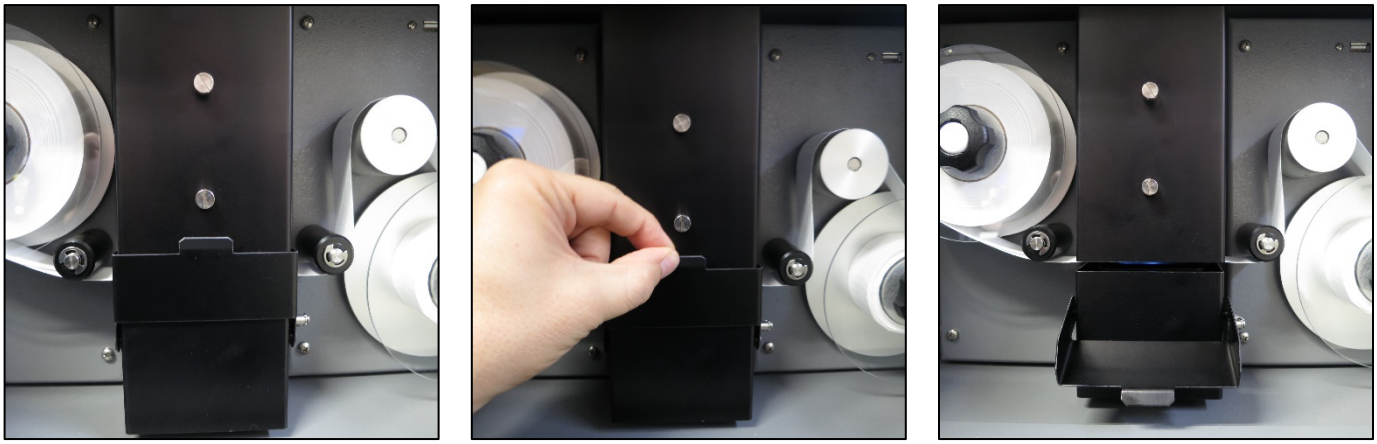


Figure 6-37 Removing the Measurement Head Cover

Loosen the tape by manually turning the tape supply reel counterclockwise. Pull the tape forward through the slot far enough to be able to lay the tape beneath the cover as shown in **Figure 6-38**. Care should be exercised to avoid breaking or damaging the tape.

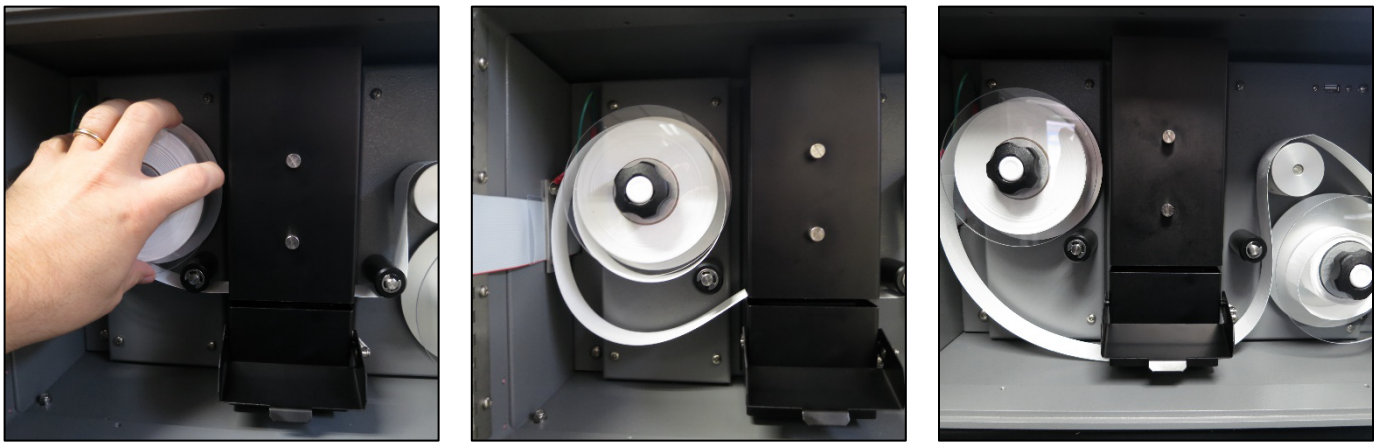


Figure 6-38 Losening Filter Tape for Cover Removal

Loosen the two thumb screws on the measurement head module, remove the cover, and then re-install the tape as normal shown in **Figure 6-39**.

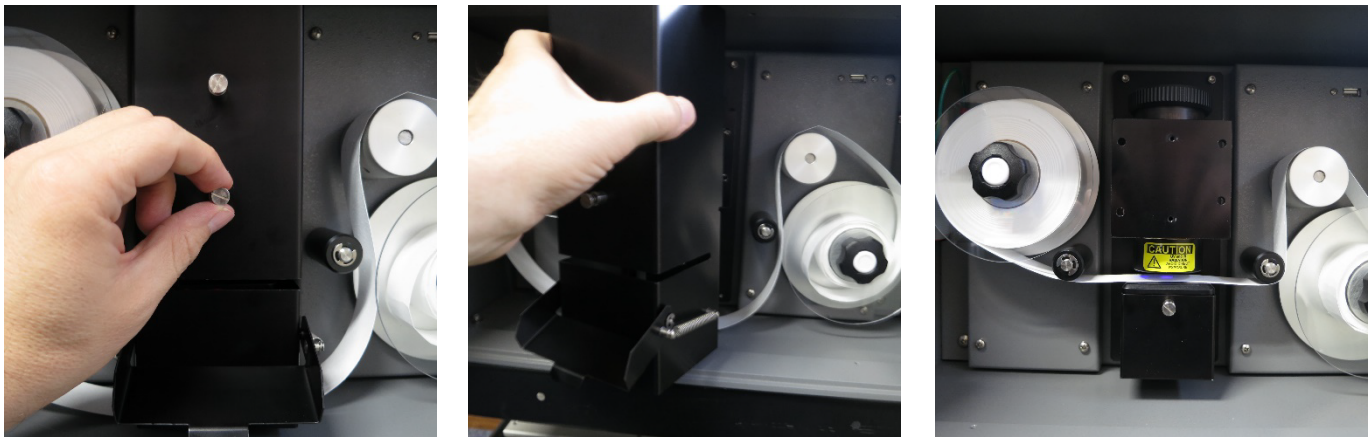


Figure 6-39 Measurement Head Cover Removal

Press the MOVE option (see **Figure 6-36**) to properly tension the tape and advance it to a clean spot. *The tape must be moved if a dirty spot is currently under the nozzle*.

Closing the door during the measurement will increase repeatability.

When the START key is pressed, the ZERO test will begin.

The Zero test will be completed in under two minutes.

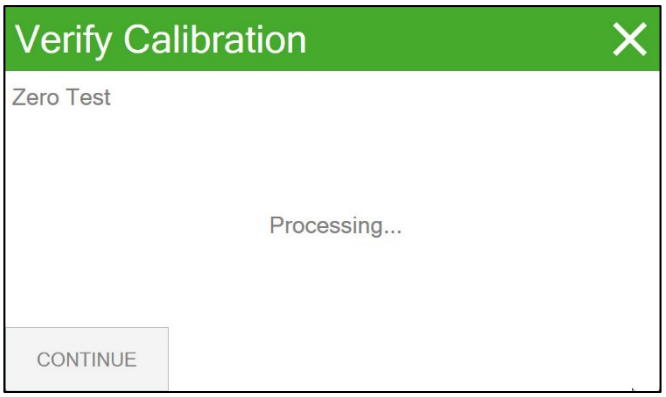


Figure 6-40 Verify Cal Zero Test Start Screen

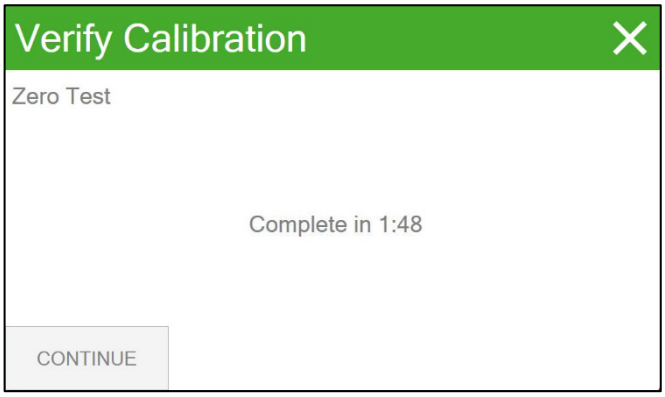


Figure 6-41 Zero Test Count Down Screen

The measurement head will lower onto the tape and the display will show the completion time remaining for the blank filter portion of the test.

At the end of the ZERO portion of the test, the measurement head will raise and the display will show INSERT ND FILTER as shown in **Figure 6-42.**

Insert the Span Check Membrane neutral density filter above the tape.

The alignment tabs will insert into notches on the mounting plate and the filter will press squarely against it when properly inserted. See **Figure 6-43**.

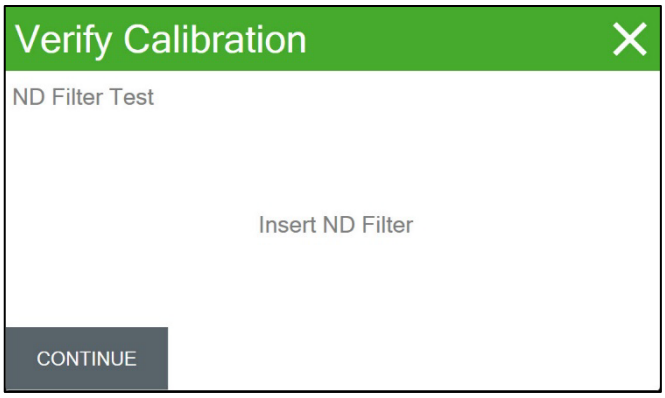


Figure 6-42 ND Filter Test Screen

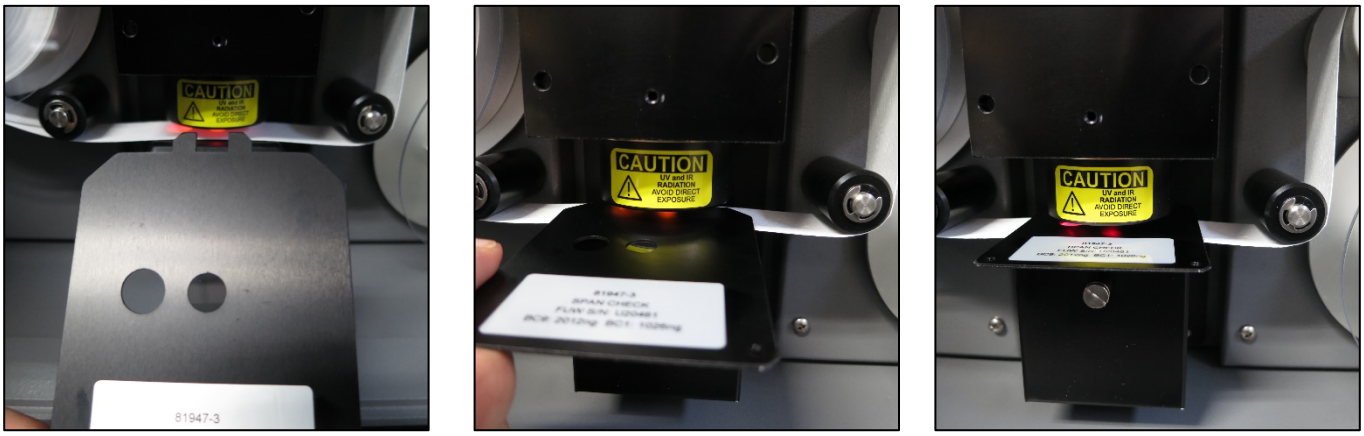


Figure 6-43 ND Span Membrane Insertion

Press CONTINUE and the measurement head will lower and begin the span check. The display will show the completion time remaining for the ND filter test.

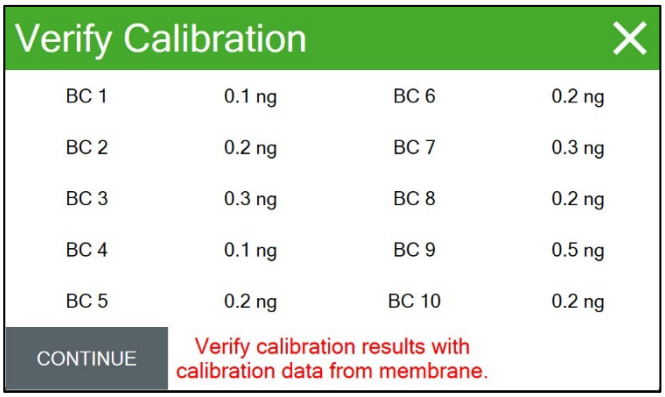


Figure 6-44 ND Filter Test Results Screen

At the end of the test, the calibration results will be displayed (see **Figure 6-44**).

The values should be within ± 5% of the values indicated on the label inside the Span Check Membrane holder mounted on the inside of the door of the BC 1054.

Record the results and then Press CONTINUE.

The measurement head will raise, and the display will indicate when it is safe to remove the ND Span Membrane.

Remove the filter and then press the EXIT button to return to the CALIBRATE menu.

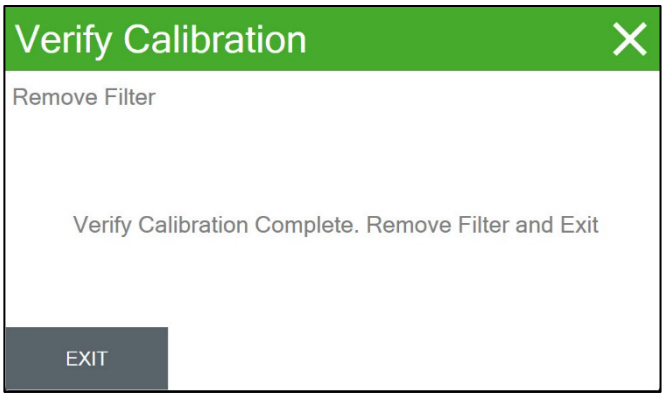


Figure 6-45 Verify Calibration Compleation

Should the values fail to be within ± 5%, the most likely reason is inadvertent tape movement during the test. The test should be run again with particular attention paid to the filter tape remains stationary. If the test still fails, contact the Met One Instruments, Inc. service department for assistance. See **Section 1.2** for contact details.

Loosen the tape supply wheel and lay the tape across the bottom of the enclosure to allow room to reinstall the measurement head cover. Reinstall the cover, open the access door (if necessary) and reload the filter tape.

7. DATA RETRIEVAL

This section describes the methods used to retrieve data files from the BC 1054 carbon monitor. The unit communication ports include "COMPUTER RS232", RS-232 "MODEM" port, the USB type B serial converter port, Ethernet port and a USB type A port. The ports are used for digital data transfer and can be used with a local computer, digital data logger, or with a remote network connection.

7.1 *Exporting Data to a USB Flash Drive*

Exporting data from the BC 1054 to a flash or thumb drive is the recommended way to retrieve data for convenience.

Export Data screen location: Side Menu Pane>Export.

The BC 1054 can copy data files to a user-supplied USB flash drive. This drive must be inserted in the USB port located behind the front door, in the upper right corner of the tape transport.

Figure 7-1 USB Port Location

The Data Export Screen is where data ranges are selected, the type of export file and the file download status.

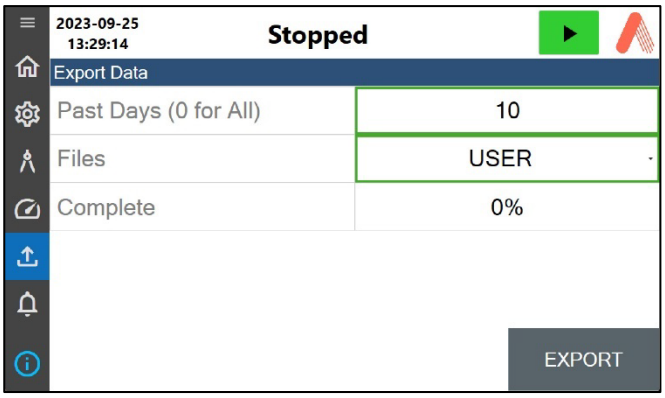


Figure 7-2 USB Data Export Screen

Past Days (0 for ALL): The number of days of data to be exported.

Files: The user-selectable files and file type to be exported.

Complete: The Data Export Status

To select the number of days of data to export, press the green outlined box next to PAST DAYS. (See **Figure 7-3**).

To change the File type, press on the green outlined box next to Files. (See **Figure 7-4**).

Use the numerical keypad to select a number of days between 1 and 999 days. 0 will export all stored data.

Press OK to save the selection and to go back to the main EXPORT DATA screen shown In **Figure 7-2**.

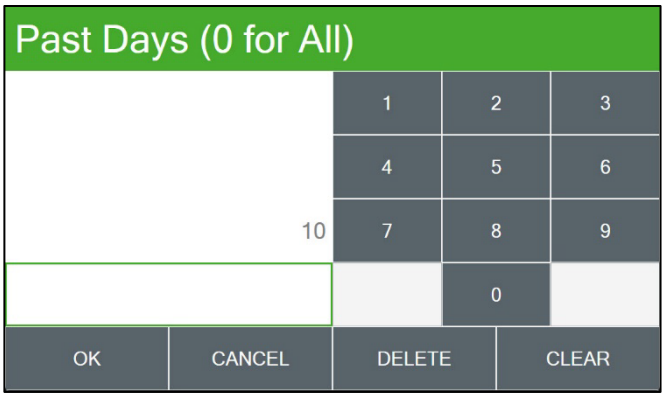


Figure 7-3 Data Export Days

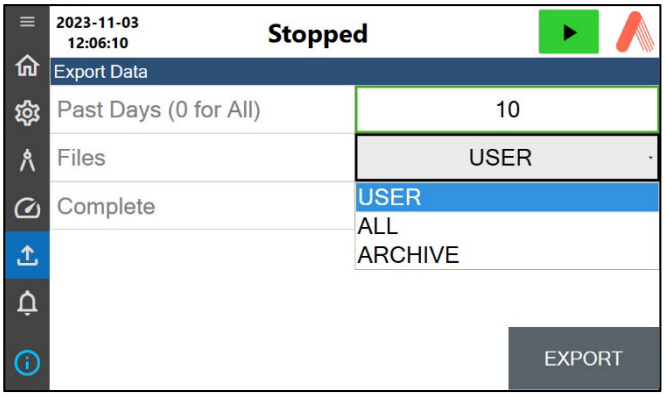


Figure 7-4 Files Drop Down Options

Press the Green outlined box next to files to access the Files drop down list. Press one of the options in the drop down to make a selection.

Details explaining each option are below.

When all selections are made, press the Export button to export the files to the USB flash drive.

USER: Selecting this option downloads the User file, the Settings file, and the Alarm file. The User file contains the corrected concentrations and is in a format that users generally want.

ALL: Selecting this option downloads the Settings file, the Alarm file, the User file, and the Diagnostics file as a CSV file. The data file contains all the raw data fields recorded by the BC 1054.

ARCHIVE: Contains the raw CSV files or diagnostics files for all the data recorded by the BC 1054. This is generally only useful for service issues.

When all selections are made, press the Export button to export the files to the USB flash drive. When the Complete status shows 100%, the USB flash drive can be removed and plugged into a computer to view the exported data files.

7.2 *Digital Communications and Data Retrieval*

This section describes the methods used to retrieve digital data files through one of the serial communications system on the BC 1054. The BC 1054 has the following ports: “Computer RS-232”, “USB COMM”, Modem, and an Ethernet. These ports may be used with a computer, laptop, modem, or digital data logger. The data can be accessed through these serial ports; and simple user commands can be sent to the BC 1054 using a terminal program or by using the free Comet software available from the Met One Instruments website.

This section provides information on the different methods for retrieving or downloading data using a local computer or over a network. Each sub section provides information about each connection type that the BC 1054 can communicate over.

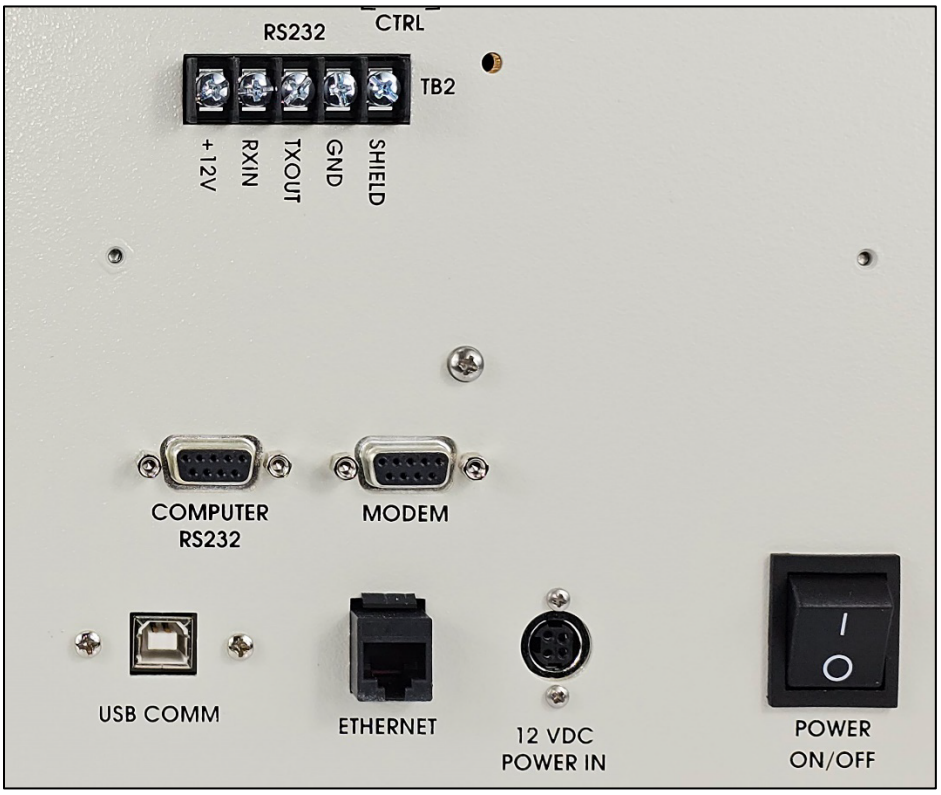


Figure 7-5 Rear Panel Data Connections

7.2.1 Ethernet Connection

The Ethernet connection can be used for local networks and remote communications with the BC 1054 if internet is available at the sample site. See **Section 4.3.3 Ethernet Configuration** for details on setting up the IP Address for Ethernet Communications. The Ethernet communication speed for this port is the fastest and most efficient way to retrieve data.

7.2.2 USB Type B Connection

BC 1054 monitors also include a USB Type B port (USB COMM) located on back panel next to the Ethernet port. The USB connection speed is the second fastest out of the connection types on the rear panel.

WARNING: A Silicon Labs CP210x Driver for this connection must be installed before connecting to this port.

USB Driver download weblink: https://metone.com/software/

The connection details are as follows:

Default Baud Rate: 115,200
Data Bits: 8
Parity: None
Stop Bits: 1
Flow Control: None

7.2.3 Modem Port Connection

The Modem Port Connection is used to connect the BC 1054 to a network modem for polling data wirelessly. The communication speed for this port is moderate. The connection details are as follows:

Default Baud Rate: 38,400
Data Bits: 8
Parity: None
Stop Bits: 1
Flow Control: None

7.2.4 Computer RS 232 Connection

Most newer computers no longer have the 9-Pin serial communications port. In these situations, BC 1054 monitors may still be connected to the computers by using a USB to serial converter. Of the converters commonly available in local electronics and office supply stores, Met One Instruments, Inc. has seen the most reliable performance from those manufactured by Belkin. The connection speed for this port has the slowest default baud rate out of the listed options. The connection details are as follows:

Default Baud Rate: 9,600
Data Bits: 8
Parity: None
Stop Bits: 1
Flow Control: None

7.3 *BC 1054 Data Output and Data Examples*

The BC 1054 outputs data files (User and Diagnostics), settings files, and alarm files. The raw format of these stored files is *.txt text (ALARM and SETTINGS) files or *.csv comma separated values format (data file) for import into a spreadsheet program.

7.3.1 Settings File

The settings file contains most of the setup menu parameters for the BC 1054. This file should be reviewed periodically to ensure that no settings have been incorrectly

changed. It also serves as a good data validation record. An example of a BC 1054 settings text file is shown in **Figure 7-6**.

```
BC 1054 Settings Report
2023-11-06 09:25:43

            BC 1054,  84059, V1.0.1, Rev 49
           Firmware,  84024, R1.0.0
   Digital Sensor 1,  597A R1.0.2

   Calibration Date,  2023-11-02
      Serial Number,  D15207
        Location ID,  1
          Baud Rate,  9600
Serial Flow Control,  NONE
        Sample Rate,  1 MIN
     Pressure Units,  mbar
        Tape Period,  Auto
  Tape Spot Advance,  1
     Tape Remaining,  0%
        Use Loading,  ON
         Load Level,  100
Load Carbon Channel,  BC1
          Flow Rate,  5 LPM
   Dilution Control,  OFF
   Dilution Percent,  OFF
      50% Threshold,  7500
      80% Threshold,  15000
         N Spot Avg,  5
           USB Days,  3
            User K1,  1.000
            User K2,  1.000
            User K3,  1.000
            User K4,  1.000
            User K5,  1.000
            User K6,  1.000
            User K7,  1.000
            User K8,  1.000
            User K9,  1.000
           User K10,  1.000
 Flow Heater Set Pt,  30.0
  Box Heater Set Pt,  30.0

    Name,    Offset,  Slope
    Flow,    -0.086,  1.061
   DFlow,     0.064,  1.158
      AT,     0.000,  1.000
      BP,     0.000,  1.000
```

Figure 7-6 Settings File Example

The settings file also contains encrypted Factory Settings, not shown, at the end of the Settings file report.

7.3.2 Alarm Log File

The BC 1054 alarm log contains the date, time, and type of each alarm or error encountered during data collection.

```
Alarm Report
2023-11-06 09:25:43
Location, 1, D15207

Time,Alarm,Message
2023-11-01 06:39:00,TAPE ADVANCE,
2023-11-01 09:50:59,MAINTENANCE,
2023-11-01 09:52:05,MAINTENANCE,
2023-11-01 16:10:59,MAINTENANCE,
2023-11-01 16:14:35,DIGITAL LINK DOWN,
2023-11-01 16:15:29,POWER OUTAGE,
2023-11-02 07:58:06,MAINTENANCE,
2023-11-02 09:58:38,MAINTENANCE,
2023-11-02 10:11:26,POWER OUTAGE,
2023-11-02 10:11:39,MAINTENANCE,
2023-11-02 12:56:08,MAINTENANCE,
2023-11-02 14:18:59,MAINTENANCE,
2023-11-02 14:58:20,MAINTENANCE,
2023-11-03 08:37:10,MAINTENANCE,
2023-11-03 21:57:00,TAPE ADVANCE,
2023-11-04 10:31:00,TAPE ADVANCE,
2023-11-06 01:50:00,TAPE ADVANCE,
```

Figure 7-7 Alarm Log Report

7.3.3 User File

The top of the BC 1054 user file contains the header information for the file. The first line contains the name of the report, the second line contains the time stamp at which the report was requested, and the third line contains the Location ID and the serial number of the device.

Below the file header is the csv column header names which describe the data from each field. Below is a description for each header.

Time is the date and timestamp for the data record at the end of the sample.

BCx(ng/m3) is the reported black carbon concentration for the indicated channel number (1-10). This is the corrected concentration that is corrected for tape loading effects.

DC(ng/m3) is the concentration of channel BC1 minus channel BC9, this channel is also known as delta carbon (DC).

Flow(lpm) is the average sample flow rate for the sample period.

DFlow(lpm) is the average dilution flow rate for the sample period.

WS(m/s) and **WD(Deg)** are the average wind speed and wind direction values from the optional WS/WD sensor for the sample period.

AT(C), RH(%) and **BP(mbar)** are the average ambient temperature, relative humidity and barometric pressure for the sample period.. These readings are from the BX-597A AT/BP/RH sensor.

Status is the alarm status (see **Section 6.2**).

Note: Because the concentrations in the user report are corrected, the BC 1054 only reports data up to the last tape advance. The BC 1054 will continue to sample and record data, but data output in the user file is only available for correction up to when the last tape advance occurred.

7.3.4 Diagnostics File

The top of the BC 1054 data files starts with the time and date of the download followed by the Location ID and the Met One serial number of the monitor. Next is the data file header that indicates the order and content of the data parameter columns. Each row contains one complete data record. See **Figure 7-8** and **Figure 7-9** for an example.

Time is the date and timestamp for the data record. The timestamp is end of the minute. For example, a timestamp of 08:21 would represent data collected from 08:20:00 through 08:20:59.

SZ(mV) and **RZ(mV)** are the Sample and Reference, respectively, detector zero value (all LEDs off).

SBx(mV) and **RBx(mV)** are the Sample and Reference, respectively, detector readings when the LED for the indicated channel number (1-10) is on.

ATNx is the light attenuation for LED channel number (1-10) indicated.

BCx(ng/m3) is the reported carbon concentration for the indicated channel number (1-10). This value is NOT corrected for filter loading. Diagnostic file data is always uncorrected.

Flow(lpm) is the average sample flow rate for the last minute.

DFlow(lpm) is the average dilution flow rate for the last minute.

WS(m/s) and **WD(Deg)** are the one-minute average wind speed and wind direction values from the optional WS/WD sensor.

AT(C), RH(%) and **BP(mbar)** are the average ambient temperature, relative humidity and barometric pressure for the last minute. These readings are from the BX-597A AT/BP/RH sensor.

LED T(C) and **DET T(C)** are the LED and Detector board temperatures, respectively.

FT(C) is the sample air temperature (the Flow Temperature) after the optical measurement module.

Status is the alarm status (see **Section 6.2**).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	Diagnostic Report																											
2	11/6/2023 9:25																											
3	Location	1	D15207																									
4																												
5	Time	SZ(mV)	RZ(mV)	SB1(mV)	RB1(mV)	ATN1	BC1(ng/m	SB2(mV)	RB2(mV)	ATN2	BC2(ng/m	SB3(mV)	RB3(mV)	ATN3	BC3(ng/m	SB4(mV)	RB4(mV)	ATN4	BC4(ng/m	SB5(mV)	RB5(mV)	ATN5	BC5(ng/m	SB6(mV)	RB6(mV)	ATN6	BC6(ng/m	SB7(mV)
6	11/1/2023 0:00	3.551	4.508	1007.822	1076.22	0.48943	643.2	1131.894	1183.59	0.36822	595.5	1238.15	1090.032	0.27832	505.9	1317.974	1090.566	0.2154	449.9	1342.707	1158.234	0.1901	437	1377.267	1327.592	0.17953	431.9	1410.072
7	11/1/2023 0:01	3.551	4.508	1006.548	1076.237	0.49072	639.6	1130.785	1183.613	0.36922	580.2	1237.156	1090.019	0.27911	498	1317.093	1090.519	0.21603	441.1	1341.943	1158.219	0.19065	421.7	1376.624	1327.683	0.18006	423.7	1409.447
8	11/1/2023 0:02	3.543	4.504	1005.259	1076.251	0.49201	643.9	1129.639	1183.631	0.37025	593.3	1236.136	1089.998	0.27992	505	1316.244	1090.519	0.21667	452.1	1341.163	1158.21	0.19123	431.3	1375.971	1327.785	0.18061	433.4	1408.816
9	11/1/2023 0:03	3.543	4.502	1003.987	1076.28	0.49331	646.6	1128.513	1183.657	0.37127	592.1	1235.177	1090.03	0.28073	508.7	1315.434	1090.546	0.21732	452.3	1340.405	1158.211	0.1918	429.7	1375.307	1327.865	0.18116	431.9	1408.146
10	11/1/2023 0:04	3.546	4.501	1002.687	1076.27	0.49461	643.7	1127.36	1183.658	0.3723	594.8	1234.187	1090.033	0.28154	507.9	1314.623	1090.56	0.21795	445.3	1339.648	1158.218	0.19237	434.2	1374.643	1327.939	0.1817	428.3	1407.488
11	11/1/2023 0:05	3.539	4.505	1001.408	1076.291	0.4959	641.2	1126.212	1183.656	0.37331	583.8	1233.196	1090.03	0.28233	498.5	1313.793	1090.575	0.21859	448.9	1338.891	1158.224	0.19293	425.4	1374.003	1328.052	0.18225	429.8	1406.849
12	11/1/2023 0:06	3.536	4.506	1000.153	1076.313	0.49717	634.7	1125.068	1183.667	0.37434	592.4	1232.214	1090.038	0.28314	504.3	1312.921	1090.553	0.21923	451.2	1338.111	1158.214	0.19351	431.9	1373.376	1328.173	0.18279	431.4	1406.202
13	11/1/2023 0:07	3.538	4.504	998.902	1076.33	0.49845	633.8	1123.96	1183.684	0.37535	581.5	1231.26	1090.058	0.28393	501.4	1312.112	1090.565	0.21987	444.2	1337.35	1158.209	0.19408	429.2	1372.738	1328.269	0.18334	427.1	1405.568
14	11/1/2023 0:08	3.537	4.508	997.622	1076.348	0.49975	646.1	1122.829	1183.716	0.37638	596	1230.252	1090.053	0.28475	509.5	1311.26	1090.57	0.22052	458	1336.564	1158.206	0.19466	439.5	1372.061	1328.353	0.18389	437.8	1404.882
15	11/1/2023 0:09	3.535	4.504	996.355	1076.358	0.50104	639.7	1121.686	1183.706	0.37739	586.8	1229.286	1090.063	0.28555	501.9	1310.437	1090.57	0.22115	443.5	1335.855	1158.243	0.19522	427.5	1371.4	1328.426	0.18443	426.1	1404.247
16	11/1/2023 0:10	3.543	4.501	995.04	1076.364	0.50238	667.5	1120.515	1183.71	0.37845	612.8	1228.268	1090.059	0.28638	524.6	1309.578	1090.576	0.22182	471.6	1335.093	1158.257	0.19582	447.5	1370.703	1328.502	0.185	453.8	1403.57
17	11/1/2023 0:11	3.539	4.499	993.689	1076.371	0.50375	680.4	1119.315	1183.728	0.37954	628.5	1227.196	1090.046	0.28725	542	1308.705	1090.599	0.22251	484.6	1334.278	1158.268	0.19644	467.6	1369.98	1328.584	0.18559	465.5	1402.845
18	11/1/2023 0:12	3.54	4.503	992.404	1076.386	0.50505	650.8	1118.151	1183.721	0.38058	598	1226.16	1090.015	0.28806	511.3	1307.86	1090.599	0.22315	452.2	1333.522	1158.284	0.19702	436.5	1369.317	1328.665	0.18614	429.3	1402.163
19	11/1/2023 0:13	3.537	4.503	991.098	1076.386	0.50637	655.9	1117.002	1183.728	0.38161	598	1225.169	1090.023	0.28888	512.4	1307.018	1090.614	0.22381	462.5	1332.74	1158.278	0.1976	438.8	1368.6	1328.716	0.1867	443.5	1401.513
20	11/1/2023 0:14	3.535	4.501	989.81	1076.4	0.50769	655	1115.855	1183.748	0.38266	604.5	1224.169	1090.033	0.2897	519.4	1306.155	1090.611	0.22447	462.6	1331.985	1158.298	0.19818	441.5	1367.917	1328.798	0.18726	443.8	1400.876
21	11/1/2023 0:15	3.541	4.505	988.49	1076.41	0.50904	671.7	1114.681	1183.759	0.38373	617.2	1223.165	1090.05	0.29054	527.3	1305.256	1090.588	0.22514	470.8	1331.144	1158.26	0.19879	454.6	1367.214	1328.87	0.18783	451.5	1400.168
22	11/1/2023 0:16	3.539	4.506	987.164	1076.417	0.51039	672.2	1113.501	1183.761	0.38479	613.1	1222.125	1090.031	0.29138	523.2	1304.401	1090.601	0.22581	468.4	1330.376	1158.286	0.19938	451.4	1366.487	1328.923	0.1884	450.7	1399.476
23	11/1/2023 0:17	3.542	4.51	985.862	1076.413	0.51171	656.1	1112.298	1183.72	0.38584	606.2	1221.147	1090.061	0.29221	520.4	1303.519	1090.578	0.22646	461	1329.549	1158.238	0.19996	438.3	1365.779	1328.973	0.18896	439.2	1398.832
24	11/1/2023 0:18	3.55	4.517	984.562	1076.418	0.51304	661.7	1111.135	1183.716	0.38688	604.3	1220.165	1090.079	0.29303	516.3	1302.663	1090.583	0.22713	465.6	1328.777	1158.245	0.20055	443.9	1365.069	1329.026	0.18952	443.8	1398.148
25	11/1/2023 0:19	3.545	4.516	983.271	1076.428	0.51436	657.6	1109.995	1183.738	0.38793	604.3	1219.122	1090.042	0.29385	515.1	1301.832	1090.593	0.22777	454.4	1328.026	1158.269	0.20114	441.1	1364.343	1329.06	0.19008	438.5	1397.447
26	11/1/2023 0:20	3.547	4.514	981.989	1076.432	0.51568	655.2	1108.845	1183.739	0.38897	603.5	1218.12	1090.03	0.29467	513.6	1300.989	1090.593	0.22843	458.6	1327.256	1158.266	0.20172	439.5	1363.62	1329.079	0.19063	434.2	1396.792
27	11/1/2023 0:21	3.539	4.507	980.67	1076.427	0.51703	668.4	1107.696	1183.751	0.39002	606.2	1217.136	1090.051	0.2955	520.9	1300.124	1090.584	0.22908	463.2	1326.484	1158.275	0.20231	446.9	1362.874	1329.101	0.19119	446.3	1396.131
28	11/1/2023 0:22	3.54	4.504	979.405	1076.429	0.51833	646.8	1106.574	1183.753	0.39104	590.1	1216.156	1090.043	0.2963	504.3	1299.289	1090.579	0.22973	451.4	1325.719	1158.259	0.20288	427.8	1362.148	1329.113	0.19174	430.3	1395.478
29	11/1/2023 0:23	3.54	4.508	978.179	1076.426	0.51958	622.1	1105.466	1183.737	0.39203	570.6	1215.219	1090.051	0.29708	487.9	1298.496	1090.579	0.23034	427.8	1325.001	1158.268	0.20343	413.3	1361.442	1329.118	0.19226	411.6	1394.803
30	11/1/2023 0:24	3.534	4.498	976.946	1076.419	0.52084	628.2	1104.375	1183.74	0.39303	576.4	1214.273	1090.042	0.29785	487.6	1297.71	1090.598	0.23096	442	1324.252	1158.25	0.20398	418.9	1360.706	1329.1	0.19279	420.1	1394.161
31	11/1/2023 0:25	3.54	4.501	975.699	1076.428	0.52213	642.9	1103.254	1183.729	0.39404	584.8	1213.295	1090.03	0.29865	502	1296.874	1090.58	0.2316	443.6	1323.523	1158.262	0.20455	426.4	1359.946	1329.073	0.19333	427.8	1393.539
32	11/1/2023 0:26	3.541	4.505	974.466	1076.429	0.5234	631.4	1102.141	1183.721	0.39504	579.7	1212.337	1090.029	0.29944	495	1296.036	1090.557	0.23222	438.8	1322.817	1158.294	0.20511	423	1359.225	1329.071	0.19386	417	1392.922
33	11/1/2023 0:27	3.542	4.505	973.217	1076.424	0.52468	638	1101.007	1183.692	0.39605	582.7	1211.366	1090.011	0.30023	494.4	1295.242	1090.575	0.23285	444.2	1322.123	1158.331	0.20567	422.1	1358.472	1329.043	0.1944	422.7	1392.241
34	11/1/2023 0:28	3.542	4.507	971.967	1076.419	0.52597	638	1099.892	1183.683	0.39706	582	1210.405	1090.014	0.30103	500.1	1294.408	1090.565	0.23349	445.7	1321.379	1158.335	0.20623	426.4	1357.73	1329.034	0.19494	425.8	1391.575
35	11/1/2023 0:29	3.547	4.508	970.74	1076.407	0.52723	626.7	1098.799	1183.675	0.39805	574.6	1209.459	1090.006	0.30181	489.4	1293.6	1090.553	0.2341	433.5	1320.632	1158.318	0.20679	418.7	1356.964	1328.982	0.19546	417.6	1390.935

Figure 7-8 Diagnostics File (First Half)

	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB
	RB7(mV)	ATN7	BC7(ng/m	SB8(mV)	RB8(mV)	ATN8	BC8(ng/m	SB9(mV)	RB9(mV)	ATN9	BC9(ng/m	SB10(mV)	RB10(mV)	ATN10	BC10(ng/r	Flow(lpm	DFlow(lpr	WS(m/s)	WD(Deg)	AT(C)	RH(%)	BP(mBar)	LED T(C)	DET T(C)	FT(C)	Status
	1365.633	0.15393	418.3	1414.631	1381.108	0.13958	410.1	1489.61	1625.447	0.0981	371.6	1492.806	1596.75	0.08906	373.6	2.01	0	0	0	22.85	31.9	979.51	29.85	29.84	29.84	0
	1365.663	0.1544	411.8	1414.12	1381.186	0.14	390.8	1489.17	1625.454	0.0984	357.7	1492.41	1596.758	0.08933	348.8	2.01	0	0	0	22.83	31.9	979.51	29.85	29.83	29.82	0
	1365.698	0.15487	414.8	1413.617	1381.296	0.14043	404.7	1488.733	1625.492	0.09871	374.1	1491.969	1596.744	0.08962	363.8	2.01	0	0	0	22.83	31.9	979.51	29.84	29.83	29.8	0
	1365.698	0.15535	422	1413.101	1381.388	0.14087	404.9	1488.289	1625.515	0.09903	375.4	1491.558	1596.756	0.0899	366	2.01	0	0	0	22.83	31.8	979.53	29.84	29.83	29.82	0
	1365.702	0.15582	417.2	1412.587	1381.477	0.1413	403	1487.823	1625.508	0.09934	371	1491.187	1596.802	0.09018	359.3	2.01	0	0	0	22.81	31.9	979.52	29.83	29.82	29.81	0
	1365.73	0.15629	412.6	1412.078	1381.58	0.14173	399.4	1487.41	1625.562	0.09964	362.5	1490.801	1596.843	0.09046	357.2	2.01	0	0	0	22.81	31.9	979.52	29.83	29.82	29.81	0
	1365.758	0.15677	422.7	1411.56	1381.68	0.14217	409.2	1486.931	1625.55	0.09996	373.3	1490.392	1596.873	0.09075	374.5	2.01	0	0	0	22.8	31.8	979.51	29.82	29.81	29.81	0
	1365.781	0.15724	415.5	1411.062	1381.778	0.14259	398.6	1486.502	1625.583	0.10027	370.8	1489.999	1596.896	0.09103	360.4	2.01	0	0	0	22.8	31.8	979.5	29.82	29.81	29.8	0
	1365.774	0.15772	424.5	1410.533	1381.876	0.14304	413.7	1486.032	1625.59	0.10059	378.9	1489.612	1596.947	0.09132	371.2	2.01	0	0	0	22.8	31.8	979.5	29.82	29.8	29.79	0
	1365.793	0.15819	412.9	1410.008	1381.954	0.14347	402.8	1485.598	1625.613	0.10089	367	1489.205	1596.956	0.0916	359.9	2.01	0	0	0	22.8	31.8	979.5	29.81	29.81	29.79	0
	1365.801	0.15869	438.1	1409.474	1382.039	0.14392	418.7	1485.134	1625.618	0.10122	384	1488.776	1596.955	0.0919	378.2	2.01	0	0	0	22.79	31.9	979.5	29.81	29.8	29.8	0
	1365.796	0.1592	452.4	1408.907	1382.137	0.14439	441.7	1484.655	1625.655	0.10156	411	1488.377	1597.031	0.09221	405.2	2.01	0	0	0	22.8	31.9	979.47	29.81	29.8	29.8	0
	1365.789	0.15968	422.4	1408.368	1382.207	0.14482	402.7	1484.213	1625.673	0.10187	365.8	1487.962	1597.033	0.09249	356.4	2.01	0	0	0	22.8	31.9	979.47	29.8	29.79	29.8	0
	1365.82	0.16017	428.3	1407.827	1382.293	0.14527	416.2	1483.738	1625.68	0.10219	385.6	1487.532	1597.041	0.09279	376.7	2.01	0	0	0	22.79	31.9	979.47	29.8	29.79	29.79	0
	1365.865	0.16066	430.8	1407.273	1382.359	0.14571	412.5	1483.245	1625.663	0.10252	383.3	1487.069	1597.021	0.09308	383	2.01	0	0	0	22.79	31.9	979.46	29.79	29.79	29.81	0
	1365.846	0.16115	435.7	1406.697	1382.423	0.14617	427.4	1482.787	1625.689	0.10284	390.2	1486.64	1597.033	0.09338	382.7	2.01	0	0	0	22.78	31.9	979.46	29.79	29.79	29.81	0
	1365.853	0.16165	439.7	1406.123	1382.492	0.14663	426.8	1482.315	1625.706	0.10317	390.6	1486.216	1597.065	0.09369	389.9	2.01	0	0	0	22.77	31.9	979.43	29.78	29.79	29.82	0
	1365.885	0.16213	425.9	1405.543	1382.533	0.14707	412.9	1481.821	1625.681	0.10349	378.2	1485.819	1597.091	0.09397	364.3	2.01	0	0	0	22.75	31.9	979.42	29.78	29.79	29.83	0
	1365.884	0.16262	431.9	1404.975	1382.582	0.14751	411	1481.366	1625.7	0.10381	380.8	1485.337	1597.038	0.09426	375.6	2.01	0	0	0	22.75	31.9	979.4	29.78	29.79	29.82	0
	1365.863	0.16311	427.5	1404.386	1382.626	0.14796	419.6	1480.901	1625.715	0.10413	383.1	1484.905	1597.049	0.09456	379.3	2.01	0	0	0	22.74	31.9	979.39	29.78	29.79	29.83	0
	1365.87	0.16359	421.4	1403.806	1382.647	0.14839	404.1	1480.43	1625.703	0.10444	374	1484.435	1596.997	0.09485	368.4	2.01	0	0	0	22.72	31.9	979.38	29.78	29.79	29.84	0
	1365.898	0.16408	436.4	1403.202	1382.682	0.14885	426.1	1479.966	1625.725	0.10477	389.3	1483.985	1596.985	0.09514	379.9	2.01	0	0	0	22.72	31.9	979.37	29.78	29.79	29.85	0
	1365.897	0.16455	415.2	1402.601	1382.684	0.14928	403.7	1479.504	1625.72	0.10508	371.4	1483.576	1596.999	0.09543	368.1	2.01	0	0	0	22.7	31.9	979.37	29.78	29.79	29.87	0
	1365.858	0.16501	399.7	1402.032	1382.699	0.1497	387.3	1479.071	1625.726	0.10538	351.7	1483.225	1597.056	0.0957	347.5	2.01	0	0	0	22.71	31.9	979.38	29.78	29.8	29.87	0
	1365.86	0.16547	410.7	1401.441	1382.692	0.15012	392.5	1478.601	1625.709	0.10569	368.7	1482.808	1597.052	0.09598	360.8	2.01	0	0	0	22.7	31.9	979.4	29.78	29.8	29.89	0
	1365.877	0.16593	407.7	1400.847	1382.695	0.15055	401.1	1478.132	1625.682	0.10599	361.7	1482.376	1597.025	0.09626	356.4	2.01	0	0	0	22.7	31.9	979.4	29.78	29.8	29.89	0
	1365.905	0.1664	407.7	1400.246	1382.686	0.15097	392.9	1477.682	1625.684	0.1063	363.5	1481.974	1597.033	0.09653	352.9	2.01	0	0	0	22.7	31.9	979.41	29.78	29.8	29.89	0
	1365.871	0.16686	411.2	1399.624	1382.66	0.1514	399.4	1477.221	1625.675	0.1066	365.9	1481.586	1597.059	0.09681	358.2	2.01	0	0	0	22.7	31.9	979.46	29.78	29.8	29.9	0
	1365.868	0.16734	418.9	1398.983	1382.62	0.15183	399.5	1476.75	1625.672	0.10692	376.7	1481.153	1597.053	0.0971	369.4	2.01	0	0	0	22.7	31.9	979.49	29.78	29.81	29.93	0
	1365.853	0.16779	399	1398.362	1382.582	0.15225	391.8	1476.295	1625.657	0.10722	359.4	1480.726	1597.029	0.09738	354.1	2.01	0	0	0	22.7	31.9	979.5	29.78	29.81	29.94	0

Figure 7-9 Diagnosits File (Second Half)

Because of the number of data fields, the figures above show the data file report in two sections for readability.

7.4 *Terminal Utility Data Retrieval and communications*

The BC 1054 supports a system of ASCII based terminal commands and Escape commands that can be used to manually collect data records or to remotely change some of the settings in the instrument through the serial port. These commands can be manually sent to the instrument through Comet, using the terminal tab, or other terminal emulators. They can also be programmed into a digital data logger or similar automated system. Most of these functions are intended primarily for use with advanced or remote

data collection systems and are not usually used for routine data collection purposes. There are two modes through which the 7500 protocol commands can be used:

7.4.1 User Communication

In the User Communication (or Terminal) mode, commands are issued by entering a letter or number command and then pressing the Enter, <cr>, key. The <Esc> key is not used when sending commands in this mode.

Press the Enter key three times to enter User Communication mode. An asterisk character appears confirming that the BC 1054 has entered the mode and that the instrument is ready for a new command. Commands will be echoed back from the instrument and an asterisk will appear after a command has completed.

To issue one of the commands listed in **Table 7-1 Terminal Mode and Escape Commands**, type the command listed and press the Enter key. The command will run and display the requested information or current setting, as appropriate.

For example, to view the current date setting type the letter D followed by the Enter key. The current date will be reported. The sequence would appear like this:

D<cr>
D 2013-01-18<cr><lf>

To change a setting, the typical sequence is to type the command, press the space bar one time, enter the new value in the same format that is displayed when checking the setting, and then pressing the Enter key.

Continuing the example above, to change the date setting type the letter D, space, and then the current date in YYYY-MM-DD format followed by the Enter key. A confirmation of the new date will be reported. The sequence would appear like this:

D 2016-02-28<cr>
D 2016-02-28<cr><lf>

Pressing <Esc> or Q<cr> will exit terminal mode.

For a detailed listing of all commands and their formats, consult the BC 1054 7500 document (contact the Met One Instruments service department. See **Section 1.2**).

Some commands have a "-$" at the end of its description. The -$ means that extra parameters are required to complete the command. To retrieve a list of the available parameters, type in the command, a space, then a question mark, and press Enter. Example: PU ? will produce "0-mbar, 1-mmhg as options. If "PU 0" is entered, the pressure units will change to mbar.

Some commands with the -$ will provide the current setting. For example if D ? is entered, the current date will be shown. To set a different date enter D YYYY-MM-DD and press enter to change the date. YYYY= the current year. MM = the current month. DD = the current day. Put together, the command will look like "D 2023-01-01".

Table 7-1 Terminal Mode and Escape Commands

COMMAND	DESCRIPTION
H	Help Menu
#	Get MetRecord Revision
1	Request settings report
2	Request All data report
3	Request New data report
0	Report Diagnostic Data
7	Request alarm event report
C	Clear data log file – $
D	Get/Set date part of the real time clock – $
T	Get/Set time part of the real time clock – $
CA	Clear alarm log file – $
DS	Report data log channel descriptors– $
DT	Get/Set the date and time of the real time clock – $
ID	Get/Set location ID or address – $
OP	Get operation state – $
PR	Print report – 0-Settings, 1-User, 2-Alarm, 3-Factory Diagnostic
PU	Get/Set pressure units - $
PW	Unlock protected commands
QH	Report Data Record Header
RV	Report Model/Part/Revision
RQ	Get last data record (same as 4 command)
SB	Get/Set baud rate – $
SS	Get Met One serial number
ST	Get/Set sample time – $
SPW	Get/Set user password – $
FTSP	Get/Set flow temperature set point – $
SPOT	Get/Set number of tape advance spots – $
TENA	Get/Set tape advance loading enable – $
TPER	Get/Set tape advance period – $
DSCRC	Get the data log channel descriptors CRC – $
TLOAD	Get/Set tape advance loading – $
TCARBON	Get/Set tape advance loading carbon type – $
DFCTL	Get/Set dilution control – $
DFPCT	Get/Set dilution flow percentage – $
DFSYS	Report Dilution System presence – $
DF50TH	Get or Set 50% Dilution Threshold
DF80TH	Get or Set 80% Dilution Threshold
DFSPOT	Get or Set N-Spot Average
K x	Get/Set User K factor for each channel, x = 1-10, k 1 = BC1, k 2 = BC2, etc

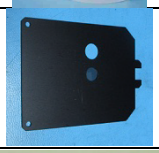
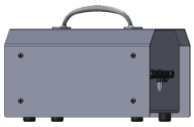
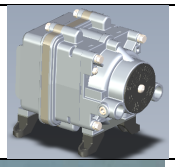
Table 7-2 shows the commands associated with editable settings, along with the default value for the setting and the settable range:

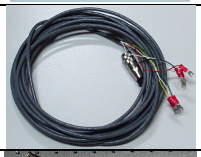
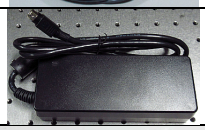
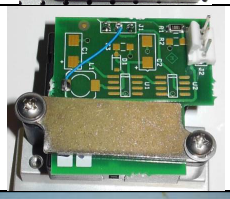
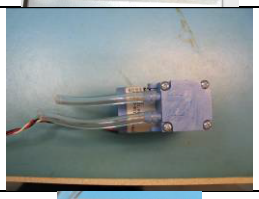
Table 7-2 User Editable Settings

DESCRIPTION	RANGE	DEFAULT	COMMAND
Location ID	1 – 999	1	**ID**
Tape advance period (HR) 0 = Advance on tape loading only	0, 1, 2, 3, 4, 6, 8, 12, 24	0	**TPER**
Number of tape advance spots	1, 2	1	**SPOT**
Tape advance loading enable	0=OFF, 1=ON	1	**TENA**
Tape advance loading set point (%)	10 to 125	100	**TLOAD**
Tape advance loading carbon type	0..9, 0=BC1, 1=BC2, etc	0	**TCARBON**
Serial port baud rate (Current Port)	2=1200, 3=2400, 4=4800, 5=9600, 6=19200, 7=38400, 8=57600, 9=115200	N/A	**SB**
Sample Period	0=1min, 1=5min, 2=10min, 3=15min, 4=30min, 5=60min	0	**ST**
User password	0 – 9999	0	**SPW**
Number of days of data to copy to USB drive	0 = All data, 1 - 999 days	0	**UD**
User K-Factor K 1 = BC1, K 2 = BC2, etc	K 1 = BC1, K 2 = BC2 0.1 – 9.99	1.0	**K x**

8. PARTS and ACCESSORIES

The following parts are available from Met One Instruments for maintenance, replacement, service, and upgrades. If unsure about a part, please contact the technical service department. Some of these parts may require technical skills or special instructions before use or installation.

Description	Part Number	Graphic
Filter Tape Roll	**460211**	
Span Check Membrane (ND Filter)	**81947-3**	
Debris Filter Assembly	**580356**	
Debris Filter, Replacement Filter Element Only	**580292**	
Fuse, 8A	**590862**	
Flow Control Assembly	**82322-1**	
External AC Pump Box, 110 VAC	**83055**	
External AC Pump Box, 220 VAC	**83054**	
Replacement AC Pump Assembly, 110 VAC	**83058**	
Replacement AC Pump Assembly, 220 VAC	**83057**	
Pump Re-build kit	**83305**	
Inlet Support Tube	**8936-5**	
Sharp Cut Cyclone, PM 1, 2 LPM	**SCC 111**	
Sharp Cut Cyclone, PM 2.5, 2 LPM	**SCC 112**	
Sharp Cut Cyclone, PM 1, 5 LPM	**82344**	
Sharp Cut Cyclone, PM 2.5, 5 LPM	**82336**	
Dilution Flow System	**82480**	

Plug, Push-To-Connect, 1/2" OD, Red	**580183**	
Cap, Vinyl, 1/2" ID x1/2" Long, Black	**770025**	
TSP Inlet	**9441**	
Straight Fitting (Mates Tubing to the cyclone)	**580399**	
Hose Clamp	**480773**	
Tubing, Polyurethane, ESD, 90A, 1/2" x 3/8"	**960216**	
Grounded Inlet Tubing Kit	**82934**	
Ambient Temperature, Pressure, RH Combination Sensor	**BX-597A**	
BX-597A Digital Sensor Cable, 25 foot length	**30010-25**	
Power Supply, AC/DC Switching Adapter, 12V, 8.5A	**510634**	
Flow Sensor Assembly (Dilution System)	**9049-5**	
Pump Module, Dilution Flow System	**82885**	
Solenoid, 3 Way, Dilution Flow System	**82886**	

Filter, Dilution Flow System	**82887**	
Inlet cyclone O-Ring replacement kit	**8658-2**	
Serial Cable, RS-232, DB-9 Male to Female	**550065**	
Fan, Box Heater Circulation	**590080**	
USB Cable	**500784**	
Clock Battery Assembly	**390021**	

9. PRINCIPALS of OPERATION

Rosen, et. al.[i] established the relationship between the attenuation of laser light through quartz filters onto which ambient particulate samples containing soot had been collected and the concentration of "graphitic carbon" of the same samples thereby establishing the viability of optical BC monitoring techniques as determined by Raman scattering.

Gundel, et. al.[ii] later demonstrated reasonable linear correlation over a wide concentration range between measured attenuation of graphitic carbon collected onto quartz filters and "BC" concentrations determined by thermo-optical methods leading to an estimate of its "specific attenuation" σ.

BC concentration in the BC 1054 is determined by measuring the change in optical transmission as BC-containing particulate matter accumulates onto filter tape and then converting this transmission data into BC concentration. The 460211 Met One Instruments BC 1054 filter tape will extend the possible period of unattended operation to several months under most conditions.

In the BC 1054, transmission of light coming from light emitting diodes is measured across filter tape onto which sampled aerosol containing BC is being accumulated. Reference transmission across a clean portion of the filter tape is simultaneously measured. As BC accumulates onto the filter tape, light transmission across that portion of the tape will decrease.

9.1 *Mass Calculation*

There is not a universally agreed to soot reference material "SRM" that could be used to calibrate filter-based optical thermal-optical EC or filter-based BC analyzers such as the BC 1054.[iii] Since a precise definition of soot does not exist, its exact quantification cannot be made. Instead, filter-based BC monitors, such as the BC 1054, report BC concentrations based on a presumed relationship between measured optical attenuation through the filter tape, as BC accumulates and ambient BC levels based on historical measurement data collected by thermo-optical methods, which are themselves, only semi-quantitative. The default calibration settings on the BC 1054 are derived from those. The mass attenuation cross section "MACS" and its wavelength dependence are derived from the empirical relationship, shown in Equation 1, based on absorption onto quartz filter media and thermo-optical measurements.[iv] [v]

Equation 1: MACS Relationship

$$\sigma(m^2 g^{-1}) = \frac{14{,}625}{\lambda(nm)}$$

BC is calculated by measuring the changes in transmission of light through the portion of the filter accumulating particulate matter relative to the transmission of light through a

portion of the filter not accumulating particulate matter. The relative measured intensity, I_t is defined as the measured signal at time t through the filter accumulating the PM divided by the measured signal at time t of light through the reference as shown in Equation 2.

Equation 2: Measured Relative Intensity

$$I_t = \frac{S_B(t) - S_Z(t)}{R_B(t) - R_Z(t)}$$

$S_B(t)$ is the measured signal at time "t" with the illumination source on through the sampled filter spot. $S_Z(t)$ is the measured signal at time "t" with the illumination source off through the sampled filter spot. $R_B(t)$ is the measured signal at time "t" with the illumination source on through reference portion of the filter and $R_Z(t)$ is the measured signal at time "t" with the illumination source off through the reference portion of the filter.

Equation 3: Attenuation

$$ATN(t) = -ln\left[\frac{I_t}{I_0}\right]$$

$ATN(t)$ as defined in Equation 3 is calculated from the change in measured optical transmission through the filter that occurs over the time period Δt as PM accumulates. The filter-based aerosol absorption coefficient of the collected particulate matter is defined in Equation 4. A is the cross sectional area of the filter spot, Q is the volumetric flow rate, and $\frac{\Delta ATN}{\Delta t}$ is the measured change in attenuation during time Δt.

Equation 4: Aerosol Absorption Coefficient

$$b_{ATN} = \frac{A}{Q}\frac{\Delta ATN}{\Delta t}$$

The filter-based aerosol absorption coefficient of the collected particulate matter is known to differ significantly from the true aerosol absorption coefficient of black carbon. Weingartner, et. al. describes an empirical formula used to connect the two in Equation 5.

Equation 5: True Aerosol Absorption Coefficient

$$b_{abs} = b_{ATN}\frac{1}{C \cdot R(ATN)}$$

C is the part of the difference between the true aerosol absorption coefficient and the filter-based aerosol absorption that is constant and depends only on the filter medium. $R(ATN)$ is the part of the difference between the true aerosol absorption coefficient and the filter-based absorption coefficient that is not constant, but instead is attenuation-dependent.

BC concentration is determined by dividing true aerosol absorption coefficient by the mass attenuation cross section as is shown in Equation 6.

Equation 6: Mass Calculation

$$M_{BC} = \frac{b_{abs}}{\sigma_{abs}} = \frac{b_{ATN}}{\sigma_{abs} \cdot C \cdot R(ATN)} = \left[\frac{A}{Q \cdot \sigma_{abs} \cdot C \cdot R(ATN)}\right]\frac{\Delta ATN}{\Delta t}$$

In the BC 1054, the spot size A, the mass absorption coefficient σ_{abs}, and the filter tape constant C, are constants. Therefore the BC concentration M_{BC} is calculated by multiplying the change in attenuation over time $\frac{\Delta ATN}{\Delta t}$, as is measured by the BC 1054 by the inverse of $R(ATN)$ and a proportionality constant $\left[\frac{A}{Q \cdot \sigma_{abs} \cdot C}\right]$.

9.2 *Instrument Calibration*

The Met One Instruments BC 1054 default calibration values are the historically used mass absorption cross sections "MACS," shown in Equation 1, but adjusted for the change in filter media. This is shown in Equation 7 and Equation 8. Note that $C_{quartz} = 2.14$.

Equation 7: Filter Media Influence on MACS

$$\sigma(m^2 g^{-1}) =\cdot \sigma_{abs} \cdot C_{quartz} = \frac{14{,}625}{\lambda(nm)}$$

and

Equation 8: True Aerosol MACS used in BC 1054

$$\sigma_{abs}(m^2 g^{-1}) = \frac{6{,}834}{\lambda(nm)}$$

σ_{abs} is set to 7.770 m²/g for 880 nm illumination. In order to calculate the true aerosol absorption coefficients for other illumination wavelengths a 1/λ wavelength dependence is presumed.

The true aerosol mass absorption coefficients σ_{abs} used in the BC 1054 are shown in the table below. For the glass fiber tape used by the BC 1054, C=2.61.

Table 9-1 MACS Values for BC 1054

λ(nm)	σ_{abs} (m²/g)
370	18.48
430	15.90
470	14.55
525	13.02
565	12.10
590	11.59
660	10.36
700	9.77
880	7.77
950	7.20

9.3 *Filter Media and Loading Effects*

The convenience of using filter-based methods to measure BC is somewhat offset by several measurement artifacts caused by interaction between sampled BC and the filter media, non-linearity of response between measured absorption and BC concentration at high BC filter loadings, scattering of non-absorbing particulate matter and other issues. Non-linearity of response is often referred to as the "filter loading" effect and is more apparent in highly time resolved data where high BC concentrations are being tracked. The filter-loading effect for BC measurements may be mitigated somewhat by frequent tape advances.

Data output to the User data file has been corrected for filter loading by an internal algorithm.

---

[i] Rosen, H., Hansen, A. D., Gundel, L., and Novakov, T., "Identification of the optically absorbing component in urban aerosols." Appl. Opt. 17:3859-3861 1978.

[ii] Gundel, L., Dod, R., Rosen, H., and Novakov, T., *"The relationship between optical attenuation and black carbon concentration for ambient and source particles." The Science of the Total Environment,* **36**:197-202 1984.

[iii] Baumgardner, D., Popovicheva, O., et. al., *"Soot reference materials for instrument calibration and intercomparisons: a workshop summary with recommendations*." *Atmos. Meas. Tech.* **5**: 1869-1887, 2012.

[iv] Gilardoni, S., Vignati, E., Wilson, J., "Using measurements for evaluation of black carbon modeling" *Atmos. Chem. Phys.* **11**:439-455 2011.

[v] Jennings, S. G., Pinnick, R. G., *"Relationships between visible extinction, absorption and mass concentration of carbonaceous smokes", Atmospheric Environment* **14**:1123-1129 1980.