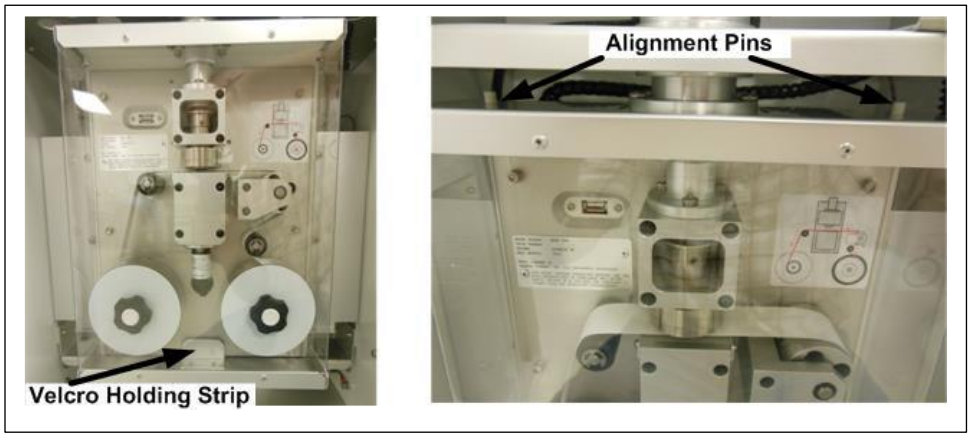
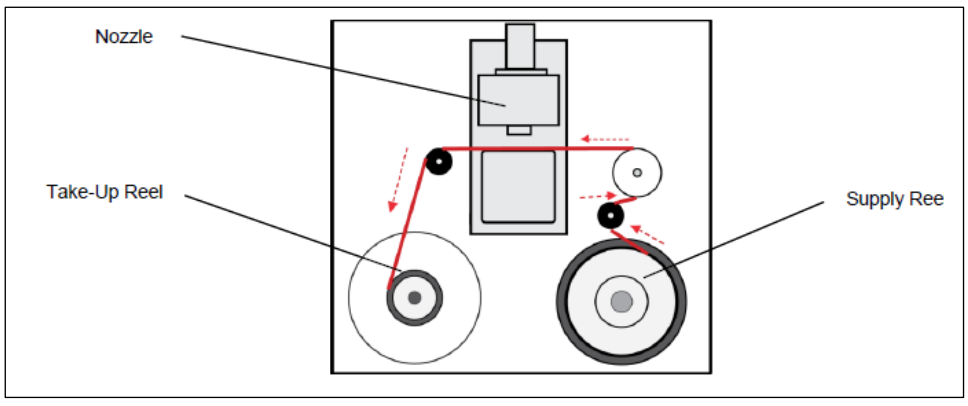
MET ONE BAM-1022 OPERATION

Install Filter Tape

1. **Operate Menu** > **Load Filter Tape**.
2. Remove the clear plastic box that covers the tape, nozzle, and emitter/detector.
3. Remove the plastic reel covers.
4. Install an empty plastic core on the take-up (left) reel.
5. Load the new roll of filter tape on the supply (right) reel and guide the tape into the transport assembly as shown in the drawing just right of the nozzle.
    a. Handle the filter tape only by its edges to avoid contaminating the sampling surface.
    b. Note: the BAM 1022's tape routing is different from the BAM 1020.
6. Use adhesive tape to fasten the loose end of filter tape to the empty core on the take-up reel.
7. Rotate the reels by hand until the filter tape is taut.
8. Install the plastic reel covers. Tighten them until the metal plates behind the reels just begin to turn.
9. Align the filter tape so that it is centered under the nozzle.
10. Press **MOVE**.
11. If the tension is ok, green text "TAPE IS OK!" will appear.
12. Exit the Load Filter Tape menu.





Self-Test

The BAM 1022's built-in Self-Test function automatically tests the tape, counting and flow systems to ensure that the BAM is ready to enter sampling mode. The Self-Test should be run initially and after any interruption to sampling, such as a quality control check, filter tape change, or performance evaluation.

1. **Main Operating Screen > Test Menu** > **Run Self-Test**.
2. The Self-Test will run. You will hear mechanical noises and then the pump will turn on.
3. When it is done, a passing result will display "SELF-TEST COMPLETE" in blue or green letters.
4. If the Self-Test fails, it will display a failure and will take you to the Alarms menu. Use this information along with the User's Manual to troubleshoot the issue.
5. When you have resolved the issue repeat the Self-Test until you get a passing result or determine that the instrument needs more in-depth repairs.

Leak Check

1. **Test Menu** > **Tape Test**. Press **MOVE TAPE** 5 times to advance the tape to a clean, unsampled spot.
2. Remove the PM10 head from the end of the sample inlet.
3. Install the leak check adapter in place of the PM10 head, above the VSCC. Turn the flow audit adapter valve to the closed position (perpendicular to the inlet).
4. **Test Menu** > **Leak Test**.
5. Make sure that the nozzle is down by pushing **NOZZLE DOWN**.
6. Turn the pump on. The displayed lower pressure is an important diagnostic and should be read before opening the valve on your filter. Note the ambient pressure when the pump is off.
7. Allow the pump to stabilize for 20-30 seconds.
8. Read the flow rate on the BAM display and record it in the **As-Found** Leak Check section of the BAM 1022 QC form. The flow rate must be ≤ 1.5 LPM for the leak check to pass. If the leak check does not pass, see Section 6.4 to perform an advanced leak check.
9. Turn off the pump.
10. **Important:** Allow the Lower Pressure value to return to ambient. This will take a minute or so.

Once the pressure has returned to ambient, open the flow audit adapter and remove it. Waiting for equilibration is very important, because the detector in a 1022 is directly in line with the flow path. **Opening the valve before equilibration of the pressure can push debris from the filter into the detector**.

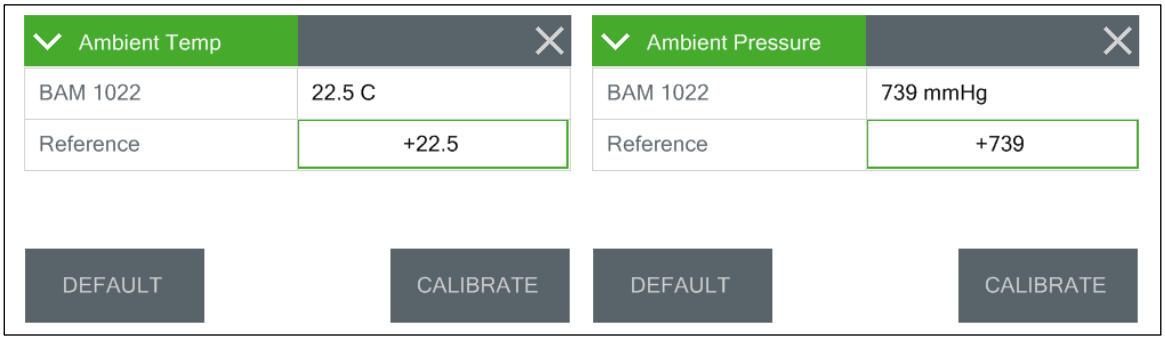
Ambient Temperature and Pressure Verification

As temperature and pressure change, so does the density of air. They are measured to correct flow (and by extension concentration) to a value that can be compared across meteorological conditions.

The Ambient Temp and Ambient Pressure screens allow the user to view and calibrate the probes used to measure ambient conditions. For each parameter, the BAM shows the instrument's indicated **BAM 1022 value**. The **REFERNCE value** is typically identical to the BAM value by default, although it is whatever was last entered for a calibration.

Note: Operators should complete a full initial QC before making any changes to the REFERENCE value. If recalibration is needed, record the results of the initial QC checks in the QC form labeled "**as found**." Calibrate the necessary parameters following the steps in the Calibration section. Then repeat the QC check and record the results in the QC form labeled "**as left**."

1. Remove the PM10 inlet head and install the flow audit device (DeltaCal or AliCat) above the VSCC on the inlet downtube.
2. Allow the flow audit device to equilibrate for 5 minutes. If using the AliCat flow device, insert the tip of the certified, NIST-traceable thermometer into the radiation shield and allow it to equilibrate for five minutes.
3. **Select Test Menu** > **Ambient Temp**.
4. Record the temperature reported by the flow audit device or thermometer on the "**as found**" section of the QC form.
5. The screen will show the ambient temperature measured by the BAM 1022.
6. Record the BAM 1022 temperature in the "**as found**" section of the QC form.
    a. If the temperature verification passes (±2°C) no further action is needed. If it fails, you will need to calibrate it as described in the Calibrate section below.
7. Press **X** to exit.
8. **Select Test Menu** > **Ambient Pressure**.
9. Measure the ambient pressure with flow audit device or NIST-Traceable pressure sensor and record it in the "**as found**" section of the QC form.
10. Record the BAM 1022 pressure the "**as found**" section of the QC form.
    a. If the pressure verification passes (±10 mmHg) no further action is needed. If it fails, you will need to calibrate it as described in the Calibrate section below.



Ambient Temperature and Ambient Pressure Menu

Three-Point Flow Verification

Although the BAM 1022 operates at a flow rate of 16.7 LPM, the QC check also tests the BAM 1022 at flows of 14.0 and 17.5 LPM. Testing three flows ensures not only that the operating and design flows are accurate but also that the slope of the BAM's mass flow sensor is properly calibrated.

1. Ensure the certified flow transfer standard or flow audit device (DeltaCal or AliCat) is installed above the VSCC on the sample inlet downtube in the correct direction of flow.
2. **Select Test** > **Flow Calibration.** The pump will start, and the flow will equilibrate at 16.7 LPM.
3. Once the flow has stabilized, record the BAM flow and the flow observed by the flow audit device in the "**as found**" section of the QC form (**Flow 1 @ 16.7**).
4. Touch the **Set Point** box, select the **17.5** LPM flow and press **OK**.
5. Once the flow has equilibrated at 17.5 LPM record the BAM flow and flow observed by the audit device flow in the "**as found**" QC form (**Flow 2 @ 17.5**).
6. Touch the **Set Point** box again, select **14.0** and press **OK**.
7. Allow the flow to equilibrate to 14.0 LPM and enter the BAM flow and flow observed by the flow audit device in the "**as found**" QC form (**Flow 3 @ 14.0**).

The acceptable ranges for each parameter are:

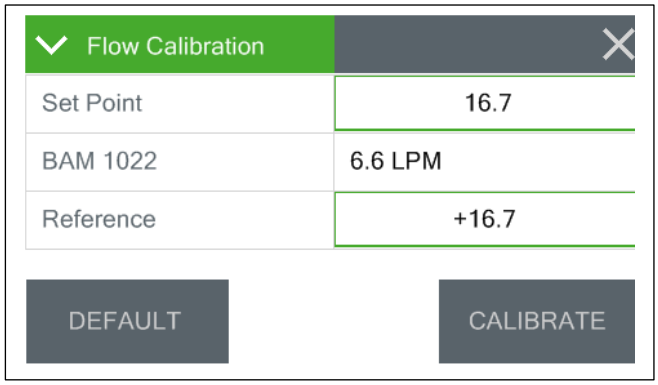
- Ambient Temperature: ±2°C
- Ambient Pressure: ±10 mm Hg
- Flow: ±4% of reference standard and ±5% of design flow (16.7 LPM)

If any parameter falls outside of these ranges, document the observed value in the "**as found**" section of the QC form, and proceed with calibration as described below. After calibration, repeat the QC checks and record the results in the "**as left**" section. Record all calibration activities in the site log.

Calibrate Temperature, Pressure, and Flow

The ambient temperature, ambient pressure, and flows must be calibrated upon installation and relocation of the BAM 1022. It is recommended that the user default to factory settings before calibrating. Temperature, pressure, and then multipoint flow should be calibrated in order.

1. Remove the PM10 inlet head and install the flow audit device (DeltaCal or Alicat) above the VSCC on the inlet in the correct direction of flow. Allow the flow audit device to equilibrate for 5 minutes.
    a. If using the Ali-Cat flow device, insert the tip of the certified, NIST-traceable thermometer into the radiation shield.
2. **Select Test Menu** > **Ambient Temp**.
3. Press **DEFAULT**.
4. Measure the actual ambient temperature inside the radiation shield using a certified, NIST-traceable thermometer or flow audit device.
5. Enter the temperature value from the flow audit device into the BAM's Reference field.
6. Press **Calibrate** and exit to the Test Menu.
7. Record the BAM 1022 value and Reference value into the "**as-left**" section of the QC form.
8. Select Ambient Pressure.
9. Press **DEFAULT**.
10. Measure the actual BP at the BAM inlet using a flow audit device or certified BP standard.
11. Enter the reading from the standard into the Reference box on the BAM.
12. Press **Calibrate** and exit to the Test Menu.
13. Record the BAM 1022 value and Reference value into the "**as-left**" section of the QC form.
14. Select **Flow Calibration** to enter the flow calibration screen. The pump will start.
15. Press **DEFAULT**.
16. Select **Set Point** and choose **14.0**.
17. Once the flow equilibrates, enter the value from the flow standard in the Reference box.
18. Push **CALIBRATE**
19. Record the BAM 1022 flow and Reference flow into the "**as-left**" section of the QC form (**Flow 1 @ 14.0**).
20. Repeat this for values of **17.5** and **16.7** LPM. Record flow values onto QC form.
21. If done, return to the home screen.



Flow Calibration Screen

Span Mass Audit

The Span Mass Audit checks the stability and performance of the BAM 1022's beta particle detection system. To do this insert two "foils", a "zero foil" and a "span foil" over the filter tape. Each set of foils are instrument-specific, and not interchangeable. It is important to make sure that the filter tape is loaded and to be careful not to tear the filter tape or introduce dust when inserting and removing the foils.

Note: Once the foils are properly loaded, the nozzle will automatically lower. Once the measurement is done, and you have advanced the screen, the nozzle will raise. If the span mass audit fails, repeat it, and make sure that the foils are properly centered when the nozzle lowers. Small movements after you place it in can result in large reported mass changes. Sometimes the foils move when you remove your fingers from them, so it is best to hold it in place until the nozzle is lowered.

1. **Test Menu** > **Span Mass Audit**.
2. The screen will prompt you to load the zero foil. Once it is properly inserted the nozzle will automatically lower and a 240 second countdown will begin.
3. When it finishes the nozzle will raise and the screen will prompt you to remove the foil.
4. When the screen shows the span value, record it in the station log (see Section 6.2) and press **CONTINUE**.
5. The screen will prompt you to insert the Span Foil above the tape. Again, the nozzle will lower when the foil has been inserted correctly.
6. A 240 second countdown will begin.
7. Once complete the test will display the calculated mass (Mass), the recorded value (Span), and the percent error on to the QC form.
8. Exit the test.
9. The nozzle will raise and prompt you to remove the span foil.
10. Remove it, place it in the sleeve and store it safely.

Clock Verification

1. Verify that the BAM clock is the same time as the data logger clock. If not connected to a logger, time should be set to the time reported by an internet-connected device (i.e. cell phone).
2. Record the data logger time and as-found BAM time in the Clock Verification section of the BAM 1022 QC form.
3. If the BAM does not report the same time as the data logger or internet-connected device, adjust the BAM clock in **Setup Menu** > **Set Clock.** Record the results on the QC form as the "as left" BAM time.

Perform Self-Test

The BAM's built-in Self-Test function automatically tests the tape and flow systems to ensure that the BAM is ready to return to sampling mode. The Self-Test should be run after every QC check and any other interruption to sampling, such as a filter tape change or performance evaluation.

1. **Select Test Menu** > **Run Self-Test**.
2. Read the "Status" line when the Self-Test is complete. If it displays SELF TEST PASSED, select **EXIT** to return to the home screen.
3. If the status displays ERROR OCCURRED, look for an error in the individual test parameters on the BAM screen. Resolve the error and repeat the Self-Test until it passes. If you are unable to resolve the failure, contact the calibration and repair lab.
4. Remove the flow audit device or transfer standard and re-install the SCC or VSCC and PM10 inlet head.

Perform Leak Check

1. **Test Menu** > **Tape Test**. Press **MOVE TAPE** 5 times to advance the tape to a clean, unsampled spot.
2. Remove the PM10 head from the end of the sample inlet.
3. Install the leak check adapter in place of the PM10 head, above the VSCC. Turn the flow audit adapter valve to the closed position (perpendicular to the inlet).
4. **Test Menu** > **Leak Test**.
5. Make sure that the nozzle is down by pushing **NOZZLE DOWN**.
6. Turn the pump on. The displayed lower pressure is an important diagnostic and should be read before opening the valve on your filter. Note the ambient pressure when the pump is off.
7. Allow the pump to stabilize for 20-30 seconds.
8. Read the flow rate on the BAM display and record it in the **As-Left** Leak Check section of the BAM 1022 QC form. The flow rate must be ≤ 1.5 LPM for the leak check to pass. If the leak check does not pass, see Section 6.4 to perform an advanced leak check.
9. Turn off the pump.
10. **Important:** Allow the Lower Pressure value to return to ambient. This will take a minute or so.

Final Checks

Before leaving the site, always verify that the flow audit device is removed, the SCC or VSCC and PM_{10} head are installed, the BAM displays the home screen, and the results of all QC checks and maintenance are recorded in the field data sheet and/or site logbook.