

PM_{2.5} Continuous Monitoring

Qualitative Issues on PM_{2.5} Continuous Methods

National Ambient Air Monitoring
Conference
Atlanta 2014





Topics in this section:

In this section we will focus on areas where monitoring agencies, instrument companies, and review of the data suggest actions to ensure good data comparability between PM_{2.5} FRMs and continuous FEMs

Note: Not Method Specific

- ✓ Site and Shelter Considerations
- ✓ Method Setup
- ✓ Firmware updates?
- ✓ Leak Tests?
- ✓ AIRNow QC tools
- ✓ Data Reporting
- ✓ Summary



Site and Shelter Considerations

- Collocation Distance - 2012 PM NAAQS Final Rule provides more flexibility in collocating PM_{2.5} Continuous monitors and FRMs
 - Typical collocation for low volume samplers = 1 to 4 meters
 - Collocation may also be approved up to 10 meters for sites at neighborhood and larger scales
- Ensure down tube can be installed perpendicular to the ground
- Should an Uninterruptable Power Supply (UPS) be used? Most sites won't need this, but some do run their data logger on a UPS.



Site and Shelter Considerations (Continued)

- Stand alone shelter or in main shelter?
- Minimize Vibration?
 - Isolate pump
- Warm enough to avoid condensation
- Steady control of HVAC
- Avoid AC blowing directly on downtube
- Grounding of the chassis?





Method Set-up (Not Method Specific)

- ✓ Acceptance Testing options:
 - Run on a bench in your lab/shop
 - Collocate with another continuous FEM
 - Compare to a buddy site

- ✓ Initial Instrument settings:
 - Make sure your flow system is set to report data at local conditions
 - Verify all settings for use as FEM

- ✓ Verification of:
 - Flow
 - Temp, BP, RH

- ✓ Ensure data are stable before they are reported. Typically, a few hours to overnight

Met One BAM 1020



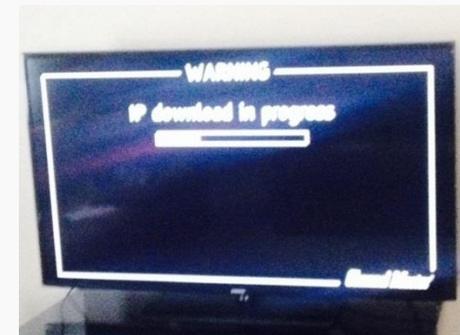
Thermo BAM 5030i





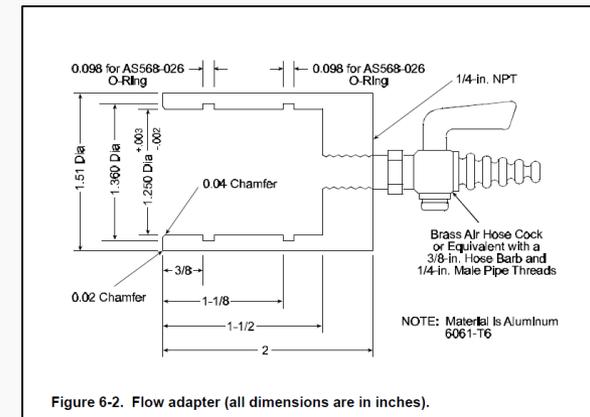
Firmware Updates?

- FEM designations typically describe firmware as “with Version x.xx or later”
- Be aware of whether a firmware update is appropriate for your network
 - It may not be necessary to update every firmware release.
 - Know what’s in an update and whether you need it.
 - If possible, test on one to ensure its goes smoothly
- A firmware update may help with improvements, or there may be potential consequences of firmware updates:
 - User selections may be set to default rather than what you need for your program
- Record all locally entered information before updating firmware.
- Review and ensure all locally entered information is still appropriate after firmware update.



Leak Tests?

- We have always thought leak tests as being a critical check.
- However, recent discussions have raised concerns regarding whether we are stressing samplers and monitors under too much vacuum?
 - Too much vacuum may have consequences depending on the monitor used
 - Met One BAM 1020 – adjustments to the nozzle to minimize a leak may lead to “punching” holes in the tape.





AIRNow QC Tools

- **Quality Control Criteria** - A set of QC criteria that can be set by site, pollutant, and hour for several variables
 - Default values are set by pollutant
- **Buddy Sites** - A buddy site check, when enabled, allows a value at one site to be checked against the difference between the average value at its *Buddy Sites*.
- **Email Notifications** - Reports on QC and Buddy site checks can be emailed to you or others in your agency
- Details on these checks are available in AIRNowTech.

http://www.airnowtech.org/Resources/airnow_quality-control-pt1.pdf

http://www.airnowtech.org/Resources/airnow_quality-control-pt2.pdf



AIRNow Quality Control Criteria

- **Max Suspect (Default = 75)** Data values above the selected Maximum Suspect value will be flagged suspect.
- **Max Severe (Default = 175)** Data values above the selected Maximum Severe value will be flagged invalid.
- **Rate of Change (Default = 40)** This check determines the difference in data values between two consecutive hours. If the difference, or rate of change, exceeds the specified Rate of Change value set by the user, the data will be flagged invalid.

Parameter: ▼

Quality Control Criteria

[QC Descriptions](#)

Hour (LST)	Max Suspect	Max Severe	Rate of Change	# of Sticking Hours	Sticking Value	Minimum Drift
0000	75.00000	100.00000	50.00000	6	5.00000	0.00000
0100	75.00000	100.00000	50.00000	6	5.00000	0.00000
0200	75.00000	100.00000	50.00000	6	5.00000	0.00000



AIRNow Quality Control Criteria (Continued)

- **# of Sticking Hours (Default = 4)** This check looks for data values that are "stuck" at the same value for a specified number of hours.
- The **Sticking Value (Default = 10)** column sets the minimum value for which data will be checked for sticking. This criteria exists because some air quality parameters do stick at low values for several hours with the data being physically valid.
- **Minimum Drift (Default = 4.99)** Data values below the selected Minimum Drift value will be flagged invalid.

Parameter:

Quality Control Criteria

[QC Descriptions](#)

Hour (LST)	Max Suspect	Max Severe	Rate of Change	# of Sticking Hours	Sticking Value	Minimum Drift
0000	75.00000	100.00000	50.00000	6	5.00000	0.00000
0100	75.00000	100.00000	50.00000	6	5.00000	0.00000
0200	75.00000	100.00000	50.00000	6	5.00000	0.00000



AIRNow QC Check Report

- Provides Network summary by parameter that includes:
 - Hour
 - Number of sites reporting
 - Count of QC flags that were set in the hour
- Available in AIRNowTech at:
 - My Account
 - Notifications
 - Agency Daily

PM2.5 Hour	#Sites	#QC
0000	17 of 17	0
0100	17 of 17	1
0200	17 of 17	0
0300	17 of 17	0
0400	17 of 17	0
0500	17 of 17	0
0600	17 of 17	0
0700	17 of 17	0
0800	16 of 17	0
0900	16 of 17	0
1000	16 of 17	0
1100	16 of 17	1
1200	16 of 17	1
1300	16 of 17	0
1400	16 of 17	0
1500	16 of 17	0
1600	16 of 17	0
1700	16 of 17	0
1800	16 of 17	0
1900	16 of 17	0
2000	16 of 17	0
2100	16 of 17	0
2200	16 of 17	0
2300	16 of 17	0



Buddy Sites in AirNow

Compare hourly data values to those at nearby stations.

Settings include:

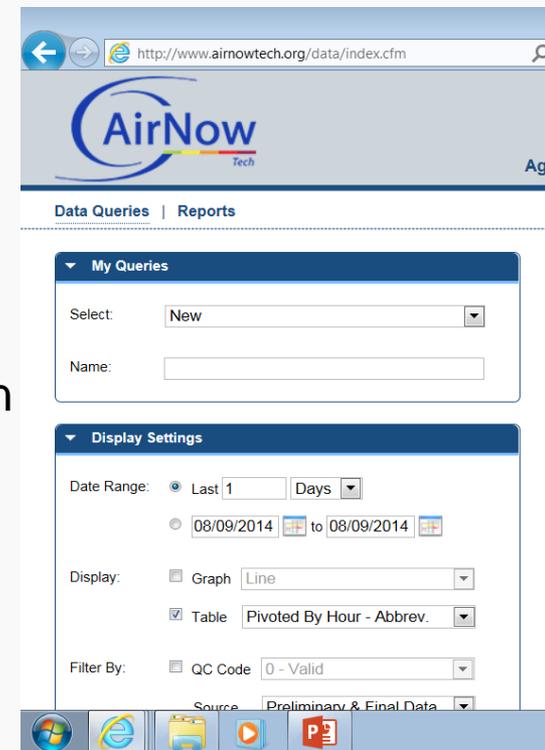
- Selected monitoring sites
- **Threshold** – absolute concentration difference allowed between monitors
- **Minimum Number of Buddy Sites** (that must be below the **Threshold**)

A screenshot of the "Unit1001 PM2.5-88502 - 88502 / 1 Hr / 1" configuration window. The window has a blue header bar. Below the header, there are several sections: "Parameter(s):" with a dropdown menu set to "PM2.5 Continuous" and a "Parameter Selector" link; "Site(s):" with a dropdown menu set to "Raleigh-Durham Area" and a "Site Selector" link; "Filtered Data Set(s):" with a list box containing four entries: "Millbrook NCore/PM2.5-88502 - 88502/1 Hr/1", "Millbrook NCore/PM2.5-88502 - 88502/1 Hr/3", "Millbrook NCore/PM2.5-88501 - 88501/1 Hr/3", and "Millbrook NCore/PM2.5-88101 - 88101/1 Hr/3". Below the list box are four arrow buttons (double down, single down, single up, double up). The "Selected Data Set(s):" section is currently empty and has a "Clear" link. At the bottom, there are two input fields: "Threshold:" and "Minimum Number of Buddy Sites:". At the very bottom of the window are two buttons: "Save Buddy Sites" and "Cancel".



Data Reporting Considerations

- Digital is preferred over analog.
- Use Start Hour
 - 00:00 is the first hour of the day
 - Ensure your time stamp is correct. This is especially important when the value from a monitor has a lag of an hour in being logged by an external data system.
- Ensure both your internal monitor settings and datalogger process valid negative numbers
- Verify that the data in your monitor is the same as what's reported by your data system



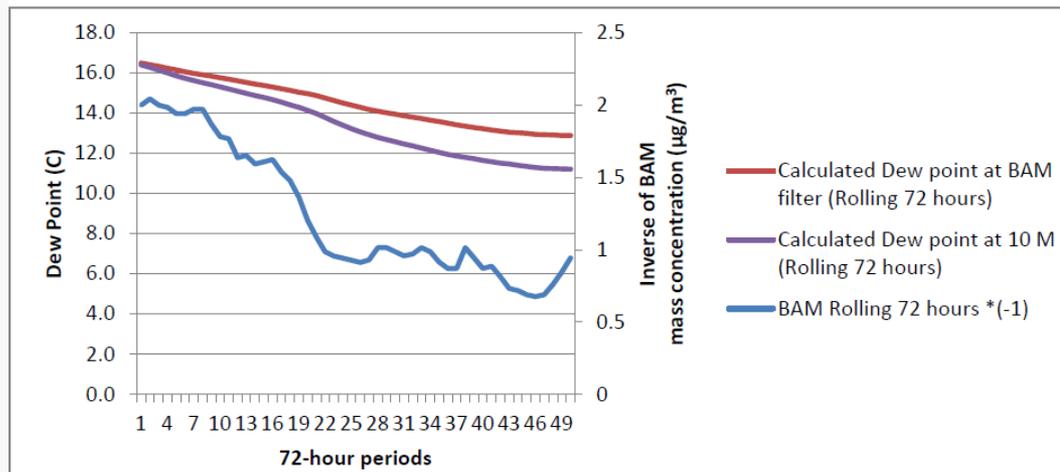


Method Specific Topic

Met One BAM Zero Test

- After Denver Conference, several agencies shared their zero test data (IN, MD, NC, NH, Albuquerque NM, BAAQMD, Cherokee, Hamilton County OH)
- A relationship between ambient dew point and the zero test results of the Met One BAM was identified at most, but not all sites

Met One BAM zero data in RTP, NC from September 7th to 12th, 2012

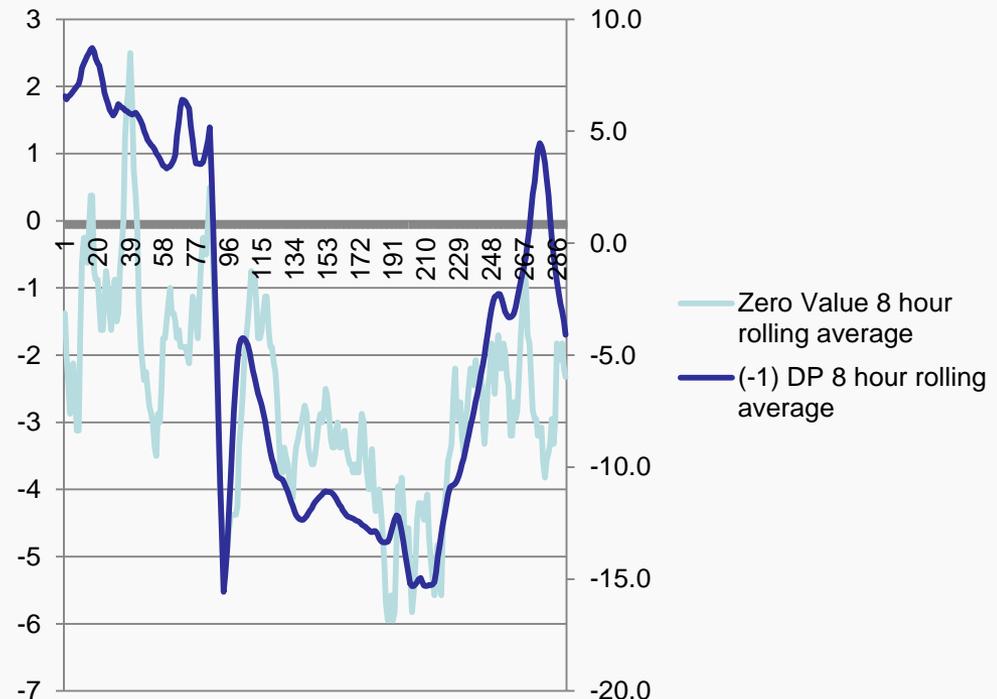




Met One BAM Zero Test

- Relationship between ambient Dewpoint and zero test results:
 - When dew point goes down the BAM zero test data goes up.
 - The magnitude of the BAM 1020 zero response is somewhat variable; however, data indicate that a 5 to 10 C drop in dew point corresponds to a 1 to 3 $\mu\text{g}/\text{m}^3$ increase in the mass concentration.

RTP, NC Met One BAM Zero Tests
Rolling 8-hour averages





Met One BAM Zero Test

- Recommendations:
 - Perform zero tests at the beginning of a season when the dewpoint will be representative of that season.
 - Enter the negative of the zero test results in the Met One BAM in the field “BKGD”. For example, an average from the sample period of $-3.0 \mu\text{g}/\text{m}^3$ is entered as 0.0030
 - **Delta-T.** Log this channel in the BAM 1020 settings. See: Met One Presentation at the Denver 2012 National Monitoring Conference (<http://www.epa.gov/ttn/amtic/files/2012conference/1B02BAM.pdf>), page 9; set the Datalog Delta-T: to “YES”.
 - Log Met One BAM temperatures and RH data to your data logger

```
CALIBRATE SETUP
                FLOW RATE: 16.7
CONC TYPE: ACTUAL   FLOW TYPE: ACTUAL
                  Cv: 1.047           Qo: 0.000
                  ABS: 0.822         μsw: 0.306
                  K: 1.005           BKGD: -0.0030
STD TEMP: 25C      HEATER: AUTO
SAVE              EXIT
```

```
Heater Setup
  RH Control: YES
  RH Setpoint: 35%
  Datalog RH: YES (Chan 4)
  Delta-T Control: NO
  Delta-T Setpoint: 99 C
  Datalog Delta-T: YES (Chan 5)
SAVE              EXIT
```



Notes on PM_{2.5} Continuous FEMs

- **Good comparability with filter-based methods can be achieved**
- There are several reasons why a PM_{2.5} continuous method may not meet the desired comparability with a collocated filter-based method
 - Filter-based methods are known to have their own biases
 - e.g., In filter-based methods, the sample is often left in the sampler for several hours to days after the end of the collection period
 - Continuous methods need to account for varying levels of moisture in the atmosphere; however, heating of the sample stream can lead to significant loss of PM
 - Different measurement principles can lead to different results
 - We are still learning how to fully optimize the use of PM continuous methods
- No method is perfect, but many can be sufficient to meet the monitoring objectives



Summary of Best Practices

- ✓ Ensure your getting good FRM data
- ✓ For most methods, slightly negative numbers can be valid and are to be reported
- ✓ Align your second stage separators (i.e., VSCC to VSCC)
- ✓ Site and Method Set-up
- ✓ Firmware updates?
- ✓ Leak Tests?
- ✓ Quality Assurance/Quality Control
- ✓ Utilize QC checks in your own data system and/or AIRNowTech.
- ✓ Data Transfer and Reporting
- ✓ Method Specific Topics
- ✓ Assessments – you need to look at your data and compare to other methods and sites.