*October 5, 2012*

**To: Met One BAM Users**
**From : Tim Hanley, U.S. EPA, OAQPS**
**RE: Zero Tests on the Met One BAM 1020**

**Introduction:**

Over the last few months a number of monitoring agencies have shared their Met One BAM zero test data with me (IN, MD, NC, NH, Albuquerque NM, BAAQMD, Cherokee, Hamilton County OH). I have been reviewing these data and have identified a relationship between ambient dew point and the zero test results of the Met One BAM at most, but not all sites.

The relationship is such that when dew point goes down (as we expect coming off the summer into fall; at least in the East and Mid-West), 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 $\mu g/m^3$ increase in the mass concentration. While we still learning the specifics of how this is happening, this issue can potentially be explained due to the changes in moisture affecting the tape during zero tests, which would also affect the tape during normal operation[1]. We are evaluating this issue and are also working with Met One on possible ways to use the information we have to improve use of the zero tests.

While we intend to investigate this further, we are sending this note to Met One BAM users now since many areas of the country are in the middle of a seasonal change in dew point and our recommendations may be of use to a number of those monitoring agencies.

**Recommendations:**

1. **Perform Zero test.** For those locations with seasonal changes in ambient dew point and especially for those locations impacted by high summer dew points (e.g., where the ambient dew point may be expected to be within several degrees centigrade of the stations internal temperature[2]) we are recommending a zero test be performed and if appropriate a new zero set-point entered in the BAM 1020. For many locations early fall may be an appropriate time to perform a zero test to represent the expected dew points over the coming months. In late Spring, if there are seasonal changes to dew point for your network, it may be necessary to run another set of zero tests for your sites to ensure the zero is representative of conditions at your

[1] During both normal operation and zero tests, a beta count is taken over the first few minutes of an hourly sample ($I_0$) and again at the end of the hourly sample ($I_3$). In most cases the tape is relatively dry during the initial beta count. If there is a large amount of moisture moving through the tape during a sample; even if no condensation occurs as the smart heater is functioning correctly and keeping the filter relative humidity below 35% RH, the tape may still undergo a slight change in size due to the additional moisture. This change can result in a decrease in the final beta count, which will be subsequently be reported as a larger mass concentration for that hour. Again, this is the case when the ambient air has high dew points relative to a tape that is initially dry.

[2] For example, if the ambient dew point reaches 18C at a station with an interior temperature near the bottom of the 20 to 30 C station temperature criteria.

sites for that time of year. As a reminder, please follow Met One's instructions for performing a zero test. There are three key things to keep in mind in performing a successful zero test:

a. Ensure a stable response of the zero concentration. Met One has a spreadsheet on their web site to test this. (http://www.metone.com/bam_user.php)
b. Per instructions in the BAM 1020 Manual (BAM-1020-9800, Revision G) page 57. The zero test "should not be performed during a period of rapidly changing weather".
c. Ensure that the background level (labeled as BKGD under the SETUP>CALIBRATE menu) entered in the Met One BAM is the negative of the average from the valid 72 hour test. For example, an average from the sample period of -2.0 µg/m$^3$ is entered as 0.0020.

2. **Datalog Delta-T.** Per the Met One Presentation at the National Monitoring Conference in Denver this past May (http://www.epa.gov/ttn/amtic/files/2012conference/1B02BAM.pdf), page 9; set the Datalog Delta-T: to "YES". This will log the Delta-T (the increase in filter temperature of the BAM 1020 over ambient temperature) to Channel 5.

3. **Log Met One BAM temperature and RH data to your data logger.** If the station data logger is capable of recording relative humidity, Delta T, and ambient temperature from the BAM 1020, configure the data logger to record these values. These data will enable your staff to track changes in dew point (which requires a calculation[3]) and how they may affect the zero data at your site. If you are unable to log these data directly, include these data when retrieving the digital data from the instrument during maintenance.

**Follow-Up:**

As mentioned above, I am sending this technical note now as a large portion of the country is transitioning from relatively higher to lower dew points. As you incorporate these changes, we are interested in hearing from you on your experiences and results of incorporating these more frequent zero tests. If you or your monitoring agency has information or results you think others may be interested in, please share that information with the applicable technical contact on monitoring from your EPA Regional Office. We may potentially refine these procedures at a later date, based on additional testing and/or what we learn from experiences in the field.

**Additional Background:**

Here is some background on a recent extended zero test in RTP, NC:

In September, when we knew the RTP, NC area was to be impacted by the remnants of a tropical storm, a zero test was performed on our Met One BAM 1020 over five days (a total of 121 hours). I have

[3] A calculation for dew point: $T_D$ = temperature of the dew point in degrees C; f = relative humidity in percent; and T = the ambient temperature in degrees C.

$$T_D = \left(\frac{f}{100}\right)^{1/8}(112 + 0.9T) + 0.1T - 112$$

plotted results of that test by taking 72 hour averages of available dew points and the inverse of the 72 hour BAM zero data. This results in 49 rolling 72 hour periods. As you can see from the figure below, as the area went from relatively higher dew points at the beginning of the test to lower dew points at the end of the test there is a noticeable change in the response of the BAM zero data. Note, since these are 72 hour averages, there is a lag in the change from the impact of the warm moist air during the storm to the relatively drier period at the end of the test. So as you can see if we were to take the one of the first few 72 hour periods, the dew point would have been above 16C and the zero value about 2.0 µg/m$^3$. If we had taken one the 72 hour periods from towards the end of the test the dew point would have been around 12C and the zero test data less than 1.0 µg/m$^3$.

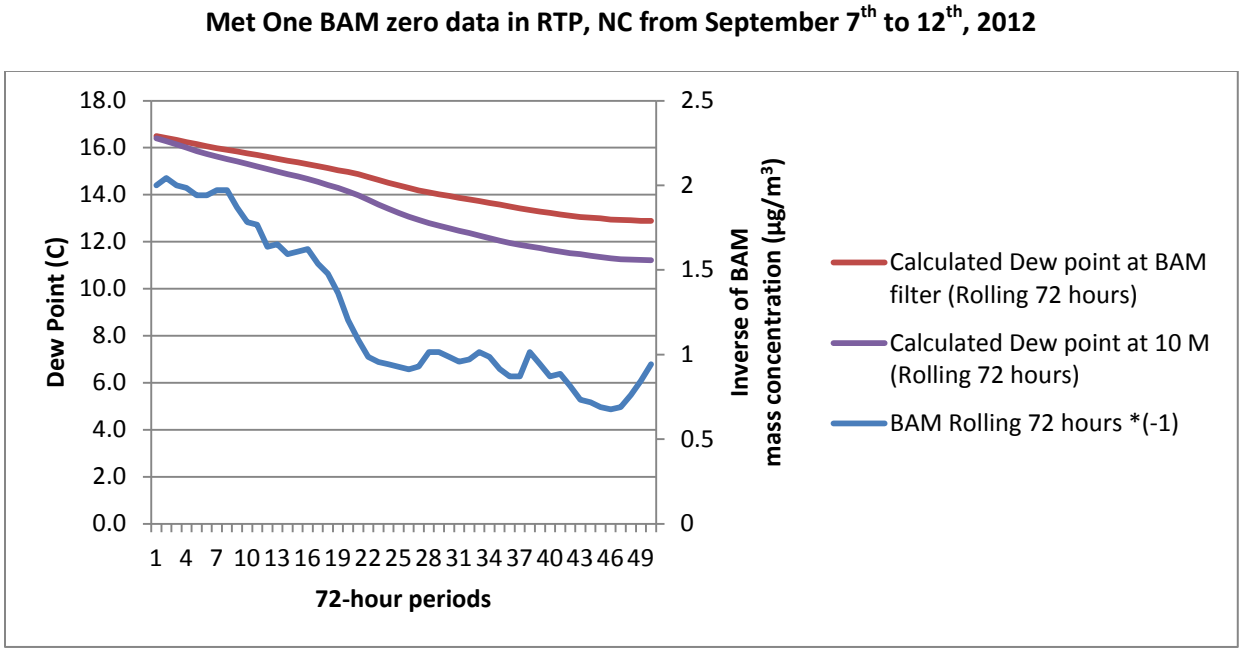


Figure 1