Met One Technical Bulletin

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BAM-1020 Filter Pressure Drop Setting

The vacuum pumps used with the BAM-1020 particulate monitor are carefully selected for the ability to maintain the required 16.7 lpm sample flow rate at various filter loads and altitudes. The 1 cm^2 filter tape sample spot is a significant airflow obstruction, and the additional dynamic load of sampled particulate building up on this spot causes additional flow obstruction. In dirty air, the filter spot can eventually become so loaded that the 16.7 lpm flow can no longer be maintained, and a flow alarm is generated.

The BAM-1020 monitors the pressure drop across the filter tape throughout the sample period, in order to monitor filter loading. Pressure drop is the difference between ambient barometric pressure and the low pressure beneath the filter with the pump on, in millimeters of mercury (mmHg). The BAM measures the static pressure drop of the clean filter spot at the beginning of the sample period, then monitors the dynamic additional pressure drop caused by particulate buildup during the sample. If this Additional Pressure drop exceeds the “AP” threshold setting, the BAM generates a “P” pressure drop alarm.

Firmware prior to rev 3.6 would continue to run the sample anyway, and if the flow regulation subsequently failed due to the filter loading, a hard flow error was generated and the hourly concentration point was invalidated. This situation was undesirable in some high concentration areas, so firmware 3.6 and later stops the sample early if the AP threshold is exceeded, and calculates a valid concentration based on the partial sample volume. A “P” alarm is still generated to indicate the event.

The default AP setting of 150 mmHg is appropriate for the vacuum capacity of the standard Medo and Gast pumps. So these pumps can typically handle the pressure drop of the filter material, plus at least another 150 mmHg of pressure drop caused by particulate load, while maintaining 16.7 lpm flow. The Gast pump has slightly larger capacity than the Medo, and is preferred at higher altitudes. The 50 Hz version of the Medo pump has marginal vacuum capacity when used with the BAM, even in low concentration air, and is no longer recommended.

In some special situations, larger pumps with greater vacuum capacity can be used, in order to allow a higher AP threshold setting. Also, some users supply their own pumps for use with the BAM-1020. In any case, if a pump or filter tape other than a standard Met One item is used, then the suitability of the AP setting should be tested and optimized as follows:

1. Set up the BAM-1020 on a test bench, and connect the vacuum pump to the BAM as usual. Ensure that the BAM nozzle and vane are clean and install a roll of filter tape. Install a short inlet tube and a standard leak check valve. Verify the BAM leak check and flow calibrations.
2. Set the AP setting to 500 mmHg in the SETUP > ERRORS screen. This will just prevent the P alarm from being triggered during the test. Set the COUNT TIME to 4 MIN in the SETUP SAMPLE screen, and set the BAM clock time to just before the start of an hour. This will just expedite the test.
3. Enter the OPERATE > NORMAL screen. At the start of the clock hour, the BAM will start a new sample cycle, perform the 4-min zero count, then start the pump. After the flow has regulated to 16.7 lpm, record the AMB P ambient pressure and the TAPE P filter pressure from the BAM display. The difference between these two values is the clean-tape static pressure drop.
4. Very slowly start to close the valve on the BAM inlet a small amount at a time, so that the flow just starts to be reduced. Allow the BAM flow controller time to re-regulate the flow to 16.7. Continue to close the valve in small increments while you watch the TAPE P display and the flow display. The

TAPE P will be reduced as the valve is closed and the vacuum builds below the filter. Do not close the valve too rapidly or you may trigger a flow alarm which stops the sample.

5. As soon as the valve is closed to the point where the BAM flow controller can no longer maintain 16.7 lpm even with the flow controller at max flow, record the final TAPE P filter pressure value. The difference between the TAPE P with the valve open and the TAPE P with the valve partially closed is the maximum amount of dynamic pressure drop increase that can be tolerated by the setup, and thus the max AP setting. The AP setting in the BAM should then be set slightly lower than this max value.
6. After the test, stop the sample cycle and reset the BAM setup settings to the correct values.

Example:

AMB P Ambient Barometric Pressure:	728 mmHg
TAPE P Filter Pressure (valve fully open @ 16.7 lpm):	**553 mmHg**
Calculated Clean Tape Static Pressure Drop:	728 – 553 = 175 mmHg
TAPE P Filter Pressure (valve partially closed to < 16.7 lpm):	**385 mmHg**
Calculated Max Dynamic AP Additional Pressure:	553 – 385 = 168 mmHg
Appropriate AP value to set in the BAM:	**150** mmHg

Test Notes:

The standard BAM leak test valve is somewhat difficult to close in small increments. It is easier to conduct this test of you have a multi-turn needle valve that you can install on the inlet instead. Any valve used for this test must have minimal flow restriction when fully open.

As an alternative to using an inlet valve at all, it is possible to apply smoke to the open BAM inlet in order to restrict the flow by loading down the filter instead of by closing the valve. A lit stick of incense smoke works well. Apply the smoke slowly and allow the BAM time to maintain flow regulation. The resulting max pressure drop value should turn out to be identical to the value determined using the inlet valve method.