

# **STANDARD OPERATING PROCEDURES**

## **Met One E-BAM Particulate Monitor**

### **AMBIENT AIR MONITORING PROGRAM for the 130 LIBERTY STREET DECONSTRUCTION PROJECT**



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# Standard Operating Procedures

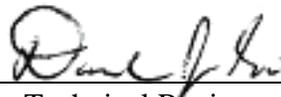
## Met One Instruments, Inc. E-BAM Particulate Monitor

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## **1.0 PURPOSE OF SOP**

This SOP was designed to describe the procedures used for continuous real-time monitoring of particulates in ambient air.

## **2.0 EQUIPMENT DESCRIPTION**

The E-BAM is a portable and continuous ambient air sampler based upon the principle of beta attenuation. The operator will refer to the manufacturer's operation manual for pictorials and additional information to aid in performing maintenance and operations. (Document No. E-BAM-9800 Rev F)

### **2.1 Operating Principle**

Beta attenuation is defined as the decrease in the number of beta particles due to absorption by the traversed medium. A small Carbon<sup>14</sup> source emits a constant 60 microcurie signal of low to medium energy electrons known as beta particles. The beta particles are detected by a scintillation detector and counter positioned near the source. A filter tape is placed between the source and detector and a beta particle count is performed. A vacuum pump pulls a measured amount of air through the filter tape where the particulate is deposited. A second count is then performed across the filter tape with the deposited particulate. The second count will be less than the first count due to the absorption of beta particles by the deposited particulate. The degree of attenuation of the beta signal is used to determine the mass concentration of particulate matter on the filter tape. The mass is then divided by the sampled air volume to calculate the concentration of particulate in the ambient air.

### **2.2 Parts of the E-BAM**

The instrument is enclosed in a weather tight case with a weather tight inlet tube connected to the top. The system is made up of six primary parts: E-BAM console, ambient temperature probe, inlet adaptor tube, sample head, filter tape, and tripod.

## **3.0 EQUIPMENT OPERATION**

In order to operate the E-BAM, it is necessary to assemble the instrument.

### **3.1 Equipment Assembly**

1. Lift the tripod and remove the three lock pins. Spread the tripod legs and re-insert the three locking pins.
2. Lift up the E-BAM enclosure with the aerosol inlet oriented upwards. Slide the slot on the back of the cabinet down over the tab of the tripod. Bolt the cabinet to the tripod with the provided ¼ inch nut and bolt.
3. After removing the plastic end caps from the inlet adaptor tube, push it into the E-BAM inlet. The tube must pass through two O-rings by pushing and twisting the tube into the enclosure until it stops. Hand tighten the large black screw at the top

- of the E-BAM enclosure.
4. Place the sampling head (PM<sub>10</sub> or PM<sub>10</sub> equipped with sharp cut cyclone for PM<sub>2.5</sub>) onto the inlet adaptor tube. Push and twist the sampling head down all the way until it stops. The head must pass through two O-rings. The O-rings are factory lubricated but with frequent removal/replacement of parts they will need to be re-lubricated with silicon grease.
  5. Install the cross arm on the pipe at the top of the tripod and tighten. Clip the temperature sensor onto one arm of the tripod and plug the signal cable into the 5-pin plug under the E-BAM enclosure.
  6. Attach the power cable to the power supply and plug the other end of the power cable into the receptacle at the bottom of the enclosure.

### 3.2 Instrument Start Up

When the E-BAM is powered up it quickly runs through a minimum of eight screens. These screens verify that the time, date, and averaging period are correct. The E-BAM also checks for filter tape and proper operation of vital subsystems.

1. Undo the latch and swing open the E-BAM cover. The display should be displaying “ARE YOU READY TO START?”  
Press the white “hot” key under YES to proceed.
2. The pre-set time and date will then be displayed.  
If the time and date are correct, push the right “soft” key directly under where YES is displayed. Press NO to make a change.  
Use the arrow keys to make any time and date changes. When finished, press set to save the changes. Press CONTINUE to exit without making changes.
3. E-BAM Averaging and Location Start up screen will now be displayed.  
Press OK to proceed to the next screen or press EDIT to make changes. Use the arrow keys to make changes. The following can be changed:

LOCATION – location ID for the E-BAM. This may be a value from 0 – 99. All data downloaded from this E-BAM will have this location ID number associated with it.

FILTER ADVANCE – determines how often the filter will advance. This value can be set to any of the following times: 1, 2, 3, 4, 5, 8, 12, or 24 hours. (NOTE: For the 130 Liberty Street ambient air program, this is set to 24 hours.) Note: the filter tape will advance automatically if the particulate concentration is too high or if the filter becomes clogged. If the filter tape advances due to high concentrations an alarm is written to the Event Log.

REAL-TIME AVE – is the averaging period for the real-time concentration value. This value may be set to the following time periods: 1, 5, 10, 15, 30, or 60 minutes. (NOTE: For the 130 Liberty Street ambient air program, this is set to 10 minutes.)

Press SAVE to save the changes. Press CONTINUE to proceed and not make changes.

4. PLEASE REMOVE PACKING MATERIAL will now be on the display if the nozzle packing has not been removed.  
The nozzle will move upward then remove the stainless steel nozzle packing material and press CONTINUE.
5. The next screen will display CHECKING FOR LOADED TAPE  
If the unit finds that filter tape is not loaded, the screen will display PLEASE LOAD TAPE! E-BAM WILL NOT OPERATE WITHOUT TAPE. To load tape, remove the clear plastic spool covers. Put a full roll of filter tape on the right (supply) spool and feed the tape in a counter-clockwise direction over the rollers and under the nozzle to the left take-up spool. Attach the filter tape to an empty roll core tube on the take-up spool with a piece of tape. Gently tension the tape and replace spool covers. Press CONTINUE when finished installing filter tape for E-BAM to confirm the presence of the filter tape. The display will state: CHECKING FOR LOADED TAPE. PLEASE WAIT...
6. The next screen display is the battery condition display which will read: BATTERY: 13.0 VOLTS ESTIMATED OPERATION TIME FOR 100 AMP-HRS IS 42 HRS. Press CONTINUE to proceed.
7. SELF TEST RUNNING will now be displayed. This will take several minutes and when complete the E-BAM will begin sampling. If the self test fails, check the display and correct problem indicated.

### 3.3 E-BAM Operation

Prior to sampling, the E-BAM must be leak checked and a flow audit performed. See calibration section for the procedures to be followed. Following start the E-BAM will display the default screen which is the sampling screen. This screen is 13 lines long and due to the size of the display only 4 lines are displayed at a time. Use the down arrow to move the window to see other lines. Each line must be reviewed and edited to meet the sampling events requirements. The displayed lines are as follows:

1. **Date and Time** – the date and time are displayed as the DAY-MONTH-YEAR. If the date was not corrected during start up, press the MENU key. From the MENU screen, using the arrow keys highlight SETUP and press MENU/SELECT. The first SETUP screen is the DATE/TIME screen. Press the right/left arrow keys to highlight the digits to modify and the up/down keys to change the digit. When the correct date and time are displayed, press SET and then continue until the main menu is displayed.
2. **Real-Time Concentration** – displays the REAL-TIME AVE selected during instrument setup. To modify this setting press MENU/SELECT and highlight SETUP with the cursor and press MENU/SELECT again. Press CONTINUE until the Location Averaging screen is displayed. Modify the settings by highlighting the value and incrementing the reading with the UP/DOWN keys. Press SET and then continue until the main menu is displayed.
3. **Hourly Concentration** – Displays the hourly concentration. This line can not be modified.

4. **E-BAM Status** – This line shows the current E-BAM operation. If the line is displaying UNIT OFF, press the hot key directly under the message to turn on the unit.
5. **Sample Flow Rate** – This line displays the instantaneous flow rate. To modify press MENU/SELECT and highlight SETUP with the cursor and then press MENU/SELECT. Press CONTINUE until the FLOW RATE screen is displayed. Modify settings by highlighting the value(s) and incrementing the reading with the UP/DOWN keys. Press SET and then continue until the main menu is displayed. (NOTE: For the 130 Liberty Street ambient air program, the desired flow rate is 16.7 liters per minute.)
6. **Wind Speed and Direction** – If the E-BAM is connected to a wind sensor this line will display the wind speed and direction. This line is not modified.
7. **Ambient Temperature** – Displays ambient temperature. This line is not modified.
8. **Filter Temperature** - Displays filter temperature. This line is not modified.
9. **Relative Humidity Internal and Filter Temperature** – This line displays the sensor readings used to control the inlet heater. (The inlet heater is used to control condensation on the filter paper). To modify press MENU/SELECT and highlight SETUP with the cursor and then press MENU/SELECT. Press CONTINUE until the HEATER screen is displayed. Modify settings by highlighting the value(s) and incrementing the reading with the UP/DOWN keys. Met One recommends using an RH setpoint of 45% and a DELTA-T setpoint of 8 degrees Celsius with the RH Control set to ON. Press SET and then continue until the main menu is displayed.
10. **Relative Humidity External** – If E-BAM is equipped with the sensor, the relative humidity is displayed. This line is not modified.
11. **Battery Voltage** – Displays the measurement of incoming power. This line is not modified.
12. **Secondary Flow** – This line is displayed only when the E-BAM flow is selected as STANDARD flow. This line is not modified.

## 4.0 CALIBRATION

A flow system must be audited following initial setup of the E-BAM and prior to sampling and periodically, as defined by the QAPP, during the sampling event. The flow system audit consists of two checks, a leak check and flow audit.

### 4.1 Leak Check

To perform a valid leak test, perform the following:

1. Press MENU/SELECT and highlight FIELD CALIBRATION/PUMP TEST and select LEAK CHECK.
2. Remove the sampling head and replace with a leak test valve (Met One part No.: BX-305).
3. Close leak test valve.

4. The flow rate on the display should drop to under 1.5 LPM. If flow drops to less than 1.5 LPM, leak check passed; open and remove valve and replace sampling head. If leak check fails, refer to Section 3.3.1.3 of the manual for fixing a leak.

## 4.2 Flow Audit

To perform the flow audit, attach the flow standard to the E-BAM inlet. Let the E-BAM pull through the standard for 1 minute until stabilization and then check the E-BAM flow rate. The flow reading from the E-BAM must be within 4% of the flow reading of the flow standard device and the flow reading from the E-BAM must be within 5% of the designated flow rate of 16.67 LPM. If the E-BAM does not agree with the standard, then a flow calibration must be performed.

## 4.3 Flow Calibration

Three parameters (temperature, pressure, and flow) must be verified/calibrated to perform a flow calibration on the E-BAM. Perform the following steps to perform a flow calibration.

1. Press MENU/SELECT and highlight FIELD CALIBRATION and press MENU/SELECT again.
2. From the FIELD CALIBRATION display, highlight and select TEMPERATURE.
3. The TEMPERATURE display will show three parameters; the set point (POINT:) which is either HIGH (ambient) or LOW (ice bath), E-BAM temperature reading (E-BAM), and the reference temperature (REF:) which the E-BAM uses to calculate its temperature. Select POINT to HIGH and let E-BAM and reference thermometer come to equilibrium.
4. Compare the reference temperature with the E-BAM display. If the readings are within 0.5 degrees Celsius or 1 degree F, no recalibration is required. If not, highlight the REF: line and enter the reference temperature and press CALIBRATE.
5. Repeat calibration procedure for the second point.
6. From the FIELD CALIBRATION display, highlight and select PRESSURE.
7. Compare the E-BAM pressure reading with a reference pressure. If the pressure values are within 2 mm Hg no recalibration is needed. If not, enter the reference pressure in the REF: line and press CALIBRATE.
8. From the FIELD CALIBRATION display, highlight and select FLOW.
9. The FLOW display will show three parameters; flow set point (FLOW SP:), E-BAM flow rate (E-BAM:), and the reference flow rate (REF:). The flow set point is selectable with three points (14.0, 16.7, and 17.5 LPM). The 16.7 LPM set point should be selected.
10. Remove sampling cap and place the reference flow audit device on the inlet tube. Wait for 5 minutes for the flow to equilibrate.
11. Compare reference flow to the E-BAM flow. If the flows are within 4% no calibration is required and go to step 16. If not, highlight REF: and enter audit device flow rate and press CALIBRATE.
12. Highlight FLOW SP: and select one of the other two selectable flow rates. The E-

- Bam will automatically turn the pump and regulate to the flow setpoint.
13. Wait for 5 minutes for the flow to equilibrate.
  14. Highlight REF: and enter audit device flow rate and press CALIBRATE.
  15. Perform steps 13 and 14 with the remaining selectable flow setpoint.
  16. Remove the flow audit device and replace sampling cap.

The E-BAM flow rate is now calibrated and ready for sampling.

#### **4.4 Calibration Verification**

Calibration verification of the E-BAM measuring system should be done at a frequency specified in the QAPP. Verification is accomplished using two calibration plates that represent ZERO and SPAN factory calibration points. The set of calibration plates are unique to each E-BAM and have the same serial number as the E-BAM. **Make sure the proper calibration plates are used.** The following steps are to be used to perform the calibration verification:

1. Press MENU/SELECT and highlight FIELD CALIBRATION and press MENU/SELECT again.
2. Highlight MEMBRANE TEST and press START. The filter tape will advance, the nozzle will lower and the E-BAM will take a four-minute blank zero count. Press CANCEL to re-start the test.
3. When the nozzle moves up, insert the ZERO membrane calibration plate.
4. After the four-minute sample, the nozzle will move up and the display will state: REMOVE MEMBRANE, remove zero calibration plate.
5. The E-BAM will then perform a four-minute blank SPAN count and the nozzle will then move up and wait for the SPAN calibration plate to be inserted. The display will read: INSERT SPAN MEMBRANE, insert SPAN calibration plate.
6. The nozzle will lower and perform a SPAN count. The test results will then be displayed on the screen. Record the test results in log book. IF ZERO or SPAN fails, repeat the test.
7. IF E-BAM continues to fail calibration, clean the detector (refer to Section 3.3.2.2 of manual) and re-run the test.

#### **5.0 MAINTENANCE**

Maintenance on the E-BAM consists primarily of cleaning the nozzle, vane, and sampling cap, changing the filter tape, and ensuring that the O rings in the sampling cap are clean and lubricated due to the removal and replacing of the cap during continuing calibration verifications. Refer to the manual for cleaning procedures.

##### **5.1 Recommended Spare Parts**

- Filter tape
- DC pump

## **6.0 ADDITIONAL INFORMATION**

A more detailed equipment manual is available from Met One and is located in the site office for any other questions about the E-BAM (Document No.E-BAM-9800 REV F).