

## Standard Operating Procedure Aethalometer™

The following Standard Operating Procedure (SOP) for use of an Aethalometer was edited by M. Murphy of CTDEP's Air Monitoring QA Group from the SOP developed by Harvard.

This SOP is for Black Carbon (BC) measurements using the Magee Scientific dual channel Aethalometer (Aeth) with a BGI, INC. Sharp Cut Cyclone (SCC) rated for flow rates of 1 to 11 lpm. Flow is reported at Standard Temperature and Pressure (STP) of 25°C and 760 mmHg. The flow rate shall be set to 2.0 lpm. The SCC operates as a PM<sub>1</sub> inertial separator at this velocity.

The Aeth sample train, from the back of the instrument to the connection of the SCC, consists of approximately 13 feet of 3/8 inch OD black plastic and/or stainless steel tubing. The inlet of the SCC is one meter above the shed roofline. A check of sample line pressure drop is performed upon installation by measuring flow at the SCC and again at the back of the Aeth. These flow checks are to be recorded on the Aeth's Operations Check Sheet (✓ sheet) in the **Comments** section. Differences of >0.14 vlp<sub>m</sub> will necessitate redesign of the sample train.

The Aeth operates with the following parameters:

- 2.0 +/- 0.20 vlp<sub>m</sub> (volumetric liters per minute at STP).
- 5-minute averaging time as recommended in operator's manual.
- Tape saver mode OFF.
- 2 spots per tape advance.
- 150 nm maximum attenuation of the UV beam.
- Data is reported in Eastern Standard Time (EST)

### Daily:

BC Data is polled via dedicated phone line and modem. This data is automatically polled from the Windsor Lab via a PC with ESC software. This polling is done daily and is the responsibility of the Windsor Lab supervisor or designee. BC data collected in this manner is printed out in hard copy at the end of the poll. It will thus be reviewed daily for instrument malfunction, reported value, time and flow rate (as is), and communication problems to alert the site operator to possible problems. Additionally, the site operator is required to retrieve the Aeth download data disk. See the section "Once each month" for more details.

Any time that data is not valid while the system is enabled should be noted on the ✓ sheet, along with any comments or notes. If at all possible, avoid doing any procedure that causes loss of data during periods with BC concentrations greater than 5 µg/m<sup>3</sup>.

### Once Each Week:

1. Check the system date and time on the Aeth display and on the external data logger (DL). The instrument time should be within 5-minutes of the DL time. Record the difference (+ or -) on the ✓ sheet. If the time is adjusted, record the actual adjusted to time on the ✓ sheet. The Aeth must be in **STOP** mode to change the time, but does not need to be taken **off-line** from the DL, since the 5-volt output in this mode automatically flags the data as *void* in the DL. A security code must be entered to **STOP** the Aeth to perform certain other system operating tasks; the default code is 111 and should not be changed. If there is a clear trend in the system time error (for example, an Aeth typically gains 2-minutes each week), set the time off in the opposite direction of the trend to reduce the need for frequent Aeth time adjusts. For the fast clock example given above, set it no more than 4-minutes slow each clock reset.
2. Record the **As-is Flow** from the Aeth display on the ✓ sheet. The flow should be  $2.0 \pm 0.20$  vlp<sub>m</sub>. If not, follow the flow check and adjust procedure in the following section.
3. Check the Aeth display for normal operation (no error messages, etc).
4. Check the filter tape supply. Record the approximate % of tape left on the supply spool. Re-tension the take-up spool if needed. Inspect any visible used filter tape spots for distinct and uniform borders between the exposed and unexposed areas. Indistinct boarders are indicative of poor seals. Clean or change the seals. Note this in the **Comments** section of the ✓ sheet.
5. Record the display **DISK**: capacity in weeks or days on the ✓ sheet.

### **Once Each Month:**

These checks will be recorded in the Monthly Check section of the ✓ sheet. If a quarterly flow audit is due, accomplish that before attempting this procedure. Perform all weekly checks before proceeding below.

1. Record current data from Aeth display and the DL on ✓ sheet in the spaces provided. Concentrations reported should agree within  $0.2 \mu\text{g}/\text{m}^3$ . If not, time correlation may be at fault. See weekly checks for time adjust.
2. Disable the Magee channel from the site DL. See ESC 8816 SOP.
3. Stop the instrument: press **STOP** twice.
4. Enter code 111.
5. Scroll to **Signals and Flows** function and press → key. Volumetric flow rates should appear on screen. Record this as **Display Flow** on the ✓ sheet in the space provided.

6. Attach a leak-check device to the end of the sample line and close its valve. The display screen flow rate should fall below 50% (1.0 vlp<sub>m</sub>) of the operating flow (2.0 vlp<sub>m</sub>). This is the Leak Rate. If the operating flow does not fall below 50%: tighten fittings and/or advance tape, then try again. Contact the QA Group to determine corrective action if the leak-check still fails. Record the Leak Rate on the ✓ sheet in the space provided.
7. Release the leak-check valve.

NOTE: This method intrinsically leaks. Flow measured at the back of the Aeth will always be lower than the flow through the internal flow meter. Therefore, a valid leak check (below 50% of the flow rate) must be performed prior to the flow audit measurement comparison to the Display Flow.

8. Attach a Sierra Toptrak mass flow meter (MFM) to the leak check device. Take a flow reading from the roof of the shed at the end of the sample line. Record the MFM reading on the ✓ sheet in the space provided.

NOTE: The Sierra mass flow meters are factory calibrated annually at STP of 25°C and 760 mmHg. The Aeth is set to volumetric flow at the same STP.

9. Calculate and record the flow % difference:  
$$\frac{(\text{Display flow} - \text{MFM flow})}{\text{MFM Flow}} \times 100$$
10. Report to QA if the % difference is > +/- 10%.
11. Clean the SCC:
  - Unscrew the SCC's connections.
  - Clean the insides with a clean/damp lint-less wipe (Such as a Kimwipe®).
  - Reassemble
  - Remove the leak-check device/MFM.
  - Reinstall the SCC.
12. Eject the data disk and replace with a blank disk. Record in the Comments section. The data disk will be delivered to the Windsor Lab within the first week of every month.
13. Restart the instrument in normal operational mode.
14. Enable the Magee channel on the site DL. See ESC 8816 SOP.
15. On the first to the seventh of each month remove and replace the ✓ sheet and carbon copy. Secure the carbon copy in the Aeth logbook. Return the original to the lab.
16. Fill out the new ✓ sheet with all data from the header and the last entry on the last month's ✓ sheet. Update the quarterly/6-month due dates if performed.

**Quarterly: See Audit SOP**

**Annually:**

~~For 1 month a year two Aeths will be collocated at a site to obtain precision data. The collocated inlets must be within 1 meter of each other and will be sampling at the aforementioned flow rate and averaging times. Use the comments section to document the collocated unit. Remove the Aeth and return it the Maint Group for annual maintenance. Install a maintained Aeth in its place.~~