



Measurement Principle

Incremental optical transmission absorption due to aerosol deposit collected continuously on quartz fiber filter.

Analytical Method

AE42-2 ('Dual-Wave'):

Combination optical absorption measurement at 880 nm ('EC'), and 370 nm (designated as 'UVPM'; interpreted as an indicator of aromatic organic compounds such as are found in tobacco smoke, PAH mixtures, wood and biomass-burning smoke, etc.).

AE42-7 ('Spectrum'):

Simultaneous measurement at 7 wavelengths for studies of aerosol optical absorption, atmospheric optics, radiative transfer etc.: 370, 470, 520, 590, 660, 880 and 950 nm. Special 'alternative wavelength set' optical sources are available upon request.

Interpretation

Optical absorption is interpreted in real time as concentration of Elemental Carbon ('EC', also called 'Black Carbon - BC').

Specificity

No other aerosol species has optical absorption even 0.001 times that of Elemental Carbon in the visible range.

Time Resolution (User setting)

AE42-2: 1 hour to 1 minute

AE42-7: 1 hour to 2 minutes

Intercomparison

Aethalometer readings compare 1:1 with chemical analysis for EC on parallel filter samples.

Sensitivity

Proportional to flow rate, inversely proportional to time resolution - approximately $0.1 \mu\text{g}/\text{m}^3$ @ 1-minute resolution @ 3 LPM.

Noise Cancellation:

Short-timebase data may be integrated over longer periods to recover data exactly equivalent to higher-sensitivity operation at longer timebases.

Flow Rate (User setting)

2 to 4 LPM optimum, monitored by mass flow meter. Internal pump provides 2 to 6 LPM, stabilized by closed-loop control.

Aerosol Sizing

Instrument collects all aerosol presented at inlet port. Size-segregating inlets (impactors, cyclones etc.) may be attached.

Note: In almost all situations, the vast majority of EC aerosol is in the PM_{2.5} submicron aerodynamic size range (i.e. less than 2.5 μm).

Sampling Medium

Reinforced quartz fiber tape. Tape advances automatically to avoid optical saturation, advances 1 cm typically once every few hours depending on concentration and flow rate. 10-meter roll of tape usually lasts from months to years at most locations.

Sample Retention

Aerosol is collected on quartz fiber tape. Subsequent chemical analysis can be performed on the sample spots following collection.

Sample Collection Area

Sample is collected on a defined spot on the filter fiber tape.

Options: 'High Sensitivity' option provides a small, concentrating spot for optimal performance at locations of low concentration.

'Extended Range' option provides a larger, dispersing spot for optimal performance in areas of high concentration.

Internal Control

All functions controlled by embedded single-board computer. Program and operating parameters stored in non-volatile RAM.

Data Output

Digital data is transmitted from rear COM port. Analog output connector represents BC data as 0~5 volt DC signal, scalable in software.

Data Recording

Data are written to recording medium once every timebase period.

Option

Flash memory drive is standard.

Floppy disk may be substituted.

Display and Interface

4-line display screen (date, time, BC etc.); status indicated by color-coded LED's (OK, initializing, problem etc.); keypad for menu selection entries.

GPS Tracking Data Input

OPTION: the rear panel COM port may be configured to accept serial data input from an optional GPS receiver. Position coordinates are then appended to the data lines on the disk files.

Attention Required

Instrument is completely automatic. No user attention is required at all while operating. Starts and runs automatically upon switching on. Recovers automatically from power interruptions.

Consumables Required

Filter tape (sample): 1 to 4 rolls per year, depending on concentrations, and cartridge filters (bypass flow; internal purge flow; flow meter protection): approximately one per year, each.

Periodic Maintenance

We recommend a flow rate verification every three months, and cleaning the inlet assembly once per year.

Reliability

Aethalometers have been operating at hundreds of urban, regional, rural and remote locations on all continents, continuously since 1986.

Size

Instrument constructed in portable cabinet with carrying handle: 11" high, 12" deep, 8" wide.

Weight

Approx. 25 lbs (11 kg).

Power Requirement

Operates from internal battery; 12 volt power cables; or AC powered battery charger 100~240 VAC 50~400 Hz. Consumption approx. 25 watts.

Operation Environment

Specified for typical indoor conditions. Not inherently weatherproof - additional enclosure recommended.

Temperature

0 ~ 40 °C operating. Electronics have active temperature stabilization.

Vibration

No effect for vibration up to levels typical of car at highway speed. 'Portable' Aethalometers have been used in cars, buses, trains, and light aircraft.

Initialization

Approximately 15 minutes required from power-up to valid data.

