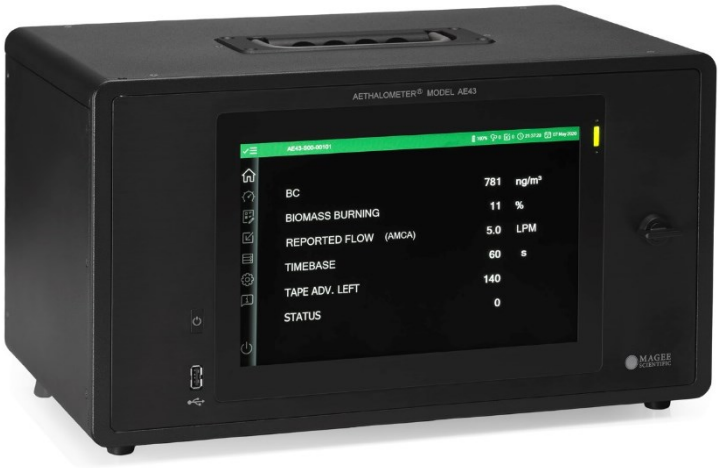
Portable Magee Scientific Aethalometer®

Model AE43

'Anywhere' measurement of Carbonaceous Aerosols



Berkeley, Ljubljana June 2020

The 'Portable' Aethalometer®
Model AE43

Summary

The new Model AE43 Aethalometer® from Magee Scientific/Aerosol Co. is built for portability. It incorporates all of the well-proven and rugged design principles of our aerosol monitoring instruments, and includes the following key features:

- Patented 'Dual Spot' ™ technology for filter loading compensation in real time.
- Optical analysis of BC samples at multiple wavelengths identifies contribution from fossil fuel and biomass burning.
- Sampling time-base of 1 second or 1 minute.
- Sample collection on Teflon-coated glass fiber filter tape reduces the effects of varying Relative Humidity from air-conditioning perturbations.
- Automatic flow calibration procedure using external standard.
- Built-in 'zero' test from internal clean-air source checks leakage and noise.
- Validation test of optical detector performance using NIST traceable optical standards.
- Large color touch-screen User Interface for operation and visualization of the data, including advanced features (wind rose charts, trends, timelines)
- Network connection provides remote access, operation and data retrieval.
- Front-panel USB ports provide local download without interruption of data.
- External battery power supply (DC 12 V) for true portability (optional accessory).
- Low power consumption (25 W or less) is ideal for off-grid use.
- Completely automatic operation upon power-up provides continuity.
- Hermetic sealing prevents ingress of dust and moisture.
- Direct coupling to CO_2 sensor (optional accessory) integrates BC and CO_2 data for emissions testing.
- Direct coupling to meteorology sensor (optional accessory) reports pressure, temperature and relative humidity and permits calculation of BC concentration data under 'local' conditions.
- GPS sensor (optional accessory) adds position information to the data file.

Magee Scientific and Aerosol Co. are pleased to announce the Model AE43 'Portable' Aethalometer®,. This product incorporates the most recent scientific, technical and instrumentation features to enhance the application portfolio of BC aerosol measurement. Vertical profiling, emission testing, health effects research, mobile mapping, and field measurements at remote locations are all made easier by the features of the AE43. The AE43 is built upon the same technical features as the well-established rack-mount AE33 instrument: such as the patented DualSpot™ loading compensation; real-time source apportionment; multiple communication options; graphical user interface; and the ability to perform routine performance tests to verify and validate correct operation. The DualSpot™ technology provides two significant advantages: elimination of the aerosol 'filter loading' effect; and a real-time calculation of the 'loading compensation' parameter which offers insights into aerosol optical properties and has been interpreted in models of aerosol origins and aging.

The design of the Model AE43 Aethalometer® includes many features derived from our long experience with real-world uses and applications. These include:

1. Graphical User Interface (10.1" color touch-screen) with basic data display and control, advanced screens for detailed reporting and parameter setup.

2. Graphical charts of relevant data (BC @ all wavelengths, BB%) for instant monitoring and reporting. When the Ambient Meteorological Sensor (PN5510) and Wind Speed sensor (PN5520) are connected, charts of BC and its analysis with wind speed and direction are available.

3. Light-weight design with external 12 V battery supply for portability: (operation up to 15 hours). The AE43 can also be operated by an AC power adapter (100-240 VAC auto-switching) or an external DC source (e.g. vehicle power, solar PV system, etc.). We offer a lightweight waterproof, crushproof and dustproof transit case for field transportation.

The new Model AE43 Aethalometer® also includes the essential features of the well-established rack-mount instrument, the model AE33:

4. The DualSpot™ measurement method, which solves the effects common to all filter-based real-time monitors, in which the instrumental response factor may show a dependence on the filter loading.

5. Quality assurance tests, including 'dynamic zero' testing under a flow of internally-generated clean air; calibration of the response of the internal mass flow meters, if an external standard flow calibrator is connected; and validation of the photometric response by use of a kit of 'Neutral Density' optical filters whose properties may be traced to reference standards.

6. Real-time source apportionment for the discrimination of Black Carbon aerosols from fossil fuel vs. Black (or 'Brown') Carbon from biomass burning.

7. User and communications interfaces, permitting remote monitoring of operation; data retrieval; performance of internal tests; and reporting of 'state-of-health' parameters.

8. Modular construction designed for ease of routine maintenance service.

9. Real-time aerosol analysis at seven optical wavelengths, with time resolution of 1 second. This permits the measurement of optically-absorbing aerosols – 'Black' Carbon and 'Brown' Carbon components of particulate matter – in already well established applications including routine monitoring of ambient air quality for regulatory purposes; measurements of the concentration of BC in urban, suburban, regional, rural and remote locations; source testing; and laboratory-based research.

10. The Aethalometer® model AE43 can be mounted into an adapter chassis for installation in a 19" rack.

KEY FEATURES

1. Graphical User Interface:

The Model AE43 Aethalometer® has a built-in 10" color touch-screen for control and data display: both in real time, and for visualization of existing data over specified time frames. This enables a more analytical approach towards data processing (example in figure 1)

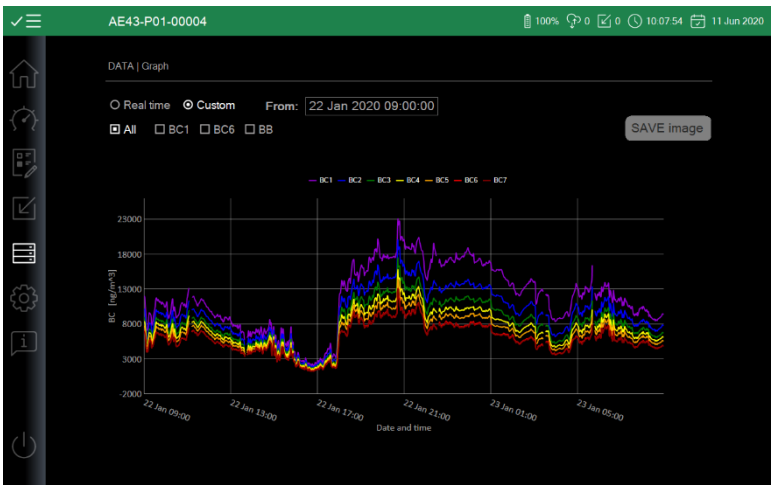


Figure 1: Data from all 7 wavelengths shown in a single chart.

2. Graphical charts

The Model AE43 Aethalometer® can display a 'one dimensional' time-series chart of data; or more advanced 2D plots. One example (Figure 2) is a polar diagram indicating the relation between BC concentrations and wind speed/wind direction (only if AE43 is

connected to a Wind speed and wind direction sensor). The wind direction defines the polar angle; the wind speed defines the radial distance from the center; and the average BC concentration within each bin is represented by the colored scale.

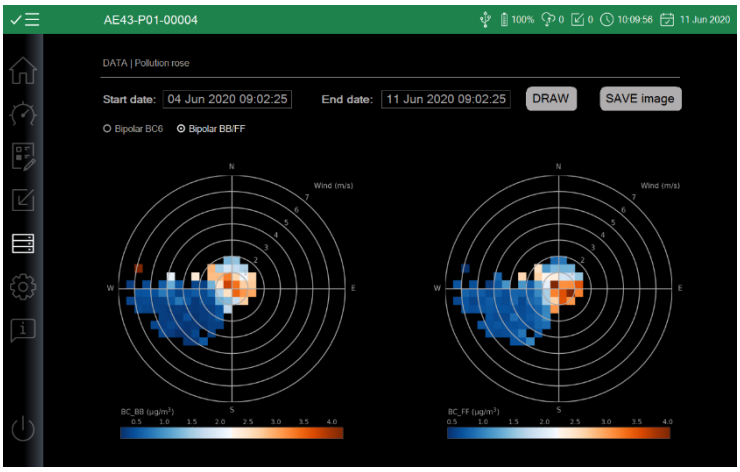


Figure 2: Polar diagram showing wind direction (angle); wind speed (radius); and BC concentration (color).

3. Lightweight design for Portability

The Model AE43 Aethalometer® is constructed from lightweight elements without compromising performance or ruggedness. The design features include:

- lightweight aluminum-alloy chassis
- optimization of support frameworks for internal components
- reduced weight of analytical chamber by machining optimization
- optimization of electronic component placement and wiring interconnections
- transit case available for in-field transportation
- Optional battery power supply with up to 15 h of run time.

4. User and Communications Interfaces

The Model AE43 Aethalometer® incorporates the following user, data and communications features:

- 10” color graphic display touch-screen for data display and user interface
- USB ports for local data download to a memory stick
- USB ports for connection of a keyboard, if needed for initial setup of parameters such as station identification
- RS-232 COM port for data transmission to digital data-logger
- Ethernet port for full network access and control, including
    i. Remote data acquisition, either batch or streaming
    ii. Remote retrieval of instrument status and state-of-health

iii. Remote control of instrument operating parameters

5. Modular Construction

The Model AE43 Aethalometer® is constructed with a modular design, so that sub-units may be easily serviced. The only item requiring attention in routine use is cleaning of the optical insert to remove accumulated dust or other contamination which may be brought in with the sample air stream. The optical chamber is attached with a bayonet fitting for quick removal; easy cleaning; and reliable re-assembly. The entire instrument is hermetically sealed to reduce the entry of dust and moisture.

6. Summary and Illustrations

The new Model AE43 Aethalometer® continues our tradition of well-proven and rugged design. The enhanced features include:

a) New Graphical User Interface with advanced real-time data visualization
b) Lightweight design with external power supply unit for portability, providing up to 15h of independent run time
c) Broader range of User and Communication interfaces
d) Patented 'DualSpot' technology to compensate for filter loading.
e) Analysis at multiple optical wavelengths with time resolution as rapid as 1 second (useful for direct combustion studies).
f) Sample collection on Teflon-coated glass fiber filter tape, to reduce the effects of varying Relative Humidity (e.g., air-conditioner perturbations).
g) Instrument is hermetically sealed to prevent ingress of dust and moisture.
h) Built-in software analyzes the multi-wavelength data, to provide real-time source apportionment of BC attributed to diesel or oil combustion; versus the BC attributed to biomass burning.
i) Capability of direct coupling to CO_2 sensor (optional extra accessory), with integration of BC and CO_2 data. This permits direct, real-time determination of the Emission Factor of BC during combustion.
j) Capability of direct coupling to meteorology sensor for P, T and RH (optional extra accessory), with integration of data
k) Built-in 'zero' test from internal clean-air source.
l) Validation test of optical detectors, using externally-inserted optical standards.
m) Network connection for remote access, operation, and data retrieval. Local data download from front-panel USB ports. Rear panel COM ports. Color touch-screen user interface.
n) Low power consumption (25 W or less), automatic operation upon power-up. May be operated at remote sites from off-grid inverter, batteries, and/or solar panels.
o) Additional connectivity to external sampling pump (HA option) to extend the operating range from 3000 m above sea level (a.s.l.) to 5000 m a.s.l.

7. References

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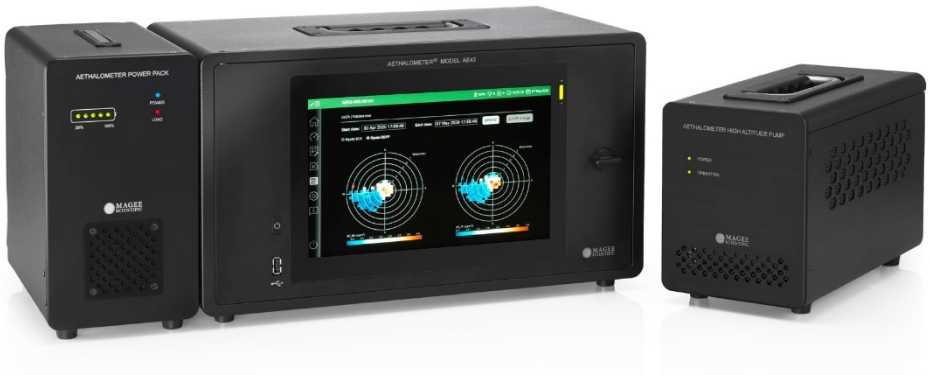

Figure 3: Magee Scientific Aethalometer® model AE43 with battery supply and external booster pump for high-altitude operation

8. Contact

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