AEROSOL
MAGEE SCIENTIFIC

THE SMART WAY FOR COMPLETE CARBONACEOUS AEROSOL SPECIATION

CASS

CARBONACEOUS AEROSOL SPECIATION SYSTEM

Higher resolution.
Smarter design.
Standard compliant.

KEY FEATURES

- Determination of BC, TC, EC, and POC, SOC fractions from solid and liquid fuels and advanced customized chartings
- High time resolution and real-time data
- DualSpot® technology
- Automated Clean Air Test
- No Glass, no Gas, and no Catalyst
- Ambient air as a carrier gas
- Automated calibration & validation
- Low maintenance & robust operation
- Flexible deployment
- Advanced and easily accessible troubleshooting guides and status descriptions

KEY BENEFITS

- Online operation
- Easy to use and maintain
- Advanced and comprehensive measurement
- Unmatched data quality
- High operational efficiency
- Future-proof flexibility (AE36, AE36s,...)
- Actionable insights
- Improved usability
- Requires minimal resources

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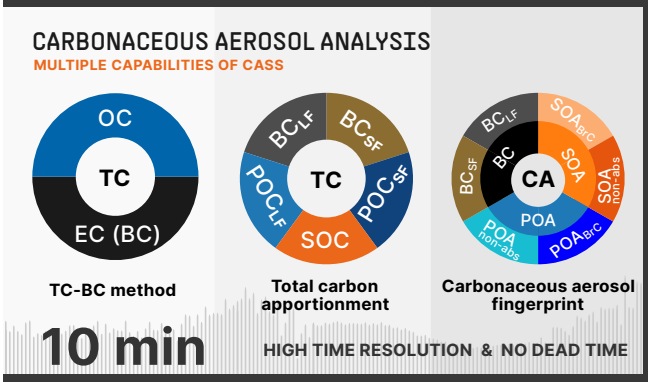
The new CASS combines Aethalometer with the latest Total Carbon Analyzer from Aerosol Magee Scientific. It represents the next generation in carbonaceous aerosol measurement. This integrated solution delivers unparalleled precision, compliance, and operational efficiency for air quality and climate research. CASS sets a new standard for carbonaceous aerosol monitoring - combining the analytical power of AE36/AE36s with the advanced automation and compliance of TCA09, all in a single, integrated system.

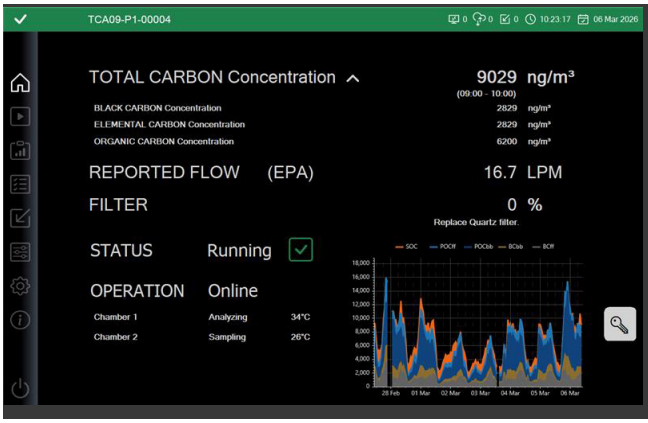
GOOD DATA. GOOD SCIENCE. GOOD POLICY.

CASS delivers advanced, comprehensive carbonaceous aerosol measurements by integrating real-time thermal and multi-wavelength optical analysis within a single system, combining the TCA09 Total Carbon Analyzer with the Aethalometer AE36 or AE36s. CASS incorporates a robust 5-component total carbon apportionment model ($TCAM_5$) that separates: Black carbon from liquid and solid fuels (BC_{LF}, BC_{SF}), Primary organic carbon from liquid fuels (POC_{LF}), Primary organic carbon from solid fuels (POC_{SF}), Secondary organic carbon (SOC).
These results are reported in real time and visualised directly on the screen, using multiple chart formats to provide immediate insight into source contributions and temporal dynamics.



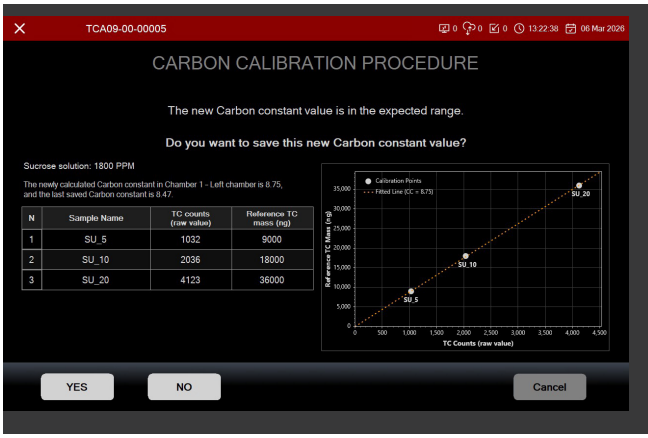
ADVANCED AND COMPREHENSIVE CARBONACEOUS AEROSOL MEASUREMENT

Leveraging the combined strengths of the AE36 or AE36s and the TCA09, CASS delivers high-resolution, source-resolved data with automated calibration, artifact correction, and robust validation. This enables precise quantification and apportionment of carbonaceous aerosols, supporting detailed air quality assessments, climate research, and regulatory compliance with minimal maintenance and maximum operational efficiency.



HIGH TIME RESOLUTION AND REAL-TIME DATA

CASS delivers advanced measurement capabilities with high time resolution and real-time data. This enables the capture of dynamic changes in carbonaceous aerosol concentrations on a 10-minute time scale. As a result, users gain immediate, actionable insights into air quality and emission events, supporting advanced research, regulatory monitoring, and timely decision-making.



AUTOMATED CALIBRATION & VALIDATION

CASS features fully automated calibration and validation processes, ensuring that every measurement is accurate, reliable, and traceable. By integrating automated calibration routines, such as sucrose-based carbon constant calibration and VOC artifact correction, with continuous system validation, CASS minimizes manual interventions and reduces the risk of human error. This robust automation streamlines routine operation and guarantees consistent data quality, supporting regulatory compliance and advanced scientific research with confidence.

CARBONACEOUS SPECIATION SYSTEM CASS

APPLICATIONS

The Carbonaceous Aerosol Speciation System (CASS) is used for various applications:

- Urban planning applications
- Climate research
- Source apportionment
- Air quality monitoring
- Carbonaceous material speciation
- Health effects studies
- Dynamic atmospheric processes
- Chamber experiments
- Emissions testing and source characterization
- Field Measurement Campaigns

ABOUT CASS

THE CASS MEASUREMENT PRINCIPLE

The Carbonaceous Aerosol Speciation System, CASS, simultaneously controls the operation of two instruments, i.e., the Total Carbon Analyzer TCA09 and the Aethalometer. The first one collects a sample of atmospheric aerosols on a quartz fiber filter positioned inside a small stainless steel chamber at a controlled sampling flow rate of 16.7 L/min. The default sampling time of TCA09 is 60 minutes, but it can be set from 10 minutes to 24 hours, depending on the ambient aerosol concentrations. TCA09 features two identical parallel channels, through which ball valves and solenoids regulate air flow. A continuous operation is enabled and sustained by the following principle of operation. While one channel collects its sample, the other analyzes an already collected sample and reports a total carbon (TC) level on a same set time base (from 10 minutes to 24 hours). After collecting the filter, two flash-heating elements combust the sample instantaneously in a small analytical flow of filtered ambient air. This converts all the carbonaceous compounds into CO_2 and creates a short, but large-amplitude pulse of CO_2 in the analytic flow passed to the NDIR CO_2 detector. The background level of CO_2 in ambient air is determined before and after the heating cycle, providing a baseline against which the combustion pulse is measured. The CO_2 concentration over the baseline is integrated to give the sample's TC content.
In parallel with TCA09, the CASS instrument also performs black carbon (BC) or elemental carbon (EC) monitoring using an Aethalometer, which conducts an optical attenuation analysis at multiple wavelengths from the near UV to near IR range to characterize black carbon aerosols accumulated on a Teflon-coated glass fiber filter tape. The Aethalometer draws the sample air stream through a filter tape with a flow rate of 2 – 5 LPM. Aerosols are collected on two spots on the tape and are illuminated by a multi-wavelength light source. Detectors measure the attenuation of light by the absorbing components of the aerosols relative to a reference through an unexposed portion of the tape. On a defined time base (1 s or 60 s or 300 s), the Aethalometer reports this BC data to TCA09. BC data and TC data are included in a simple mathematical formula: TC = BC + OC, which allows for the deduction of the OC level on the same time base as the TC level.

NO GLASS, NO GAS, AND NO CATALYST

CASS is engineered for maximum operational simplicity, requiring no special gases, catalysts, or proprietary quartz glass for its measurements. Ambient air is the analytical carrier gas at a very low flow rate. This eliminates the need for specialized gas supplies. The analytical chambers are made of stainless steel: the instrument contains no fragile glass components. This design eliminates the need for consumables or complex maintenance procedures often associated with traditional carbon analysis instruments. As a result, CASS offers a more user-friendly, cost-effective, and reliable solution for continuous monitoring of carbonaceous aerosols, making advanced air quality and climate research accessible and efficient across a wide range of environments.

LOW MAINTENANCE, ROBUST OPERATION, USER FRIENDLY AND SAFE DESIGN

CASS requires low maintenance and is constructed for robust operation, combining automated calibration, self-maintaining procedures, and extended filter life to minimize manual interventions. Its durable construction and advanced diagnostic features ensure reliable performance even in challenging environments, while continuous data validation and artifact correction maintain high data quality. This makes CASS ideal for long-term, unattended monitoring and demanding research applications, providing users with dependable, high-quality results and peace of mind.

It is easy to use, requires minimal resources with no analytic gas and no glass constituent parts.

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PRODUCT SPECIFICATIONS

BASIC DESCRIPTION
Real time/online TC/BC/EC/OC and BrC analysis with the Carbonaceous Aerosol Speciation System CASS.

The Aerosol Magee Scientific CASS is a revolutionary scientific instrument that measures TC/BC/EC/OC and BrC in near-Real-Time. The instrument contains no fragile glassware and requires no special gas supplies. In contrast to existing methods, the CASS offers greater reliability, greater flexibility, and very substantial operational cost savings for aerosol analysis.

MEASUREMENT PRINCIPLE
Optical Analysis of BC with continuous collection of aerosol on filter and simultaneous measurement of attenuation of transmitted light at wavelengths from UV to IR wavelength range. Thermal Analysis of TC with flash-heating of sample collected on a quartz filter to convert all Carbon to CO_2. The mathematical principle is simple:

Total carbon (TC) = Black (or Elemental) Carbon (BC or EC) + Organic Carbon (OC):
- Measure TC with the TCA09;
- Measure BC/EC with the Aethalometer®;
- Derive OC in near-Real Time: OC = TC - BC.

The Aethalometer® also identifies 'Brown Carbon' (BrC) by multi-wavelength optical analysis, and also separates biomass smoke from diesel emissions.

AETHALOMETER DUALSPOT TECHNOLOGY
Simultaneous analysis of light absorption by aerosol deposits collected on 2 spots in parallel at different loading rates. Mathematical combination of data yields Black Carbon result independent of "spot loading effects" and provides additional information about aerosol composition.

SOURCE APPORTIONMENT
Discrimination of Black Carbon from fossil fuel versus biomass combustion possible with built-in analysis by a two-component model in Aethalometer.

CARBONACEOUS AEROSOL SPECIATION SYSTEM CASS

SPECIFIED PERFORMANCE OF AE36 OR AE36s
Sensitivity: Proportional to time-base and sample flow rate settings: <10 ng/m³ @ 1 min, 5 LPM
Limit of detection of BC (1 hour) < 0.001 µg/m³
Detection range of BC: < 0.01 to > 100 µg/m³

SPECIFIED PERFORMANCE OF TCA09
Limit of detection: 100 ng C/m³ (1 h timebase, 16.7 LPM flow)
Detection range: 100 ng C/m³ to 1,000,000 ng C/m³ of Total Carbon (1 h timebase, 16.7 LPM flow)

SAMPLING FLOW RATES
• AE36 or AE36s sampling flow rate of BC/EC adjustable from 2 to 5 LPM, provided by closed-loop stabilized internal pump and two mass flow sensors.
• Sampling flow rate for TCA09 of 16.7 SLPM (1 m³/h), provided by closed-loop stabilized internal pump.

OPERATOR INTERFACE
• **Display**
10.1'' color touch-screens with status indicator LED's. Graphical User Interface with basic data display and control, advanced screens for detailed reporting and parameter setup. Network ready for remote management and data transfer.
DATA OUTPUT & STORAGE
• **Output**
Digital data via RS-232 COM port and Ethernet. Network ready for remote management and data transfer.
• **Timebase**
BC/EC: 1 s (1 Hz) or 1 minute @ AE36s and 1 min or 5 min @ AE36
TC/OC: 10 min to 24 h
• **Storage**
Data are written to internal memory once every timebase period. Stored data may be transferred over a network or to a manually inserted USB drive .

PHYSICAL SPECIFICATIONS
- Constructed in standard 19" rack-mount chassis.
- Dimensions (H x W x D): 62 × 48 × 52 cm (25" x 19" x 20")
- Weight: 74 kg (163 lbs)
- Electrical supply: 100-240 VAC, Voltage range: 85-264 V AC, 50/60 Hz
- Power consumption (maximum): max 1200 W; typical 100 W
- Internal sampling pump: dual diaphragm, brushless speed-controlled DC motor, stabilized flow.
- Modular internal hardware for rapid servicing.
- Constructed in fully-enclosed, self-contained rack-mount chassis.

INSTALLATION REQUIREMENTS
- Indoor or laboratory use, rack or benchtop
- Temperature: from 5°C - 45°C
- Humidity: 5 % - 95 %, non-condensing
- Operating altitude: 0 ~ 3000 m.
- Input / output connections:
  - Sampling air inlet: stainless steel Swagelok tube fitting, union, 1/2 inch tube OD
  - Sampling air outlet: standard ¼" NTPF threaded connector
  - Analytical carrier air inlet: standard ¼" NTPF threaded connector

ACCESSORIES
- Sharp cut cyclone inlet PM10 @ 16.7 LPM
- Sharp cut cyclone inlet PM2.5 @ 16.7 LPM
- Sharp cut cyclone inlet PM1 @ 16.7 LPM
- Shockproof and waterproof transit case
- Flow Calibrator ALICAT FP-25 (0.1-25 LPM) includes comunication cable includes comunication cable
- Ambient meteorological sensor GMX 300 (P, T, RH)
- Ambient meteorological sensor GMX 200 (wind speed and direction)
- Ambient meteorological sensor GMX 500 (P, T, RH, wind speed and direction)
- Sample inlet direct vertical installation for TCA09
- Inlet installation kit
- Sampling tube insulation
- Insect and water trap assembly
- Swagelok sampling tubing (various length) with different adapters
- Air splitter
- Neutral density optical filter validation kit
- Ambient meteorological sensor
- Wind speed and direction sensor
- Sample Stream Dryer
- PM2.5 Inlet (2.5 µm @ 5 LPM)
- PM1 Inlet (1 µm @ 5 LPM, 2.5 um @ 2 LPM)

Insect screen assembly with water trap
- Tape sensor calibration disc kit
- GPS module
- External pump for High-Altitude operation

(1) The heating chamber is covered by patents EP3832302, US2021164950 and other.
(2) The Automated Clean Air Test - patent pending.
(3) The DualSpot technology is covered by two patent families: US8411272, EP2151679B1 and US9671324, EP2937680B1 and other.
(4) A device and method for complete carbonaceous aerosol analysis in real time is covered by patents EP4033242 and other.
(5) A method for diagnostic for photometric devices is covered by patents EP2498079.

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Keeping an Eye on the Air