Aurora™ Integrating Nephelometers

CLASS-LEADING AEROSOL MONITORING & MEASUREMENT SOLUTION

acoem

CREATING ENVIRONMENTS OF POSSIBILITY

How do you shorten the path between monitoring and informed action?

For more than 50 years we have been designing and manufacturing class-leading multi-parameter environmental monitoring and industrial reliability solutions.

We offer our global customers a complete range of integrated measurement technologies and services, ensuring that your data is always accurate and your equipment operates with maximum efficiency.

We believe in helping you find the right balance between progress and preservation.

Empowering industries, government authorities, scientists and communities to make knowledgeable decisions based on reliable data, our holistic solutions lead to operational excellence and better outcomes.

At Acoem, we create environments of possibility.

World-class aerosol monitoring & measurement

Around the world, atmospheric scientists and environmental agencies, rely on Acoem's range of Aurora™ integrating nephelometers every day.

Accurate, flexible and easy to operate, they are also transportable and designed to cope with the demands of use in remote locations.

- From single or three wavelength integrating nephelometers to a polar three wavelength integrating nephelometer
- Total remote control including calibration
- Rugged and reliable
- Proven capability for long-term monitoring in remote, unattended locations
- Fully integrated with Acoem's Airodis™– data collection, validation and reporting software
- User friendly and easy to maintain in the field
- Best performance with low cost of ownership.

METEOROLOGY APPLICATION

Visibility can be impaired by aerosols reducing the amount of light reaching the observer through scattering or absorption.

Common visibility deterioration is due to excessive particulate concentration or high humidity. Particles can be of natural or anthropogenic origin, for example, from car emissions, wood burning, sandstorms or volcanic eruptions.

Aurora™ integrating nephelometers are an ideal solution for helping us identify, understand and plan ways to control pollution, and the imbalance and degradation of the environment.

They are the instruments of choice of governments and Environmental Protection Authorities (EPAs) around the world for visibility applications.

AUTOMOTIVE APPLICATION

Engine exhaust emissions are considered extremely hazardous to human health and can cause and aggravate a number of respiratory conditions. This is why reliable environmental monitoring is absolutely crucial for the automotive industry where compliance with regulatory standards is non-negotiable.

The Aurora™ adheres to specific requirements for measuring engine exhaust particulate emissions, by addressing the most common monitoring concerns including:

- **Linearity**
  The Aurora™ gives a linear response to emissions at extremely high particulate concentrations using the optical measurement principle
- **Clogging**
  The Aurora™ does not use a filter. This prevents clogging of the sample system
- **Hot sampling**
  The Aurora™ has a robust design and its lack of filter or pump allows for dilution.

Severe dust storm in Sydney, Australia

Affordable excellence

AURORA™ 1000

The clear choice for visibility monitoring

The **Aurora™ 1000** is perfect for any air quality monitoring system. It is a highly cost-effective entry level single wavelength instrument, uncompromised in its reliability and designed to run in extreme conditions.

Multiple options, features and accessories are available to be used in conjunction with the Aurora™ range. Please refer to the matrix table on page 10 for a list of options and compatibility.

FEATURES

- Single wavelength, available in 450 nm, 525 nm or 635 nm
- Wide measurement range (0.3 to 20,000 Mm-1)
- Fully automatic calibration using internal valves
- Ideal for remote locations

Enhanced correlation

AURORA™ 2000

Real-time mass concentration

The **Aurora™ 2000** single wavelength nephelometer (450 nm, 525 nm or 630 nm) is used to measure aerosol light scattering in conjunction with a Spirant™ BAM. It uses the reading from the Spirant™ BAM's hourly average to calculate a correlation factor to derive real-time $PM_{2.5}$ concentrations. When the Spirant™ BAM is not connected, you can manually derive and enter a correlation factor.

**The Spirant™ BAM measures and records airborne particulate concentrations using a ß ray attenuation method.*

FEATURES

- Enables real-time $PM_{2.5}$ concentration measurement in conjunction with a Spirant™ BAM
- 12V DC (110-240 VAC, 50/60 Hz power converter included) 13 watts nominal, 45 watts max

All-round capability

AURORA™ 3000

Proven results for long-term monitoring

The **Aurora™ 3000** is the favoured choice of researchers as it facilitates simultaneous measurement across three wavelengths, enabling wide and in-depth analysis of the interaction between light and aerosols. It integrates measurements of full scatter and backscatter, making it a perfect instrument for climate change research.

Like other instruments in the Aurora™ range, the Aurora™ 3000 has a range from 0.3 to 20,000 Mm⁻¹. A high-precision option is also available, with a lower detectable limit of 0.1 Mm⁻¹.

FEATURES

- Multi-wavelength LED light source for long-term stable measurements at 635 nm, 525 nm and 450 nm
- Integrates measurements of full scatter & backscatter
- Can be used in conjunction with the ACS™ 1000 for a light scattering enhancement factor measurement (optional)
- An automatic ball valve option protects against contamination of a common sampling manifold, bypassing the instrument during calibration
- Mass flow control option enables flow to be controlled in conjunction with an external pump

AEROSOL LIGHT SCATTERING APPLICATION

Aurora™ integrating nephelometers measure the light scattering coefficient of ambient aerosol particles with high sensitivity and time resolution, in a wide range of monitoring and research applications, related to air pollution and climate.

Long-Term Monitoring

> *The direct and indirect radiative effects of aerosol particles constitute the largest uncertainty in current radiative forcing estimates of the Earth's climatic system. In order to reduce the uncertainties associated with atmospheric aerosols in climate systems, detailed information on the temporal and spatial variability of different aerosol properties is required. Such information can be obtained from a combination of model simulations, remote sensing and continuous in-situ aerosol measurements.*
>
> *Lassko et al, 2010 'South African EUCAARI measurements: seasonal variation of trace gases and aerosol optical properties.' Atmospheric Chemistry and Physics.*

LIGHT SCATTERING IN REMOTE LOCATIONS

The Aurora™ range is widely used for research in remote and unattended locations, including on:

- Aerosol optical properties at high-altitude in the Mediterranean Basin by the Institute of Environmental Assessment and Water Research (IDAEA-CSIC) in Montseny, Spain
- Aerosol optical properties by Paul Scherrer Institute (PSI) as part of the CATCOS project across Indonesia, Chile, Vietnam & Kenya
- Various aerosol properties at high altitude by Observatoire de Physique du Globe, at Puy De Dôme, France.

Best in class

AURORA™ 4000 – POLAR

Measuring scattering by angular sector

The **Aurora™ 4000** builds on the same three wavelength capabilities as the **Aurora™ 3000**.
It provides measurements of light scattering up to 18 user-selectable angular sectors, using varied backscatter shutter positioning. This can help determine the phase function of aerosols, which is crucial to climate research and modelling.

Despite its advanced features, the Aurora™ 4000 maintains the same ease of use, maintenance and calibration as the rest of the Aurora™ range.

FEATURES

- Wide measurement range (0.1 to 20,000 Mm-1)
- 18 angular sectors; fully-integrated scattering, as well as integrated scattering of up to 17 different angular sectors from 10˚ to 90˚ through to 170˚
- Raw measurement counts available for customised data analysis
- An automatic bypass ball valve option protects against contamination of a common sampling manifold during calibration
- Mass flow control option enables flow to be controlled in conjunction with an external pump

AIRCRAFT MEASUREMENTS APPLICATION

The Aurora™ meets the following critical requirements expected for aircraft measurements:

- Compact and light weight
- Flow control with no restrictions
- Very low LDL
- Small cell volume
- Fast data acquisition (down to three seconds)
- Low power consumption
- Can be operated at -40 ˚C and at altitudes of up to 15,000 metres.

Aurora™ 4000 in a pressure chamber, testing the reliability when exposed to conditions expected at altitudes of up to 15,000 metres.

AEROSOL LIGHT SCATTERING RESEARCH

Optical closure studies:

> *Atmospheric aerosols play an important role in determining direct radiative transfer by scattering and absorbing solar radiation. Refractive indices are also necessary to determine the optical parameters relevant to radiative transfer such as single scatter albedo, asymmetry factor and specific absorption using the Mie-Lorenz theory. Additionally, reliable phase function and polarisation information is essential for the interpretation of satellite and aircraft measurements to infer aerosol optical depth, size and single scatter albedo.*
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> *H. Kim & S. E. Paulson 2013, 'Real refractive indices and volatility of secondary organic aerosol generated from photooxidation and ozonolysis of limonene, σ pinene and toluene.' Atmospheric Chemistry and Physics.*

The perfect complement

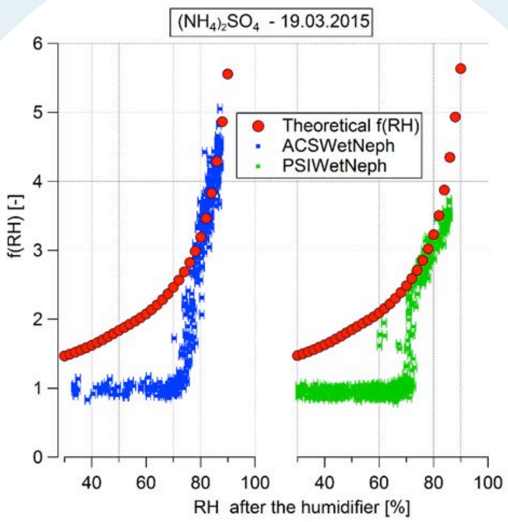
ACS™ 1000

Innovation in hygroscopic study

Acoem's Aerosol Conditioning System (**ACS™ 1000**) can be used with most aerosol monitoring instruments, adjusting relative humidity with minimal particle loss to measure the effect of water uptake on the properties of aerosols. The **ACS™ 1000** simultaneously controls differing relative humidity levels in two sample channels, allowing real-time measurement by parallel instruments for comparison.

FEATURES

- User configurable sample conditioning scheme
- Sample RH controllable between 40 % and 90 % with minimal particle loss
- Customisable flow and humidograms
- Autoranging power supply 110-250 VAC, 50/60 Hz
- Controls RH within ±0.2 % (1σ)



Ammonium sulfate particles light scattering enhancement (f(RH)) calculated (red markers) and measured by the ACS™ 1000 (blue dots) and the WetNeph developed by the Paul Scherrer Institute (green dots).
The errors bars represent the precision of the RH measurements according to the manufacturer.

Laborde et al. 2015, in prep.

Options, features & accessories matrix

	AURORA™ 1000	AURORA™ 2000	AURORA™ 3000	AURORA™ 4000
Mass Flow Control Option PART NO: E011010	×	×	✓	✓
PM_{10} Inlet PART NO: H020449 (3lpm)	✓	✓	✓	✓
$PM_{2.5}$ Inlet PART NO: H020450 (3lpm)	✓	✓	✓	✓
Automated Ball Valve Option PART NO: E011009 (Factory fitted option available)	✓	✓	✓	✓
Upgrade LDL Option PART NO: E011007	×	×	✓	✓†
External Pump Controller Kit PART NO: E011011	✓	✓	✓	✓
ACS 1000 Adaptor Plate PART NO: E011008	×	×	✓	✓
External Pump PART NO: P030004 (240 VAC P030004, 110 VAC PO30005)	✓	✓	✓	✓
Aerosol Conditioning System (ACS™ 1000)	×	×	✓	✓*
Ability to Log Raw Data	×	×	✓	✓
Ability to Display Units in µg/m^3 Using Spirant™ BAM or User K Factor	×	✓	×	×
Calibration Kit PART NO: H020331	✓	✓	✓	✓
External 12 Volt Cable Kit PART NO: C020022	✓	✓	✓	✓
Exhaust Tube Kit PART NO: H020330	✓	✓	✓	✓
Service Kit PART NO: H020335	✓	✓	✓	✓
Wall Mounting Bracket PART NO: H020005	✓	✓	✓	✓
Roof Flange PART NO: ECO-M9003004	✓	✓	✓	✓
Rain Cap PART NO: ECO-M9003011	✓	✓	✓	✓
Black Silicone Carbon Tubing Part No: TUB-1015	✓	✓	✓	✓
1/2“ Inlet Tube (0.8 m, 1 m, 1.5 m or 2 m) PART NO: H02032N (refer to footnote)	✓	✓	✓	✓
Aerosol Dryer PART NO: E010009	×	×	✓	✓
Low Dew Point Air Source PART NO: E040035	×	×	✓	✓

† The selected Aurora™ comes standard with this feature

* The Aurora™ 3000 & 4000 give RH feedback to the ACS™ 1000

N = 0 (0.8 m insulated), 2 (1 m un-insulated), 3 (1.5 m un-insulated) or 4 (2 m uninsulated) for Sample Inlet Tube

TRAINING AND SUPPORT

A partnership with Acoem

There's a lot more to our Aurora™ range and ACS™ 1000 system than what comes in the box. Acoem offers continuous support for its customers around the world.

Our in-house scientists and engineers can always be called upon for advice, knowledge and practical assistance, and they are available in any time zone.

We also facilitate user group meetings throughout the year, enabling a forum for researchers to share experiences and receive guidance from Acoem experts as well as peers.

Our website is the hub of a virtual network, offering firmware and software updates.

Owning an Aurora™ instrument means we are partners in your environmental monitoring.

The Acoem range of Aurora™ nephelometers

About Acoem

At Acoem, we **create environments of possibility** – helping organisations find the right balance between progress and preservation – safeguarding businesses and assets, and maximising opportunities while conserving the planet's resources. We deliver unrivalled, interoperable AI-powered sensors and ecosystems that empower our customers to make enlightened decisions based on accurate information.

Together with 150 distributors, our 800+ employees work across 27 offices, 5 manufacturing facilities and 3 R&D centres in 11 countries, to provide trusted, holistic data solutions for customers worldwide.

Acoem links possibilities with protection.

For more information visit acoem.com

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