

Aurora™ 1000

INTEGRATING NEPHELOMETER



Easy to use and maintain, the Aurora™ 1000 lowers the cost of ownership for aerosol light scattering, visibility and particulate monitoring instrumentation.

The Aurora™ 1000 Integrating Nephelometer uses a single wavelength for scattering coefficient visibility measurements at one of three user specified wavelengths.

ECOTECH, through collaboration with globally renowned atmospheric research institutes, now provides the scientific community with the most advanced commercially available nephelometers.

Using a single wavelength LED light source, the Aurora™ 1000 can be equipped with any of the following light sources:

- 450 nm (blue) for fine and ultra fine particulates (wood fires, automobiles)
- 525 nm (green) for visibility
- 635 nm (red) for large particulates (e.g. pollen, sea salt).

BENEFITS

- Simplified automatic calibration using internal valves, ideal for remote locations. Fully automatic zero check or adjust, automatic span check or automatic zero and span check available in intervals of 1, 3, 6, 12, 24 hrs or weekly
- Fully integrated package including: internal sample pump, sample heater, internal calibration valves, zero air pump and data logger
- Internal sample heater with temperature or RH control, which can be enabled by the user to eliminate the effects of humidity (RH: < 30 to < 90 %)
- 12 VDC operation (60 watts max, 13 watts nominal)
- Holds up to 61 days of 5 minute data averages or 2 days of 1 min data
- Data downloading and firmware upgrading software supplied on USB or internet.

Increased accuracy

- Automatic calibration
- Easy maintenance/cleaning of the measurement cell
- Long lasting LED light source
- Intuitive software and maintenance
- Automatic optical reference calibration
- Facilitates a wide measurement range (0 to 20,000 Mm⁻¹).

LED vs flash lamp

- Our LED light source is guaranteed not to fail and often exceeds 5 years, compared to a flash lamp that is recommended to be changed every 4 - 6 months
- Heat generated by the LED light source is a fraction of that generated by a flash lamp, minimising changes in sample RH
- LEDs emit light at a specific wavelength eliminating the need for band pass filters.

Lower cost of ownership

- Fully automatic zero and span calibrations
- Low power internal 12 V heater eliminates the need for external inlet heater
- Long lasting low power LED light source
- No bandpass filters to be replaced
- Unique in its simplicity and practicality.

SPECIFICATIONS

Measured parameters:	Light scattering coefficient (σ_{sp}) at (450, 525 or 635 nm)
Ranges:	0 to >20,000 Mm^{-1}
Lower detectable limit:	<0.3 Mm^{-1} (60 second averaged data)
Secondary measurements:	Sample air temperature, relative humidity (RH), barometric pressure and enclosure temperature
Flow rate:	\approx 5 l/min with default blower. Higher flow can be obtained using the external pump option (e.g. in case of common inlet)
Operating temperature:	-20 to 45 °C
Operating RH:	10 to 95 %
Calibration:	Span gas available for CO ₂ , SF ₆ , FM-200, R-12, R-22, R-134 or a user defined gas
Optics:	Reference light source measurement
Light source:	Stable LED light source (US patent 7,671,988)
Wavelength:	525 nm (green), 450 nm (blue), 635 nm (red)
Operating voltage:	12 VDC (incl 110-240 VAC 50/60 Hz power supply converter)
Power consumption:	13 watts nominal, 45 watts with heater active
Dimensions:	170 x 700 x 215 mm
Weight:	11.2 kg

COMMUNICATIONS & DATA LOGGING

Outputs:	25 pin external I/O analog outputs (2 voltage & 2 current) 2 x RS232 serial ports (multi-drop, service)
Filtering:	Kalman (digital adaptive filter), moving average (30 seconds) or no filter
Data averaging:	1 min or 5 min
Stored parameters:	Date & time, σ_{sp} (635, 525 or 450 nm), sample air temperature, enclosure temperature, RH, barometric pressure and instrument status
Capacity:	Maximum of 61 days of 5 minute averages, or 12 days of 1 minute averaged data

OPTIONS

- Internal flow control and PM_{2.5} sampling 3 slpm
- Solar power option
- Sample bypass
- Roof flange kit and rain cap with insect screen
- Gas Calibration kit
- Wall mount bracket.

APPLICATIONS

- Visibility measurements (airports, city pollution, AAQMS)
- Dust/sand storm monitoring and early detection networks
- Bushfire pollution monitoring and early detection networks
- PM_{2.5} mass measurement correlation studies.



Aurora™ 2000

PM_{2.5} CORRELATING NEPHELOMETER



The Aurora™ 2000 PM_{2.5} Correlating Nephelometer is part of the new generation nephelometers using a single wavelength and an LED light source to measure aerosol light scattering and derive particulate concentrations.

The Aurora™ 2000 enables a correction factor to be used in order to derive PM_{2.5} concentrations. This improves the correlation between the Aurora™ and Reference PM_{2.5} methods while providing 1 minute measurements from the Aurora™ 2000. The correction factor can be entered manually or automatically derived from hourly averages from a continuous PM_{2.5} monitor.

BENEFITS

- Simplified automatic calibration using internal valves, ideal for remote locations
- Fully integrated package including: internal sample pump, sample heater, internal calibration valves, zero air pump and data logger
- Internal sample heater with temperature or RH control, which can be enabled by the user to eliminate the effects of humidity (RH: < 30 to < 90 %)
- 12 VDC operation (45 watts max, 13 watts nominal).

Light Source

The Aurora™ 2000 can be equipped with any one of the following LED light sources:

- 450 nm (blue) for fine and ultra fine particulates (wood fires, automobiles)
- 525 nm (green) for visibility
- 635 nm (red) for large particulates (e.g. pollen).

CONFIGURATIONS

Aurora™ 2000 PM_{2.5} Nephelometer - manual correction factor configuration

In applications where the aerosol chemistry is stable, a correction factor can be manually entered which then provides excellent results with minimal maintenance and a high degree of correlation.

Aurora™ 2000 Automatic correlating PM nephelometer configuration

In applications where aerosol chemistry is subject to change, a correction factor derived from manual sampling may be unreliable. In this case the Aurora™ 2000 may be connected directly to a PM_{2.5} compliance monitor, either the ECOTECH Spirant BAM or the Met One BAM 1020, in order to monitor and log PM hourly averages generated by the BAM (PM_{BAM}). These hourly averages are compared to the Aurora's hourly average scattering coefficient (σ_{scat}) and a scattering to PM coefficient factor (σ_{scat}/PM) is calculated. This factor is then applied to the next hour of 1 minute scattering coefficients measured in order to determine a 1 minute average for PM concentrations (PM_{aurora}).

The derived correction factor can also be used to determine changes in aerosol sources through deviations in light scattering from the expected values.

This configuration of the Aurora™ 2000 nephelometer provides the following parameters:

- US EPA compliance data for PM_{2.5} measurement
- Scattering coefficient (σ_{scat})
- BAM_{PM} averages – 1 hour average only
- Corrected real time 1 minute PM concentrations PM_{aurora}
- Sample temperature, relative humidity and barometric pressure.

SPECIFICATIONS

Measured parameters:	$\mu\text{g}/\text{m}^3$ and σ_{Scat}
Ranges:	0 - 2000 $\mu\text{g}/\text{m}^3$ and 0 - 20,000 Mm^{-1}
Lower detectable limit:	3 $\mu\text{g}/\text{m}^3$ ($<0.3 \text{Mm}^{-1}$) (60 second averaged data)
Secondary measurements:	Sample air temperature, relative humidity (RH), barometric pressure and enclosure temperature
Flow rate:	$\approx 5 \text{ l}/\text{min}$ with default blower. Higher flow can be obtained using the external pump option (e.g. in case of common inlet)
Operating temperature:	- 20 to 45 °C
Operating RH:	10 to 95 %
Calibration:	Span gas available for CO_2 , SF_6 , FM-200, R-12, R-22, R-134 or a user defined gas
Optics:	Reference light source measurement
Light source:	Stable LED light source (US patent 7,671,988)
Wavelength:	525 nm (green), 450 nm (blue) or 635 nm (red)
Operating voltage:	12 VDC (incl 110 - 240 VAC 50/60 Hz power supply converter)
Power consumption:	13 watts nominal, 45 watts with heater active
Dimensions:	170 x 700 x 215 mm
Weight:	11.2 kg

COMMUNICATIONS & DATA LOGGING

Outputs:	25 pin external I/O analog outputs (2 voltage & 2 current) 2 x RS232 serial ports (multi-drop, service)
Filtering:	Kalman (digital adaptive filter), moving average (30 seconds) and no filter
Stored parameters:	Date & time, $\mu\text{g}/\text{m}^3$, σ_{sp} (635, 525 or 450 nm), hourly BAM_{PM} average, hourly mass correction factor, sample air temperature, enclosure temperature, RH and barometric pressure and instrument status
Capacity:	Maximum of 48 days of 5 minute averages, or 10 days of 1 minute averaged data.

OPTIONS

- Solar power option
- Roof flange kit and rain cap with insect screen
- Gas calibration kit
- Wall mount bracket.



Aurora™ 3000

3 WAVELENGTH INTEGRATING NEPHELOMETER



Aerosol particles in the atmosphere directly influence the earth's radiative balance by absorbing and scattering the solar radiation and indirectly, by changing the clouds microphysical properties.

The amount of sunlight reaching the earth's surface, rather than being scattered back to space, is an important parameter to accurately model the influence of aerosol scattering on the earth's radiative balance.

The Aurora™ 3000 provides this measurement by reporting both the integrated and back-scattered coefficient.

Using a LED light source, the Aurora™ 3000 simultaneously measures at 525 nm (green), 450 nm (blue) and 635 nm (red) to enable wide and in-depth analysis of the interaction between light and aerosols.

The ECOTECH Aurora™ 3000 includes backscatter measurements that allows both standard integrating measurements of 9 - 170° and also the back scatter 90 - 170°.

APPLICATIONS

- Studies on backscatter and forward scatter
- Scattering enhancement factor (eg. in combination with the ECOTECH ACS)
- Scattering Ångström exponent calculations
- Determination of single scattering albedo.

Analog input:

- High powered LED light source increases measurement accuracy
- Single light source and detector used for all wave-lengths
- Heat generated by the LED light source is a fraction of that generated by a flash lamp, minimising changes in sample RH
- Easy automatic calibration, ensures repeatability of measurement
- Automatic optical reference calibration
- Single light source and detector used for all wavelengths
- Facilitates a wide measuring range (0 to 20,000 Mm⁻¹).

BENEFITS

- Simplified automatic calibration using internal valves, ideal for remote locations
- Fully automatic zero check or adjust, automatic span check or automatic zero and span check available in intervals of 1, 3, 6, 12, 24 hrs or weekly
- Fully integrated package including internal sample pump, sample heater, internal calibration valves, zero air pump and data logger
- Internal sample heater with temperature or RH control, which can be enabled by the user to eliminate the effects of humidity (RH: < 30 to < 90 %)
- 12 VDC operation (60 watts max, 14 watts nominal)
- Holds up to 33 days of 5 minute data averages or 6 days of 1 min data.

LED vs flash lamp

- Our LED light source is guaranteed not to fail within 3 years, and often exceeds 5 years compared to a flash lamp that is recommended to be changed every 4 - 6 months
- LEDs emit light at a specific wavelength eliminating the need for band pass filters
- An LED light source uses the same light path for each wavelength ensuring consistency of measurement, eliminating the need for multiple PMTs and maximising light intensity.

SPECIFICATIONS

Measured parameters:	Light scattering coefficient (σ_{sp}) at (450, 525 and 635 nm) Backscatter coefficient ($b\sigma_{sp}$) at (450, 525 and 635 nm)
Ranges:	0.0 to > 20,000 Mm^{-1}
Lower detectable limit:	< 0.3 Mm^{-1} full and back scatter (60 second averaged data) (0.1 Mm^{-1} optional)
Secondary measurements:	Sample air temperature, RH and pressure. Enclosure temperature
Intensity function:	Full scatter 9 - 170 °C Back scatter 90 - 170 °C, parameterised by Mueller et al, 2010
Flow rate:	≈5 SLPM with default blower. Higher flow can be obtained using the external pump option (e.g. in case of common inlet)
Operating temperature:	- 20 to 45 °C
Operating RH:	10 to 95 %
Calibration:	Span gas available for CO ₂ , SF ₆ , FM-200, R-12, R-22, R-134 or a user defined gas
Optics:	Reference light source measurement
Light source:	Stable LED light source (US patent 7,671,988)
Wavelength:	525 nm (green), 450 nm (blue), 635 nm (red)
Operating voltage:	12 VDC (incl 110 - 240 VAC 50/60 Hz power converter) (14 watts nominal, 45 watts with heater active)
Dimensions:	170 x 700 x 215 mm
Weight:	11.2 kg

COMMUNICATIONS & DATA LOGGING

Outputs:	4 analog outputs (2 voltage & 2 current) and 2 x RS232 serial ports
Filtering:	Kalman (digital adaptive filter), moving average (30 seconds) or no filter
Stored parameters:	Date & Time, σ_{sp} (635, 525 and 450 nm), Air temperature, Enclosure temperature, RH, Pressure instrument status
Capacity:	Maximum of 33 days of 5 minute averages, or 6 days of 1 minute averaged data

LOWER COST OF OWNERSHIP

- Fully automatic zero and span calibrations
- Low power internal 12 V sample heater
- Long lasting low power LED light source
- No bandpass filters to be replaced
- Easy to clean measurement cell.

OPTIONS

- External pump control
- Sample bypass valve used in conjunction with external pump plate kit
- Roof flange kit and rain cap with insect screen
- Gas calibration kit and wall mount bracket.



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Aurora™ 4000

POLAR NEPHELOMETER



Aerosol particles in the atmosphere directly influence the earth's radiative balance by absorbing and scattering the solar radiation and indirectly, by changing the cloud's microphysical properties.

The phase function, defined as the amount of light scattered as a function of the scattering angle, is a key parameter to accurately model the influence of the aerosol scattering on the earth's radiative balance.

Polar nephelometers provide this measurement.

The Aurora™ 4000 is the first commercially available polar nephelometer in the world. The instrument provides more specific light scattering measurements for up to 18 angles between 10° and 170°, with customised resolution. This extra measurement provides comprehensive data allowing a greater characterisation of aerosol scattering than the basic backscatter measurement.

It uses the same three wavelength technology as the Aurora™ 3000 but also automatically measures the amount of light scattered in different angular sectors by varying its backscatter shutter position. The Aurora™ 4000 simultaneously measures at 525 nm (green), 450 nm (blue) and 635 nm (red), using the now proven LED light source (Mueller, 2010), to enable wide and in-depth analysis of the interaction between light and aerosols.

BENEFITS

- High powered multi-wavelength LED light-source increases measurement accuracy
- Higher flow available via the external pump option for common inlet cases
- Raw measurement counts available for customised data analysis
- Single light source and detector used for each sector measurement
- Simplified fully automatic and scheduled calibration (zero and/or span) using internal valves, ideal for remote locations
- Simplified automatic calibration using internal valves, ideal for remote locations
- Robust instrument for unattended operation.
- 12 VDC operation (60 watts maximum, 15 watts nominal)
- Automatic optical reference calibration
- Fully integrated package including; internal sample pump, sample heater, internal calibration valves, zero air pump and data logger
- Internal sample heater with temperature or RH control, which can be enabled by the user to eliminate the effects of humidity (RH: < 30 to < 90 %).

LED vs flash lamp

- Our LED light source is guaranteed not to fail within 3 years and often exceeds five years
- Heat generated by the LED light source is a fraction of that generated by a flash lamp, minimising changes in sample RH
- LEDs emit light at a specific wavelength eliminating the need for band pass filters
- An LED light source uses the same light path for each wavelength ensuring consistency of measurement, eliminating the need for multiple PMTs and maximising light intensity.

SPECIFICATIONS

Measured parameters:	Light scattering coefficient (σ_{sp}) at (450, 525 and 635 nm) over 2 to 18 angular sectors
Ranges:	0 to >20,000 Mm^{-1}
Lower detectable limit:	< 0.3 Mm^{-1} over all sectors (60 second averaged data) (0.1 Mm^{-1} full scatter and backscatter)
Secondary measurements:	Sample air temperature, enclosure temperature, sample relative humidity and sample pressure
Intensity function:	9 to 170°
Angular resolution:	1 deg increments within 0.3 deg accuracy
Flow rate:	≈5 l/min
Operating temperature:	- 20 to 45 °C
Operating RH:	10 to 95 %
Calibration:	Span gas available for CO ₂ , SF ₆ , FM-200, R-12, R-22, R-134 or a user defined gas
Optics:	Reference light source measurement
Light source:	Stable LED light source (US patent 7,671,988)
Wavelength:	525 nm (green), 450 nm (blue), 635 nm (red)
Operating voltage:	12 VDC (incl 110 - 240 VAC 50/60 Hz power supply converter) 13 watts nominal, 45 watts with heater active
Dimensions:	170 x 700 x 215 mm
Weight:	11.2 kg

COMMUNICATIONS & DATA LOGGING

Outputs:	25 pin external I/O analog outputs (2 voltage & 2 current) 2 x RS232 serial ports (multi-drop, service)
Filtering:	Kalman (digital adaptive filter), or no filter
Stored parameters:	Date & time, σ_{sp} (635, 525 and 450 nm), sample air temperature, enclosure temperature, RH, barometric pressure and status for up to 18 angles, raw measurement counts or ratios
Capacity:	2000 lines of data (based on capture of all 18 angular segments)

OPTIONS

- External pump control
- Solar power panels and batteries
- Roof flange kit and rain cap with insect screen
- Gas calibration kit and wall mount bracket.

APPLICATIONS

- Studies on backscatter and forward scatter
- Scattering enhancement factor
- Scattering Ångström exponent calculations
- Determination of single scattering albedo.

