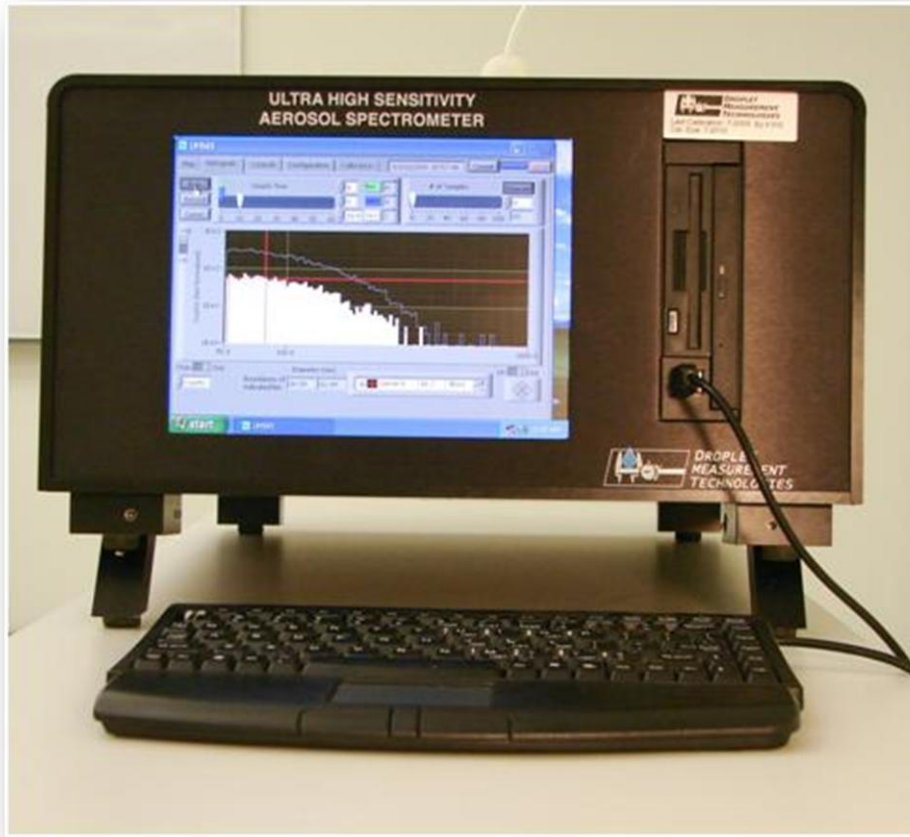


Ultra-High Sensitivity Aerosol Spectrometer (UHSAS)



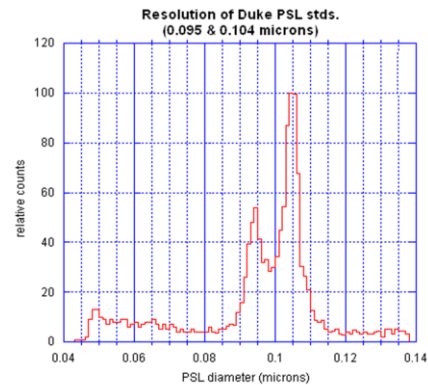
The UHSAS is an optical-scattering, laser-based aerosol particle spectrometer for sizing particles in the 0.06 – 1 μm range. The instrument counts particles in up to 100 user-specified sizing bins, with a resolution as fine as 1 nm/bin. This high sensitivity makes the UHSAS ideal for aerosol research and filter testing.

Advantages

- Measures aerosols in the 60 nm to 1 μm range
- Offers size resolution at 1-2% of particle size
- Eliminates sizing uncertainty associated with scattering spectrometers that measure at sizes larger than the excitation wavelength
- Categorizes particles by size in up to 100 bins (user selects bin number and boundaries)
- Counts up to 3,000 particles/second
- Uses aerosol spectrometry technique with two detection systems: a primary, highly sensitive APD-based system to size smaller particles, and a secondary PIN photodiode system to size larger particles
- Compensates for small drifts in laser power via automatic gain control
- Features an on-board computer, built-in monitor, and powerful LabVIEW-designed software for easy, real-time data analysis

Superior Resolution

UHSAS accurately sizes even the smallest particles. The graph at right shows the results of a test conducted with 95 nm and 104 nm standard PSL particles. Although these particle diameters are only 9 nm apart, the UHSAS has correctly identified two distinct particle peaks.



Applications

- Aerosol research
- HEPA/ULPA filter testing and characterization
- Atmospheric and air pollution monitoring and research
- Chemical process monitoring and control
- Pharmaceutical research and manufacturing
- Powders and food products research
- Inhalation toxicology research
- Combustion and emission source research
- Nebulization analysis
- Coalescence and nucleation research

Principle of Operation

A laser illuminates particles, which scatter light that is then collected by two pairs of Mangin optics. One pair of optics images onto a highly sensitive avalanche photodiode (APD) for detecting the smallest particles. The other pair images onto a low-gain PIN photodiode for detecting particles in the larger size range of the instrument. Each detector is amplified in a current-to-voltage stage that feeds into the analog electronics system. The amplification allows the system to detect particles as small as 60 nm.

Calibration

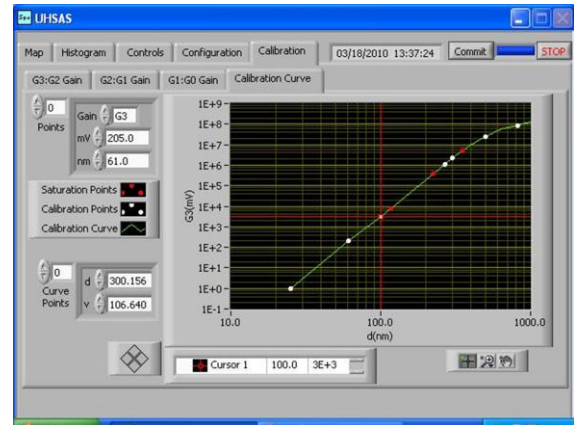
The UHSAS, with its high resolution and large number of arbitrarily settable bins, requires a complex process to ensure accurate calibration. However, the UHSAS software automates much of this process, making it a simple matter to calibrate the instrument on a daily basis.

Calibration is accomplished by adjusting the instrument's four gain stages so particles are accurately sized. First, gain stages are adjusted relative to each other, and then the scale is fixed to a known particle size using monodisperse polystyrene latex (PSL) spheres. The combination of relative and absolute gain calibration ensures that the UHSAS is properly measuring particles.

Software

The UHSAS comes with LabVIEW-designed software that provides a user-friendly virtual instrument panel for the control and data display of the UHSAS. For instance, the program enables the user to do the following tasks:

- View a histogram of particles binned by diameter, by transit time, or by peak optical signal
- Set boundaries for the histogram bins
- Control sample flow and monitor temperature, pressure, and laser current
- Calibrate the instrument



UHSAS Software – Calibration Tab

Specifications

Measured Parameters	Single particle light scattering
Auxiliary Parameters	Temperature Pressure
Derived Parameters	Particle diameter
Number Concentration Range	3,000 particles/second
Particle Size Range	60 nm – 1 μ m
Aerosol Medium	Air, 0 - 30 $^{\circ}$ C (32 - 86 $^{\circ}$ F)
Lasers	<ul style="list-style-type: none"> • Solid-state $N_d^{3+}:Y LiF_4$: \sim1054 nm, 1 kW/cm² intracavity circulating power • Pump Laser: \sim797 nm, 1.6 W
Number of size bins	100 max: <ul style="list-style-type: none"> • 99 standard bins (98 if both overflow and underflow are enabled) • One overflow bin and one underflow bin
Sample Flow	<ul style="list-style-type: none"> • Standard option: 1 – 100 standard cm³/minute (typically 50) • Other options available
Flow Control	Controlled from software; can also be manually adjusted via mass or volume flow controller
Routine Maintenance	<i>Daily:</i> <ul style="list-style-type: none"> • Monitor laser power by verifying Laser Reference voltage falls within acceptable levels; if necessary, clean critical optics to restore laser power • Zero check with high-efficiency filtered air sample <i>Monthly and around field campaigns:</i> <ul style="list-style-type: none"> • Full-scale calibration <i>Annually:</i>

	<ul style="list-style-type: none"> Flow controller calibration
Recommended Service	Annual cleaning and calibration at DMT service facility
Front Panel Display	Built-in monitor, 2 USB 2.0 ports
Rear Panel Connections	System power switch, system power connection, Ethernet, exhaust vent, exhaust port, serial stream connection
Computer System	On-board Intel® Celeron® 504 MB RAM 80 GB hard drive User interface via standard keyboard, mouse, and built-in monitor (included)
Software	UHSAS Executable program written in LabVIEW
Data Recording	<ul style="list-style-type: none"> Output file written to computer hard drive Output data sent to serial port
Communications Output	Serial, Ethernet, USB
Power Requirements	100-240 VAC, 47-63 Hz, 200W
Dimensions	56 cm L x 43 cm D x 24 cm H
Environmental Operating Conditions:	
Temp	0 – 30°C (32 - 86°F)
RH	0 – 100% RH non-condensing
Altitude	Sea level to 4 km

Specifications are subject to change without notice. The UHSAS is a Class I Laser Product with a Class IV pump laser, U.S. Patent # 5,889,589.

Options and Accessories

- Rack mountable unit (standard 19" instrument rack)
- External laptop (for remote applications, replaces flat screen display)
- Particle by particle feature (supplies information on individual particles, including inter-particle times)
- Bidirectional serial stream communication control

Items Included in Purchase Price

- Instrument
- Keyboard with touch pad
- Operator manual
- Zero-count filter
- Domestic and international power supply
- One day of training at DMT's facility
- One-year warranty
- Email and telephone technical support

Selected Bibliography

Y. Cai, D. Montague, W. Mooiweer-Bryan, and T. Deshler, "Performance characteristics of the ultra-high sensitivity aerosol spectrometer for particles between 55 and 800 nm: Laboratory and field studies," *Journal of Aerosol Science* 39 (2008) 759-769.

R. Yokelson, I. R. Burling, S. P. Urbanski, E. L. Atlas, K. Adachi, P. R. Buseck, C. Wiedinmyer, S. K. Akagi, D. W. Toohey, and C. E. Wold, "Trace gas and particle emissions from open biomass burning in Mexico," *Atmos. Chem. Phys. Discuss.* 11, 7321-7374, 2011. doi:10.5194/acpd-11-7321-2011.

R. Yokelson, S. Urbanski, E. Atlas, D. Toohey, E. Alvarado, J. Crouse, P. Wennberg, M. Fisher, C. Wold, T. Campos, K. Adachi, P. R. Buseck and W. M. Hao. "Emissions from forest fires near Mexico City." *Atmos. Chem. Phys. Discuss.* 7, 6687-6718, 2007.

How to Order

For more information or to obtain a sales quote, contact DMT at 303.440.5576 or customer-contact@dropletmeasurement.com.



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