

# Model 3314 Ultraviolet Aerodynamic Particle Sizer<sup>®</sup> Spectrometer

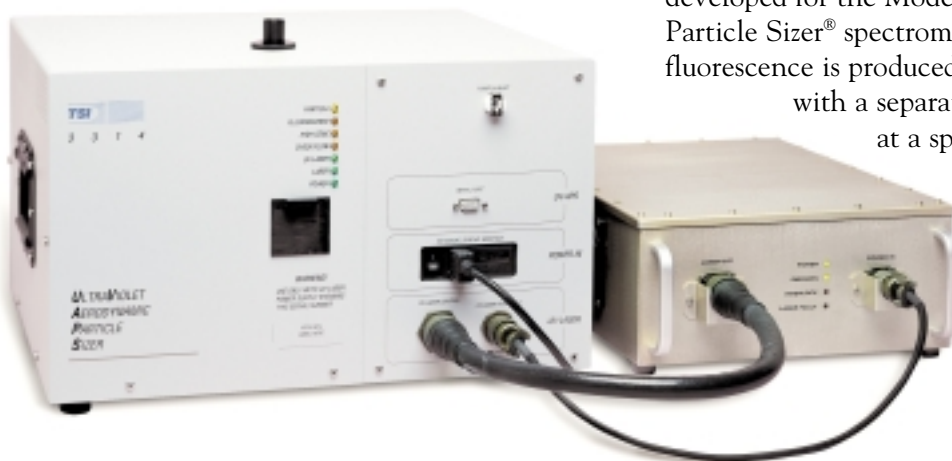
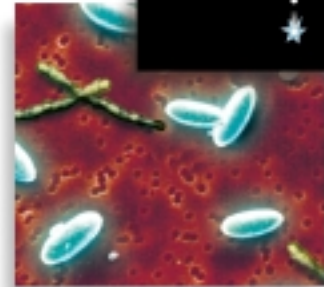
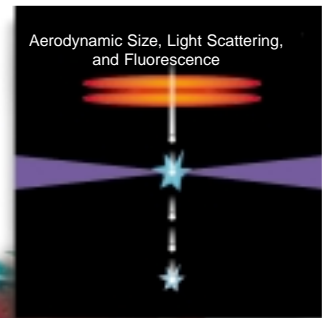
*Measure fluorescence plus aerodynamic size and scattered-light intensity!  
Three measurements give you the most comprehensive profile of ambient aerosols available from any single instrument.*

The Model 3314 Ultraviolet Aerodynamic Particle Sizer<sup>®</sup> (UV-APS) spectrometer provides three real-time measurements of airborne particles—aerodynamic size, scattered light intensity, and, for the first time, fluorescence! Using these three measurements, you can explore new aspects of your aerosol samples.

The UV-APS provides very rapid measurements of aerodynamic size and scattered light intensity for particles from 0.5 to 15 micrometers. It also measures the fluorescence characteristics of individual particles in an aerosol sample. The fluorescence measurement allows you to distinguish, in real time, biological aerosol particles from inanimate materials.

The three UV-APS measurements are made using two separate detection methods.\*

A patented, double-crest optical system provides the aerodynamic and scattered light measurements. This time-of-flight technology was first developed for the Model 3321 Aerodynamic Particle Sizer<sup>®</sup> spectrometer. Biological-related fluorescence is produced by exciting particles with a separate, ultraviolet laser beam at a specific wavelength.



\*United States patent numbers 5,561,515 and 5,701,012.

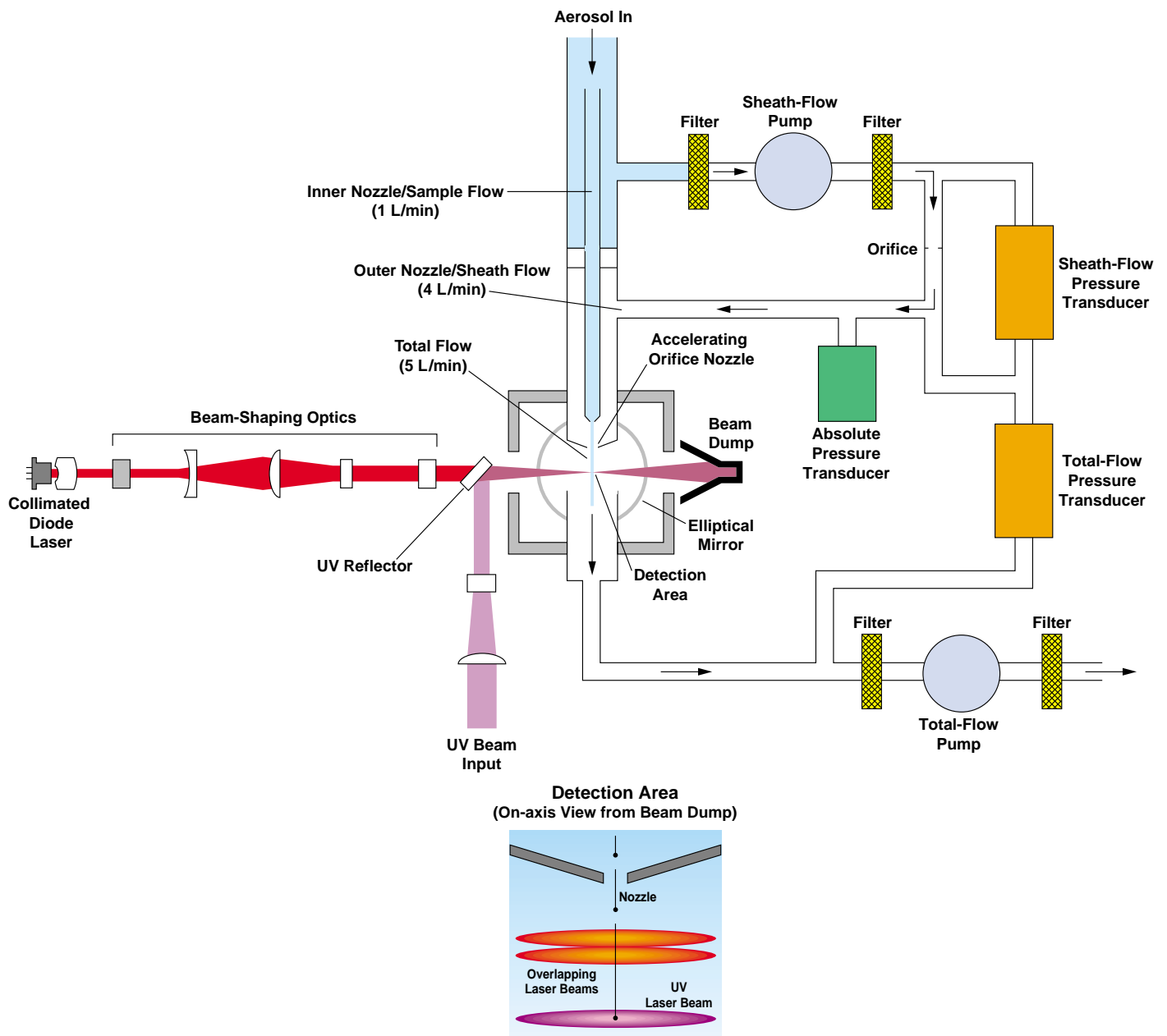
## APPLICATIONS

Originally developed to detect the presence of biological agents, the UV-APS technology is relevant to these applications:

- Biohazard detection
- Inhalation toxicology
- Indoor air-quality monitoring
- Ambient air monitoring
- Filter and air-cleaner testing
- Drug delivery studies
- Basic research

## OPERATION

The UV-APS employs sophisticated optics and timing techniques to coordinate two distinct processes and produce its three measurements. In the first process, a time-of-flight signal is used to determine particle size and light-scattering intensity. The signal then triggers the second process, which targets the particle with a UV laser and measures any resulting fluorescence. The following sections provide more detail on this unique method of operation.

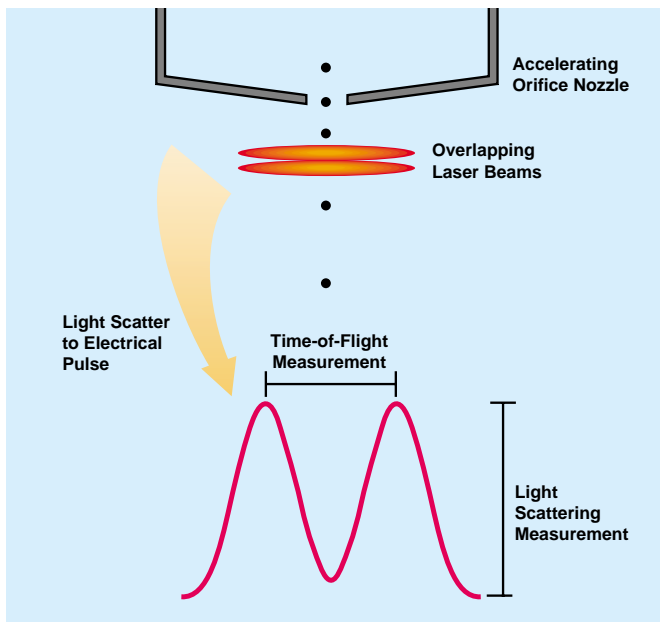


## Particle Size and Light-Scattering Intensity

Particles are accelerated through a nozzle to begin the measurement process. As they exit the nozzle, they encounter two partially overlapping red laser beams. These overlapping beams produce one double-crested, time-of-flight signal for each particle.

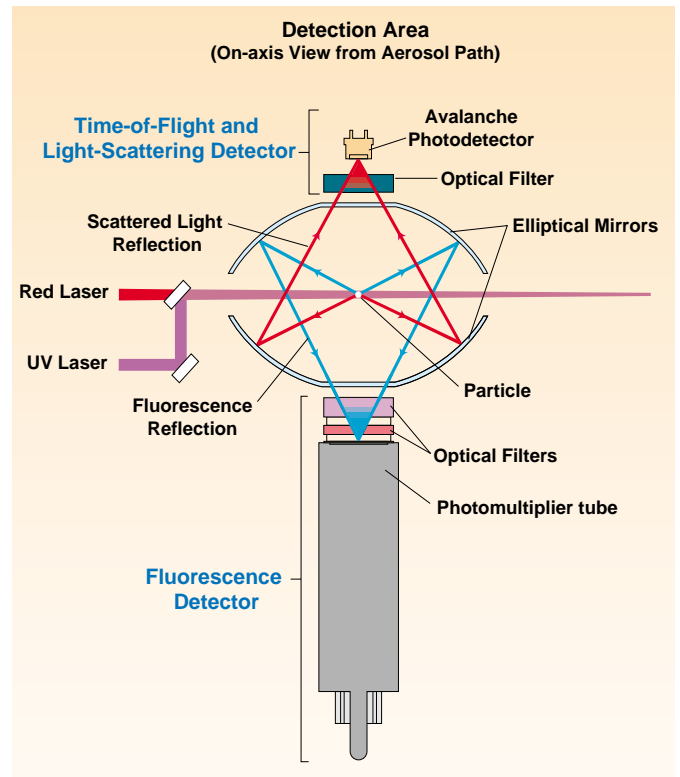
The time between the two crests is used to calculate the particle's aerodynamic size. The amplitude of the crests provides the light-scattering measurement. Scattered light is detected by an avalanche photodetector.

By using partially overlapping beams, the UV-APS creates only one signal per particle. This signifies a major advance over previous designs that produce two independent pulses. It allows the UV-APS to identify coincidence and other false signals, resulting in very accurate size distributions with little background noise.



## Particle Fluorescence Intensity

The UV-APS also uses particle time-of-flight to predict when the particle will arrive in the UV detection area. The UV laser is triggered to “zap” the particle at the excitation wavelength. Any resulting fluorescence between 430 and 580 nano-meters is detected with a photomultiplier tube. This fluorescence indicates the presence of bio-molecular life-indicating material, such as NADH or riboflavin. The intensity of the fluorescence is read by a high-speed analog-to-digital converter.



## UV-APS Optics

The unique design of the UV-APS optics is represented above. The illustration depicts a top view, looking into the detection area from the accelerating orifice. The avalanche photodetector (APD) sees red light reflected from the elliptical mirror located directly opposite the APD. Similarly, the fluorescence detector sees fluorescent (blue-green) light reflected from the elliptical mirror opposite the photomultiplier tube. Special optical filters ensure that only the correct type of light reaches each detector.

## Data Handling

An external computer (available separately) performs all of the input and controls for the UV-APS. Seven LED indicators on the instrument's front panel allow you to monitor status of the internal sensors. Time-of-flight, light scattering, and fluorescence information are stored as paired data in three two-dimensional arrays. Using Windows®-based Aerosol Instrument Manager® software, you can save, interpret, and print sample data for all three measurements.

## SPECIFICATIONS

**Particle size range:** 0.5 to 15  $\mu\text{m}$  (based on PSL calibration)

### Resolution

**Aerodynamic size:** Up to 52 channels (fewer may be selected)

**Fluorescence intensity:** Up to 64 channels (fewer may be selected)

**Scattered-light intensity:** Up to 16 channels (fewer may be selected)

**Particle type:** Airborne solids and nonvolatile liquids

### Maximum particle concentration

0.5  $\mu\text{m}$ : 1500 particles/cm<sup>3</sup> for <10% coincidence

10.0  $\mu\text{m}$ : 600 particles/cm<sup>3</sup> for <10% coincidence

**Particle size intervals for aerodynamic and light-scattering measurements:** >16 channels per decade of particle size (logarithmic)

**Sampling time:** Programmable from 1 second to 18 hours

### Flow rates (volumetric)

**Aerosol sample:** 1.0  $\pm$  0.2 L/min

**Sheath air:** 4.0  $\pm$  0.1 L/min

**Total flow:** 5.0  $\pm$  0.1 L/min

**Flow control:** Internal brushless DC pumps with feedback to control both total and sheath flow rates

**Atmospheric pressure corrections:** Internal barometric pressure transducer corrects for changes in elevation or operating pressure over the range from 700 to 1100 mbar

**Operating temperature:** 10 to 34°C (50 to 92°F)

**Operating humidity:** 0 to 95% R.H., noncondensing

### Laser sources

**Laser diode:** 30 mW at 680 nm, red

**UV laser:** Contact factory for information

**Detectors:** Avalanche photodetector and PMT

**Front-panel features:** LED indicators for check flow, particle, high concentration, fluorescence, UV-laser status, diode-laser status, power

**Power requirements:** 115 VAC, 50/60 Hz, single phase (100/220/240, 50/60 Hz, single-phase models available upon request)

### Communications

**Protocol:** Command set based on ASCII characters

**Interfaces:** RS-232 port (9-pin) and serial port (9600 baud, 7 bits even parity)

### Dimensions (LWH)

**Sensor:** 407 mm  $\times$  451 mm  $\times$  298 mm

(16 in.  $\times$  17.75 in.  $\times$  11.25 in.)

**External UV laser supply:** 549 mm  $\times$  305 mm  $\times$  132 mm

(21.6 in.  $\times$  12 in.  $\times$  5.2 in.)

### Weight

**Sensor:** 23 kg (50 lb)

**External UV laser supply:** 16 kg (35 lb)

## TO ORDER

### Ultraviolet Aerodynamic Particle Sizer<sup>®</sup> Spectrometer

Specify	Description
3314	UV-APS sensor and Aerosol Instrument Manager <sup>®</sup> software

### Optional Accessories

Specify	Description
3302A	Aerosol Diluter
3306	Impactor Inlet
3433	Small-Scale Powder Disperser

Please specify voltage requirements for Models 3314 and 3433.

## BIBLIOGRAPHY

Hairston PP, J Ho and FR Quant, "Design of an Instrument for Real-time Detection of Bio-aerosols Using Simultaneous Measurement of Particle Aerodynamic Size and Intrinsic Fluorescence," *J. Aerosol Science* 28/3 (1997).

Specifications are subject to change without notice. TSI, the TSI logo, Aerodynamic Particle Sizer, and Aerosol Instrument Manager are registered trademarks of TSI Incorporated. Windows is a registered trademark of Microsoft Corporation.

Model 3314 is protected by U.S. patents. Information available on request. This instrument is produced by TSI Incorporated under license from the Canadian Department of National Defence.



### TSI Incorporated

500 Cardigan Road, Shoreview, MN 55126 U.S.A.

**Tel:** 651 490 3877 **Toll Free:** 1 800 677 2708 **Fax:** 651 490 3860 **E-mail:** [particle@tsi.com](mailto:particle@tsi.com)

**TSI Germany Tel:** +49-241-52303 0 **Fax:** +49-241-5230349 **E-mail:** [particle-europe@tsi.com](mailto:particle-europe@tsi.com)

