



## Model 3786 Ultrafine Water-based Condensation Particle Counter

*Our most sensitive WCPC detects particles down to 2.5 nm at an incredible aerosol flow rate of 0.3 L/min!*

The Model 3786 Ultrafine Water-based Condensation Particle Counter (UWCPC) is designed primarily for researchers interested in airborne particles that are smaller than 20 nanometers. With the capability to detect particles down to 2.5 nm, this CPC is ideally suited for atmospheric and climate research, particle formation and growth studies, environmental monitoring, nanotechnology research, and mobile aerosol studies. It is also compatible with TSI Scanning Mobility Particle Sizer™ (SMPS) spectrometers.



The Model 3786 offers these additional features:

- Fast response to rapid changes in aerosol concentration ( $T_{95} < 2$  seconds)
- High aerosol flow rate (0.3 L/min) for good counting statistics
- Sheath-air-flow design that minimizes diffusion losses and produces a sharp lower cut-off point
- Single particle counting with continuous, live-time coincidence correction for maximum accuracy
- Particle concentration, total counts, or plots of concentration versus time shown on front-panel display
- Built-in SMPS compatibility
- Readily accessible condensing element for ease of maintenance

### Operation

In general, TSI CPCs operate on the principle of enlarging small particles using a condensation technique to form droplets that are large enough to be detected optically. The Model 3786 brings the convenience of using water to the measurement of submicrometer aerosol particles. Using a patented technique<sup>1</sup>, an aerosol sample is drawn continuously through a cooled saturator and then into a heated condenser, where water vapor diffuses into the sample stream. Effectively, water diffuses to the center-line of the condenser faster than heat is transferred from the warm walls, which produces supersaturated conditions. Particles that are present in the sample stream (and larger than the minimum activation size) serve as condensation nuclei for the water vapor. Once

<sup>1</sup> Technology from Aerosol Dynamics, Inc., U.S. Patent Number 6,712,881



condensation begins, particles grow quickly into larger water droplets and pass through an optical detector where they are counted easily. The UWPC counts single particles with continuous, live-time coincidence correction to provide accurate concentration measurements in the range from 0 to  $10^5$  particles/cm<sup>3</sup>.

The Model 3786 UWPC detects particles as small as 2.5 nanometers in diameter using a unique sheath-air-flow design that confines the aerosol flow path near the centerline of the condenser. This exposes particles to the region of the highest level of supersaturation and uniformity of water vapor. The incoming flow (0.6 L/min) is split 50:50. Half of the flow is HEPA-filtered and then recombined with the aerosol sample as sheath air. This unique design and a high aerosol flow rate of 0.3 L/min greatly enhance measurement response time, produce a sharply defined lower size-detection limit (counting efficiency curve), and minimize diffusion losses of ultrafine and nanoparticles.

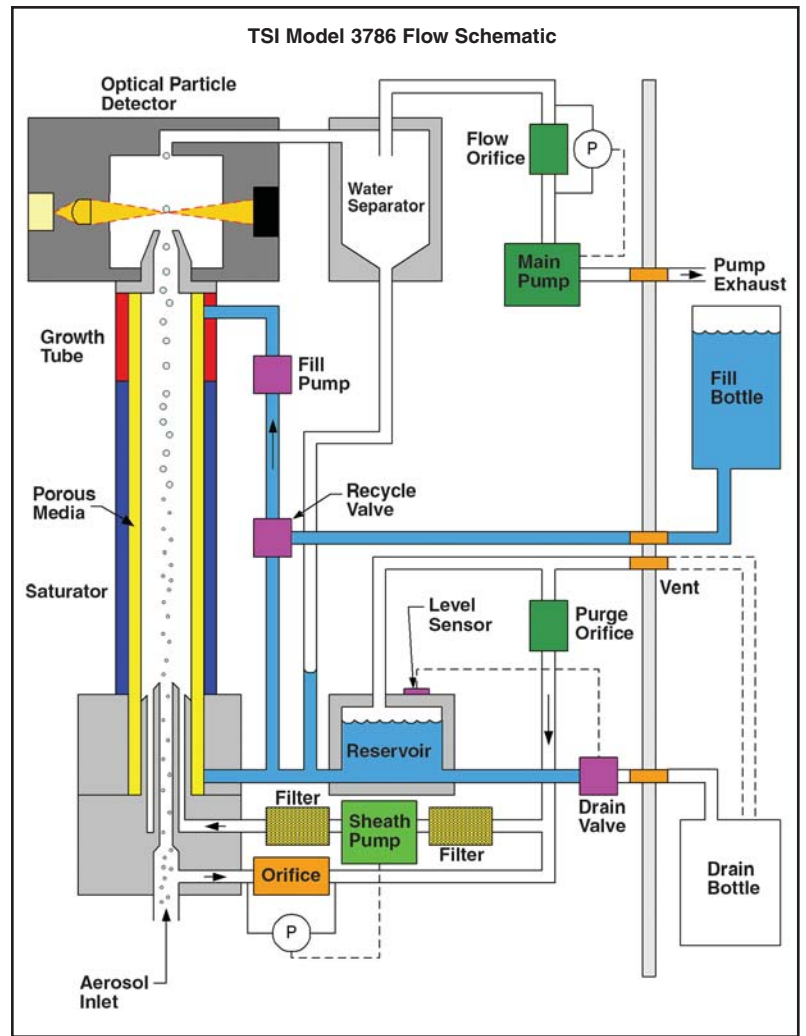
Real-time particle concentration, totalizer function, and operating parameters, as well as a graph of concentration versus time, are all viewable on the front-panel display. Data are directly accessible via standard interfaces. Records include concentration, particle count, sample time, and status information. These can be reported at an interval ranging from 0.1 to 3600 seconds.

The Model 3786 may be ordered with an optional, built-in, PC/104-style computer running a Linux operating system. User-created programs can be used to log and timestamp data. The data can then be made available through separate external serial and Ethernet connections.

### Software and Built-in SMPS Compatibility

Every Model 3786 is supplied with 32-bit Aerosol Instrument Manager® software designed for use with Microsoft® Windows® operating systems. The Aerosol Instrument Manager software is used for instrument control and provides data collection, management, and export capabilities, as well as several choices for data display.

The Model 3786 comes standard with built-in compatibility for use in TSI Series 3936 Scanning Mobility Particle Sizer (SMPS) systems. Collectively, SMPS systems configured with a Model 3786 provide size-distribution measurements from 0.0025 to 1.0 µm. Specific size ranges vary depending on the Differential Mobility Analyzer (DMA) used. Ask your TSI representative for additional information.



### Applications

TSI offers the most comprehensive line of CPCs available anywhere. Building on a tradition of more than 25 years experience, TSI CPCs have become the standard to which all others are compared. General applications for our family of CPCs include:

- Basic aerosol research
- Indoor air-quality measurements
- Filter and air-cleaner testing
- Particle shedding and component tests
- Atmospheric and climate studies
- Particle formation and growth studies
- Particle counter calibration
- Combustion and engine-exhaust studies
- Inhalation or exposure-chamber studies
- Health effects studies
- Environmental monitoring
- Nanotechnology research
- Mobile aerosol studies

Ask your TSI representative for information on our other CPCs and recommended applications.

# Specifications

## Model 3786 Ultrafine Water-based Condensation Particle Counter

<b>Particle Size Range</b>	
Min. Detectable Particle (D <sub>50</sub> )	2.5 nm, verified with DMA-classified particles
Max. Detectable Particle	>3 μm
<b>Particle Concentration Range</b>	
	0 to 1 × 10 <sup>5</sup> particles/cm <sup>3</sup> , single particle counting with continuous, live-time correction
<b>Particle Concentration Accuracy</b>	
	±12% at <10 <sup>5</sup> particles/cm <sup>3</sup>
<b>Response Time</b>	
	<2 sec to 95% in response to step change
<b>Flow</b>	
Aerosol Flow Rate	0.3 L/min (nominal)
Sheath Flow Rate	0.3 ±0.03 L/min
Total Flow Rate	0.6 ±0.03 L/min
Flow Source	Two internal diaphragm pumps
Flow Control	Two internal pumps controlled to calibrated pressure drop across orifices with inlet pressure correction
False Background Counts	<0.01 particle/cm <sup>3</sup> , 1-hr average
Aerosol Medium	Air only, 10 to 35°C
<b>Environmental Operating Conditions</b>	
Ambient Temperature Range	10 to 35°C
Ambient Humidity Range	0 to 90% RH, noncondensing
Inlet Pressure Operation	50 to 110 kPa (0.5 to 1.1 atm)
Inlet Pressure (Gauge)	±2.5 kPa (±10 in.) of water
Condensing Liquid	Water (distilled water recommended)
<b>Filling System</b>	
	Internal liquid-injection pump with water-recycling capability, source-water container located externally
<b>Communications</b>	
	CPC control and data can be accessed digitally and directly using USB or serial interfaces. External serial and Ethernet interfaces are available to the internal SBC, which has an internal serial interface to the CPC.

### Analog Output

0 to 10 V controlled via communications from PC/104 or serial interface

### Optional Auxiliary Single-Board-Computer (SBC)

Internally mounted PC/104 SBC may acquire CPC data through an internal serial link. The SBC provides externally available serial and Ethernet ports. The SBC is provided with Linux OS, Web server, FTP, and Telnet services.

### Front Panel Display

140×32-pixel VF display provides output of particle concentration, bar-graph history of particle concentration, particle totalizer, sample flow rate, and operating parameters Particle, Status, Flow, and Liquid Display, Totalizer, Pump, Drain/Prime

### LEDs

### Buttons

### Rear Panel Connections

PC/104-Ethernet, PC/104-Com1, USB, com port, power, water source, vent, water drain, pump exhaust, aerosol inlet (¼" OD SS tube), analog output BNC

### Software

Supplied with TSI Aerosol Instrument Manager software

### Calibration Check

Recommended annually

### Power Requirements

100 to 230 VAC, 50/60 Hz, 125 VA

### Dimensions (HWD)

31 × 16 × 28 cm (12 × 6 × 11 in.),

not including fill bottle or bracket

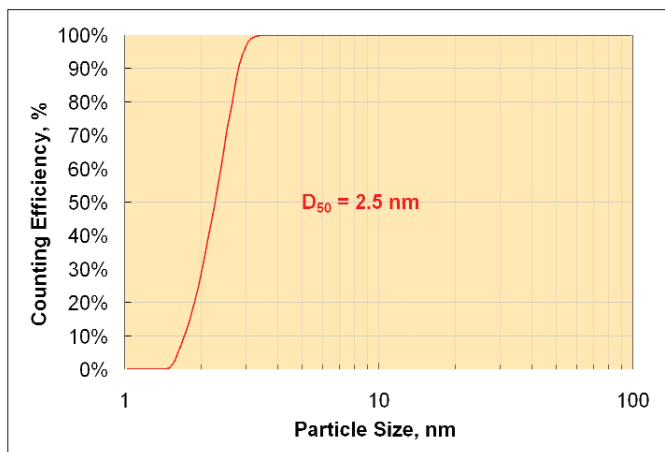
5.5 kg (12 lbs.)

### Weight

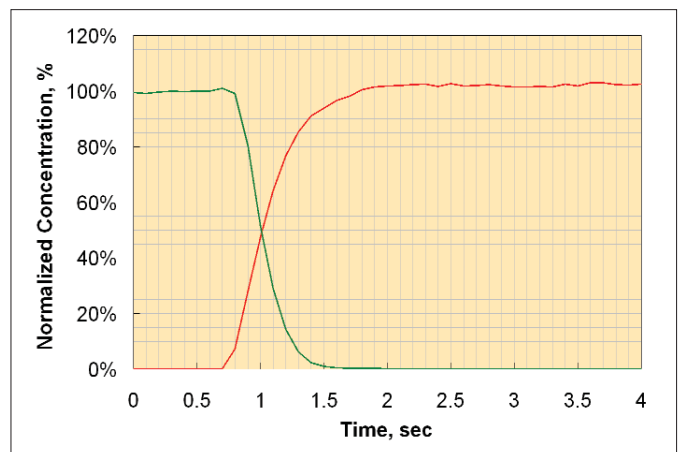
Specifications are subject to change without notice. TSI, the TSI logo, Scanning Mobility Particle Sizer, and Aerosol Instrument Manager are trademarks of TSI Incorporated. Microsoft and Windows are trademarks of Microsoft Corporation.

Ordering guidelines and bibliography on back page.

TSI Model 3786 Efficiency, (Liu *et al.* 2005)



TSI Model 3786 Response Time



## To Order

### Ultrafine Water-based Condensation Particle Counter

<i>Specify</i>	<i>Description</i>
3786	Water-based Condensation Particle Counter (includes Aerosol Instrument Manager software and built-in SMPS compatibility)
3786-PC	Water-based Condensation Particle Counter with internal PC/104 single-board computer (includes Aerosol Instrument Manager software and built-in SMPS compatibility)

## Bibliography

W Liu, BL Osmondson, GJ Sem, FR Quant, and D Oberreit, Water-based Condensation Particle Counters for Environmental Monitoring of Ultrafine Particles, platform presentation 8C-1, the Particulate Matter Supersites Program and Related Studies, An International Specialty Conference sponsored by the American Association for Aerosol Research, Atlanta, Georgia, USA, February 2005.



### **TSI Incorporated**

**Corporate Headquarters**—Tel: 651 490 2811 **Toll Free:** 1 800 874 2811 **Fax:** 651 490 3824 **E-mail:** [particle@tsi.com](mailto:particle@tsi.com)  
Contact TSI or visit [www.tsi.com](http://www.tsi.com) for information on specific office locations worldwide

