Model 3785 Water-based Condensation Particle Counter

A general-purpose WCPC that detects particles down to 5 nm, over a wide concentration range from 0 to 10^7 particles/cm^3!

The Model 3785 Water-based Condensation Particle Counter (WCPC) is a general-purpose counter that can detect airborne particles down to 5 nm in diameter. It detects these particles over a wide concentration range from 0 to 10^7 particles per cubic centimeter, at a high aerosol-sample flow rate of 1.0 L/min. As a result, this WCPC is quite versatile and is well-suited for a broad range of applications, including basic aerosol research, indoor air-quality measurements, environmental monitoring, atmospheric and climate change studies, health effects research, inhalation and exposure studies, mobile aerosol studies, and nanotechnology research. Additionally, it can be used as part of a TSI Scanning Mobility Particle Sizer™ (SMPS) spectrometer.

The Model 3785 offers these additional features:

- Fast response to rapid changes in aerosol concentration (T_{95} <2 seconds)
- High sample flow rate (1.0 L/min) for great counting statistics
- Single particle counting with continuous, live-time coincidence correction up to 20,000 particles/cm^3 for maximum accuracy; photometric mode extends the concentration range to 10^7 particles/cm^3
- 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 a size that is large enough to be detected optically. The Model 3785 brings the convenience of using water to the measurement of submicrometer aerosol particles. Using a patented technique[1], an aerosol sample is drawn continuously through a cooled saturator and then into a heated condenser, where water vapor diffuses into the sam-

[1] Technology from Aerosol Dynamics, Inc., U.S. Patent Number 6,712,881

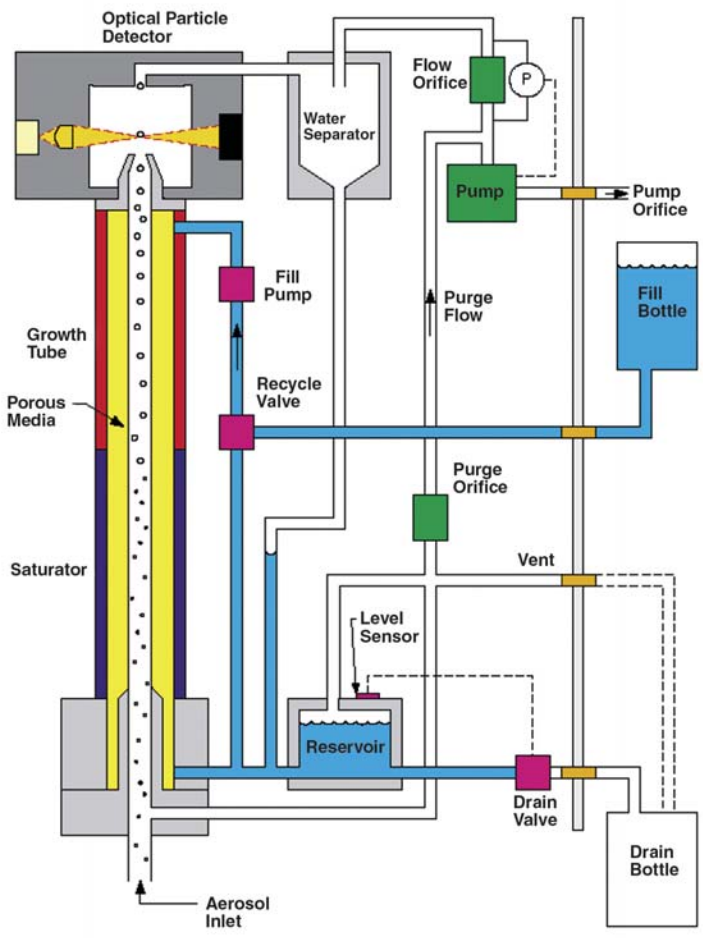
ple stream. Effectively, water diffuses to the centerline of the condenser faster than heat is transferred from the warm walls, producing supersaturated conditions. Particles that are present in the sample stream (and larger than the minimum activation size) serve as condensation sites for the water vapor. Once condensation begins, particles grow quickly into larger water droplets and pass through an optical detector where they are counted easily.

The Model 3785 WCPC combines continuous, live-time corrected, single particle counting with a temperature-stabilized photometric mode to provide accurate measurements over a very wide particle concentration range (0 to 10^7 particles/cm^3). The single-path sample flow design allows for precise, pressure-corrected flow control. Its high flow rate enables fast response to rapidly changing aerosols.

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, photometric values, and status information. These can be reported at an interval ranging from 0.1 to 3600 seconds.

The Model 3785 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.

TSI Model 3785 Flow Schematic



Software and Built-in SMPS Compatibility

Every Model 3785 is supplied with 32-bit Aerosol Instrument Manager® software designed for use with Microsoft® Windows® operating systems. TSI 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 3785 comes standard with built-in compatibility for use in TSI Series 3936 Scanning Mobility Particle Sizer (SMPS) spectrometers. Collectively, SMPS spectrometers configured with a Model 3785 provide size-distribution measurement capability from 0.005 to 1.0 µm. Specific size ranges vary depending on the Differential Mobility Analyzer 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 about our other CPCs and recommended applications.

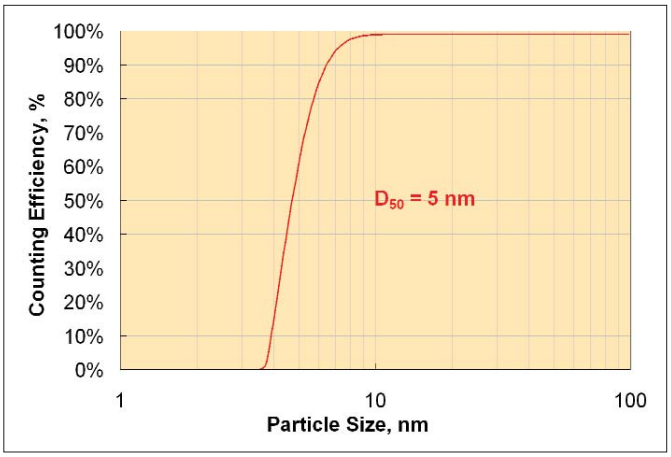
Specifications

Model 3785 Water-based Condensation Particle Counter

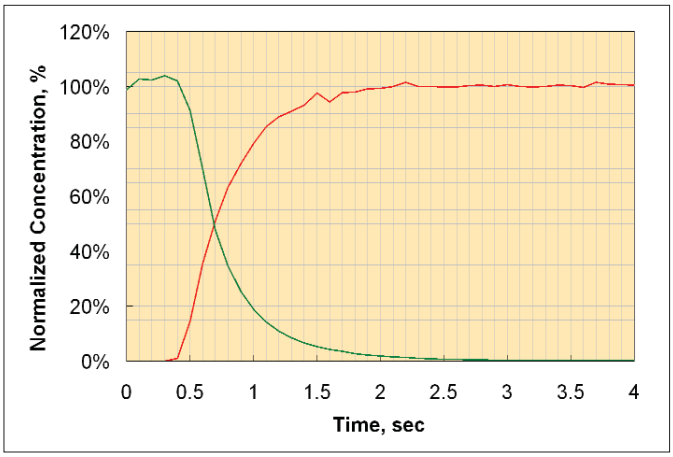
Particle Size Range	
Min. Detectable Particle (D_{50})	5 nm, verified with DMA-classified ambient and sucrose particles
Max. Detectable Particle	>3 µm
Particle Concentration Range	
Single Particle Counting	0 to 2×10^4 particles/cm³ (continuous, live-time corrected)
Photometric Counting	10^4 to 10^7 particles/cm³
Particle Concentration Accuracy	±10% at $<2 \times 10^4$ particles/cm³
Response Time	<2 seconds to 95% in response to step change
Flow	
Aerosol Flow Rate	1.0 ±0.1 L/min
Flow Source	Internal diaphragm pump. May be operated with an external vacuum and critical orifice but requires change to internal plumbing. (Consult TSI for details.)
Flow Control	Internal pump controlled to calibrated pressure drop across orifice with inlet pressure correction
Purge Flow	0.035 L/min
Inlet Flow (Aerosol + Purge)	1.035 L/min
False Background Counts	<0.001 particle/cm³, 1-hour average
Aerosol Medium	Air only, 10 to 40°C
Environmental Operating Conditions	
Ambient Temperature Range	10 to 40°C
Ambient Humidity Range	0 to 90% RH, noncondensing
Inlet Pressure Operation (Absolute)	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)
Filling System	Internal liquid-injection pump with water-recycling capability, source-water container located externally
Communications	CPC control and data can be accessed digitally and directly using USB or serial interfaces. External serial and Ethernet interfaces are available to the optional 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 acquires 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, flow rate, and operating parameters
LEDs	Particle, Status, Flow, Liquid
Buttons	Display, Totalizer, Pump, Drain/Prime
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

More specifications, ordering guidelines, and bibliography on back page.

TSI Model 3785 Efficiency, Ambient and Sucrose Particles (Liu *et al.* 2004)



TSI Model 3785 Response Time



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
Weight	5.5 kg (12 lbs.)

Bibliography

W Liu, SL Kaufman, GJ Sem, and FR Quant, Material Effects on Threshold Counting Efficiency of TSI Model 3785 Water-based Condensation Particle Counter, poster no. 6PD7, presented at the American Association for Aerosol Research 2004 Annual Conference, Atlanta, Georgia, USA, October 2004.

To Order

Water-based Condensation Particle Counter

Specify	*Description*
3785	Water-based Condensation Particle Counter (includes Aerosol Instrument Manager software and built-in SMPS compatibility)
3785-PC	Water-based Condensation Particle Counter with internal PC/104 single-board computer (includes Aerosol Instrument Manager software and built-in SMPS compatibility)

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