Working Principle of the PortaCount® Respirator Fit Tester

Condensation-Nuclei-Counter (CNC)

Application Note RFT-044 (US)

The PortaCount® Respirator Fit Tester measures the particle concentration inside (C_{in}) and outside (C_{out}) the respirator and calculates the fit factor (FF = C_{out}/C_{in}) resulting from the ratio of the two measurements. As with any aerosol-based quantitative fit test, the respirator must be equipped with high-efficiency filters (> 99%). Since only a few particles will pass through a high-efficiency filter, any particles found inside the respirator can be attributed to leaks in the face seal.

The PortaCount® Respirator Fit Tester uses a Condensation Nuclei Counter (CNC) to measure the particles. This makes it possible to detect and count even the smallest ambient particles (measuring range 20 nm to 1 µm). With the help of the CNC, it is possible to make statements about the fit of a respirator, since particles of this small size behave very similarly to air (Brownian motion).

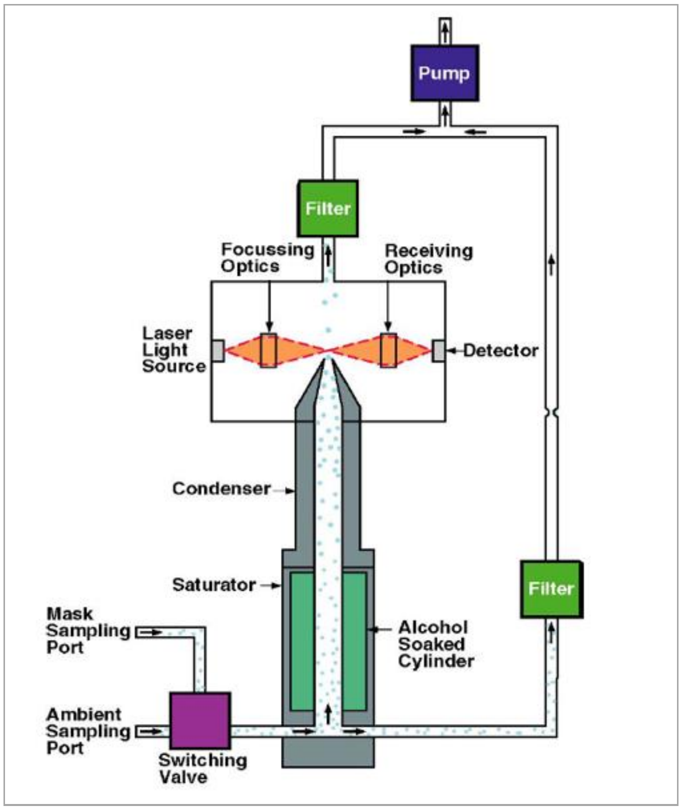

Figure 1: Schematic structure of the condensation nuclei counter in the PortaCount® Respirator Fit Tester

Condensation Nuclei Counter

The particles entering the PortaCount® Respirator Fit Tester pass through a saturation tube. This tube contains super-saturated alcohol vapor, which is produced by heating liquid alcohol from the soaked wick. The wick is located inside the alcohol cartridge which is inserted into the PortaCount® Respirator Fit Tester during setup (refer to the instrument manual for more information). As the particles in the air samples (e.g., C_{out} and C_{in}) flow through the alcohol vapor, mixing with the aerosol occurs.

The mixture then flows into the condenser tube, which is kept at a cooler temperature where it is cooled. Cooling causes the alcohol vapor to condense on the particle surface and adhere as tiny droplets. As more and more alcohol vapor condenses, a closed droplet layer forms around the particle. Creating a droplet with a particle nucleus. The particle is enlarged as condensation of the alcohol vapor occurs.

The more alcohol condenses, the larger the particles become until they are finally large enough to be detected in the optical chamber, measured by the detector and counted. This is done by passing the individual droplets/particles through a focused laser beam, causing light to scatter in other directions and decrease in the direction of the laser beam. The light signal is detected by a detector and the particle count is determined by counting the signals. With the help of the known pump volume flow, the particle concentration can thus be determined.

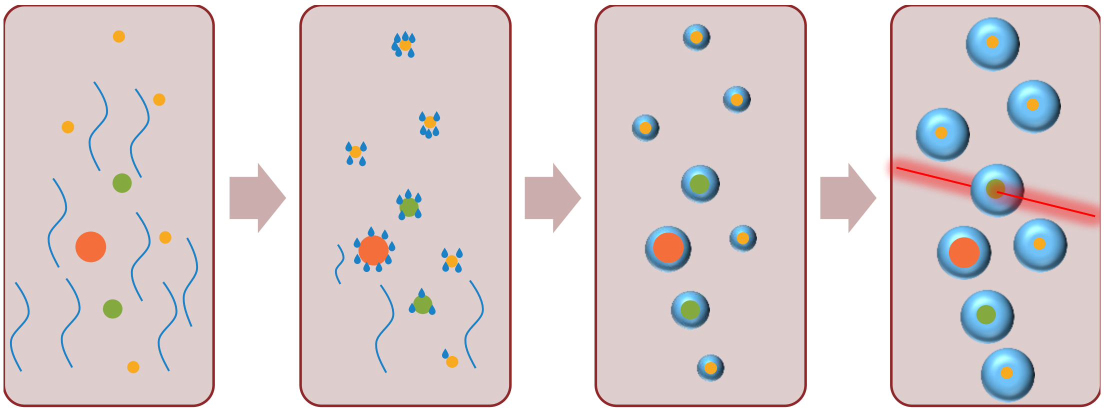

Figure 2: Schematic particle enlargement in a condensation nuclei counter

Condensation nuclei counters have been produced and sold by TSI® since 1978. As early as 1981, Dr. Klaus Willeke of the University of Cincinnati published the concept of using condensation nuclei counters for quantitative fit testing[1]. This makes it possible to perform fit tests simply with the ambient particles present in the environment without having to create an extra test atmosphere with tents, test chambers or hoods.

---

[1] Willeke, K., H.E. Ayer, J.D. Blanchard. "New Methods For Quantitative Respirator Fit Testing With Aerosols". *American Industrial Hygiene Association Journal*, Feb. (1981).

Knowledge Beyond Measure.

TSI Incorporated – Visit our website **www.tsi.com** for more information.

USA	**Tel:** +1 800 680 1220	**India**	**Tel:** +91 80 67877200
UK	**Tel:** +44 149 4 459200	**China**	**Tel:** +86 10 8219 7688
France	**Tel:** +33 1 41 19 21 99	**Singapore**	**Tel:** +65 6595 6388
Germany	**Tel:** +49 241 523030		

RFT-044 Rev A (3/9/2023) US ©2023 TSI Incorporated Printed in U.S.A.