# Comparison of Optical Particle Sensors Used to Measure Particle Concentrations in High-Purity Chemicals

## Phase I - Sensor comparison in water

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Abstract

The sensors in optical particle counters used to measure particle concentrations in high-purity liquid chemicals have different optical configurations. Differences include the wavelength of the illuminating radiation, the angles over which the light scattered by particles is collected, and the definition of the illuminated area. Even though sensors are calibrated with polystyrene latex (PSL) spheres, they may not agree when measuring naturally-occurring particles in semiconductor process liquids. In this study, four sensors with detection limits of 0.1 µm or smaller were tested for their ability to accurately size and count PSL spheres, AC Fine Test Dust (ACFTD), and ISO ultrafine dust in ultrapure water. Scanning electron microscopy (SEM) was used as a referee method in the PSL tests. In future work, the ability of sensors to size and measure concentrations of naturally occurring particles in semiconductor process chemicals will be compared.

All four sensors measured the sizes of PSL spheres accurately (within ± 20%). The sensors in two of the counters, the Particle Measuring Systems HSLIS M65 and the Pacific Scientific Microcount 80S, overcounted the number of particles present in the smaller size channels when counting larger particles. The coincidence limits (10% loss in counting efficiency) were also measured. The coincidence limits for the Particle Measuring Systems Liquistat 100 and the RION KS-16F sensors were approximately 3,500/ml while the limits for the HSLIS M65 and the Microcount 80S sensors were approximately 22,000/ml.

In tests using ACFTD and ISO ultrafine dust, the Liquistat 100 and the KS-16F sensors detected essentially identical particle concentrations. The HSLIS M65 sensor registered approximately 30% more particles than the Liquistat and KS-16F sensors. The Microcount 80S sensor indicated concentrations two to three times those indicated by the M65 sensor.

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# Comparison of Optical Particle Sensors Used to Measure Particle Concentrations in High-Purity Chemicals

## Phase II – Sensor Comparison in Chemicals

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Abstract

Optical particle sensors are used to measure particle concentrations in high-purity chemicals. The sensors are typically calibrated with polystyrene latex (PSL) spheres. Because the sensors have different optical configurations, their responses to naturally occurring particles in process chemicals vary widely. The specifications for particulate contamination set by the Semiconductor Industry Association do not describe the type of sensor optics that should be used when measuring particle concentrations. The development of more-meaningful standards requires a better understanding of the optical properties of chemicals and particles and their effects on sensor measurement. This study compares the responses of four commercially available sensors when counting naturally occurring particles in process chemicals.

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