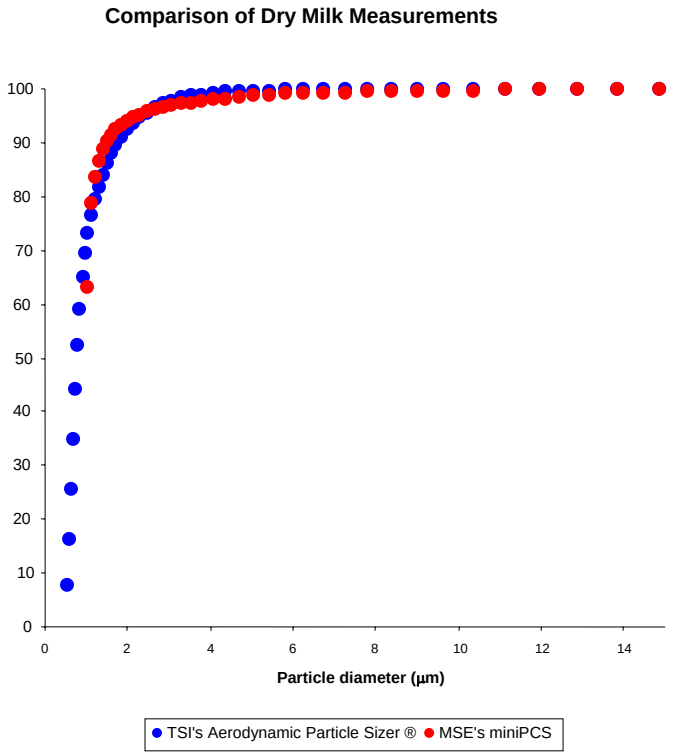
miniPCS™

A Miniature Particle Counter and Sizer

The miniPCS is a field-ready particle counter and sizer. It is powered by batteries, is a self-standing system-in-a-box, and can be operated remotely via wireless connection.

Using the principles of Mie scattering with a microscopic probe volume allows the miniPCS to measure the size of individual particles as they pass through the measurement domain. The on-board logarithmic differential amplifier and 14-bit analog-to-digital conversion ensures the maximum dynamic range possible, allowing the miniPCS to detect particles as small as 500 nanometers in diameter. Raw data is stored onto an on-board MMC card.

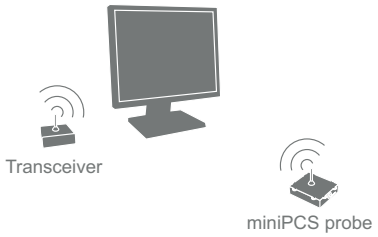
The miniPCS electronics also include a GPS unit to synchronize data between devices temporally and geographically. The wireless transceiver is used to trigger the device and to monitor its health. A pump draws air through the probe volume and a filter captures any particles that passed through the measurement channel.



A comparison of dry milk particle measurements performed with a miniPCS and an Aerodynamic Particle Sizer® from TSI, Incorporated.

The miniPCS System

The *miniPCS System* includes a miniPCS probe, wireless transceiver and device control software, and *BP-miniPCS* processing software. Since the acquisition hardware is built into the probe, the host computer need only have an available USB port for communication with the transceiver. For the laboratory or for high-interference applications, a wired version of the probe is available. After the measurement is made, data is downloaded from the on-board MMC card using a standard card reader and the calibration is applied to convert the voltage measurements into particle size.



**17" LCD monitor for scale*

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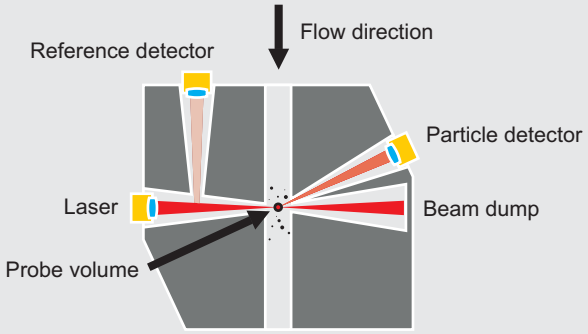
The miniPCS Concept

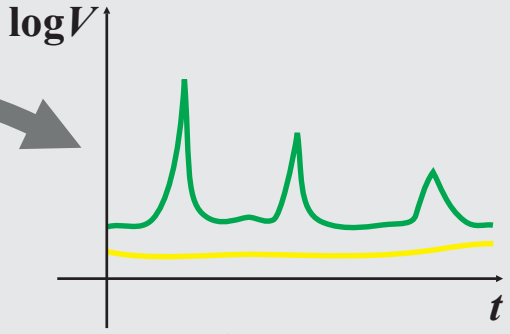
The miniPCS measures particle size using Mie's solution to the Maxwell equations (commonly known as Mie scattering). This is an exact solution for spheres illuminated by monochromatic plane waves, and allows for a relationship between scattering intensity, incident intensity, and particle size to be determined. The miniPCS hardware includes two photodiodes, one to measure the incident intensity, and one to measure the scattering intensity (at a predetermined forward-scattering angle). The reference photodiode measures the intensity of the incident laser beam much in the same way it is done for power-stabilized lasers. Any changes in operating conditions—voltage drop, temperature variations, etc.—are accounted for and the measurement of the scattered light is corrected for any anomalies.

By using calibration particles, the measurement of the scattering intensities can be converted to real-world units. The optics of the miniPCS ensure the probe volume is so small that even at high densities (10,000 particles per cubic centimeter) only a single particle is scattering light at a given time. Thus real—not presumed—particle size distributions are measured along with the exact time of the particle's passage. This data can be presented as size histograms, cumulative distributions, volume fractions, etc.—all as a function of time.

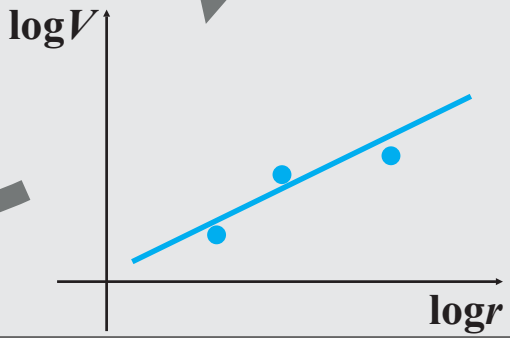
The probe volume is the intersection of the particle detector's field of view with the beam waist



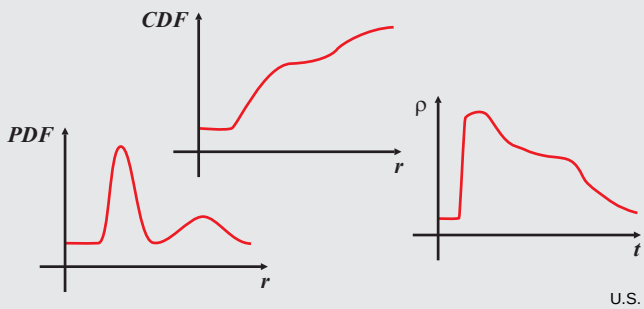
A logarithmic amplifier/digitizer records the logarithm of the voltage versus time for both particles (green) and illumination (yellow). Thus if the laser power changes due to temperature or voltage fluctuations, the measurement can be corrected.



A calibration function is used to convert voltage to particle radius



The resulting particle size distribution can be visualized in a variety of ways



U.S. Patent No. 6,580,503

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