

# Research on Nanoparticles at METAS



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## Swiss Federal Office of Metrology and Accreditation - METAS

The Swiss Federal Office of Metrology and Accreditation (METAS) realizes and makes available internationally agreed units and standards at the accuracy required. It supervises the use of measuring instruments in the fields of commerce, transport, public safety, health and environmental protection. Its services are available to researchers, industry and commerce and public administration. METAS also runs the Swiss Accreditation Service (SAS).

The research objective in the special field of nanoparticles is to establish reference values for calibration purposes for the usual quantities of measurement. This means that all measured values have to be traceable to the International System of Units (SI) within the stated uncertainty. Traceable values are the precondition to legal or standardized applications of particle measurements in combustion exhaust, in ambient air or clean rooms. METAS transfers the metrological knowledge into international standards and regulations through participation in the corresponding committees (ISO, CEN, EUROMET, OIML, etc.).

The standards for particle concentration in METAS are validated condensation particle counters and the laser particle counter. The standards for particle sizing are the (geometric) diameter of certified polystyrene particles and the equivalent electrical mobility of these spheres. The particle diameter is controlled with an atomic force microscope at METAS. The uncertainty for particle number concentration is below 15 % and for particle size (geometric or equivalent diameter) below 10 % (95 % probability). An adequate indication of number concentration includes the reference conditions (pressure and temperature) and the description of the counted objects (particle characterisation).

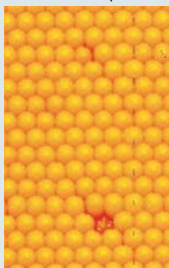
METAS offers following services: Calibration of particle counters, particle analysers and particle generators (condensation particle counter, mobility analyser, optical particle counter, etc).

## Synthetic Particles

### Aerosol Generator

The particle generator produces an aerosol with polystyrene particles between 100 nm and 900 nm. These spherical polystyrene particles from suspensions are generally called PSL-particles. The diameter of the aerosol is realised with certified latices. As a function of the diameter the generator produces number concentrations between 0 and 10'000 particles/mL.

200 nm PSL-particles



## Combustion Particles

### Generator for Combustion Particles

The generator for combustion particles (CAST = Combustion Aerosol Standard) enables the generation of real combustion particles under laboratory conditions. Because the particles origin from a flame, they are morphologically identical to combustion particles from engines. The CAST is appreciated by research and development for instance in the automotive industry.

Combustion Aerosol Standard - CAST



Optical Particle Counter for clean rooms



### Optical Particle Counter

Optical particle counters are measuring instruments that classify and count particles according to the scattered light intensity (size). They determine the number concentration in several size classes (typical lower diameter limits are: 0.3, 0.5, 0.7, 1.0 to 5.0  $\mu\text{m}$ ). Optical particle counters are required for monitoring clean rooms according the standard ISO 1644-1.

Scanning Mobility Particle Sizer - SMPS



### Size Analysis

The size of combustion particles is described with the equivalent mobility diameter. This mobility diameter is equal to the geometric diameter of spherical particles with the same electrical mobility. The equivalent mobility is finally traceable to SI by calibrating the instruments with certified PSL-particles.

Laser-Particle-Counter LAPAZ



### Laser-Particle-Counter (LAPAZ)

In the measuring cell of LAPAZ the particles arrive from a jet nozzle with a diameter of 0.1 mm. There they intersect a laser beam (wavelength 532 nm, 5 W). Each crossing particle creates flashes of stray light. The stray light is measured by a photo multiplier at an angle of 90°. The rate of flashes and the aerosol flow directly define the particle number concentration. This instrument is identified as a primary standard.

### Condensation Particle Counter (CPC)

Using CPC, the measurement of particle number concentration can be performed down to particle diameters of a few nanometres. In this instrument the particles act as condensation nuclei in a saturated butanol atmosphere. Small butanol droplets grow to sizes that can be detected optically. METAS validates their particle counters by comparing them to each other and to LAPAZ.

## Summary

METAS is equipped with and has developed various instruments for the production and measurement of synthetic and combustion particles. This instrumentation offers a unique opportunity for the investigation of the characteristics and accuracy of instruments used in particle measurements. As a result, reliable calibration which are traceable to SI base units can be offered to our customers.





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