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Mobile Condensation Particle Counter (CPC) Model 5.403

The portable high-accuracy counter for nanoparticles

The portable CPC 5.403 with integrated battery for field use.
A perfect solution for on-the-spot measurements.

Highlights:

- ✓ All-in-one-design
- ✓ Counts particles from 4.5 nm to >3 µm
- ✓ Sampling with 1 Hz
- ✓ Concentrations from 1 to 10^7/cm^3
- ✓ Compact and rugged
- ✓ Integrated Butanol tank
- ✓ Butanol safety features *(anti-spill, odor removal)*
- ✓ Fully automated use with our software
- ✓ Self-test upon start-up assures highest reliability

Applications:

- ✓ Mobile aerosol studies
- ✓ Work place monitoring
- ✓ Roadside monitoring
- ✓ Environmental & climatic studies
- ✓ Fundamental aerosol research
- ✓ Filter testing
- ✓ Nanotechnology process monitoring
- ✓ Inhalation & exposure studies
- ✓ Health effect studies

*The compact CPC 5.403 combined with our DMA as **SMPS+C** to record particle size distributions*

The SMPS+C upgraded with our optical particle counter to a Wide Range Aerosol Spectrometer.

With the CPC model 5.403 GRIMM established condensate removal and anti-spill saturator design for the modern thermal diffusion – laminar flow CPC.
These features improved accuracy and handling considerably. Along with the compact design GRIMM created a truly portable high-accuracy nano particle counter that can be used in a large variety of applications.
The instrument includes pumps, Butanol tank, battery, internal memory, and the option for remote operation. The model 5.403 provides highly accurate measurements for nano particles as small as 4.5 nm over a wide concentration range of up to 10^7 particles/cm^3.

2012

Measuring Principle

The sample air is continuously drawn into the CPC and saturated with Butanol vapour in the heated (35°C) saturator chamber. Then, aerosol particles and Butanol vapour pass through the cooled (10°C) condenser unit, where the Butanol vapour condenses on the particles that act as condensation nuclei. This process increases the size of each individual nano particle to approximately 10 µm. Such large droplets can be conveniently detected by light scattering.

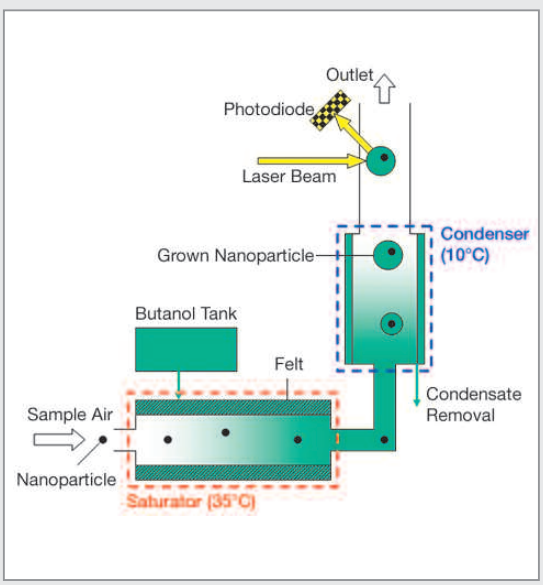
Within the self tests, the CPC supervises also the size of the Butanol droplets to ensure a proper condensation process.

Light scattering works in such a way that the droplet enters the laser illuminated optical volume. Each droplet passing the laser beam generates scattered light that is collected at 90° scattering angle with a mirror onto a photodiode. The signal is converted to an electrical pulse and counted.

For standard concentrations below 14,000 particles/cm^3, each particle is counted individually (single count mode with coincidence correction).

Higher concentrations (14,000 to 10^7 particles/cm^3) are measured with the photometric mode, where concentrations are calculated from calibrated total scattered light intensity of all particles in the detection zone.

The measured concentration is continuously displayed on the instrument's LCD and saved to internal memory or transmitted to the attached computer via the RS-232 serial interface.

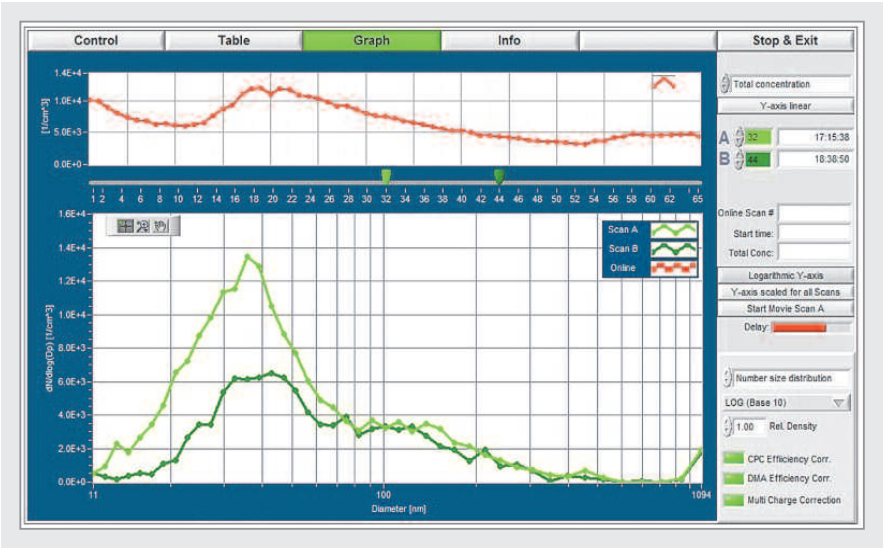


Schematic of a thermal diffusion – laminar flow CPC

Software

The GRIMM universal software for nanoparticle instruments records measured data and a complete set of instrument parameters. Results are shown as graph or as table, and can be exported to common file formats. The use of data loggers and the online transfer of data to internet servers via mobile networks is supported.

The software operates CPCs as counters, Differential Mobility Analyzers (DMAs) in generator mode, or SMPS systems for measuring size distributions. SMPS systems can be used as SMPS+C (with CPC as detector) or as SMPS+E (with Faraday Cup Electrometer, FCE). Data inversion is done in real time and the algorithms, developed by Professor Reischl (University of Vienna), were adapted to the new standard for calculating size distributions from mobility spectrometers, ISO 15900. The software calculates number, surface, and mass size distributions, optionally with or without corrections, and a variety of statistical parameters.

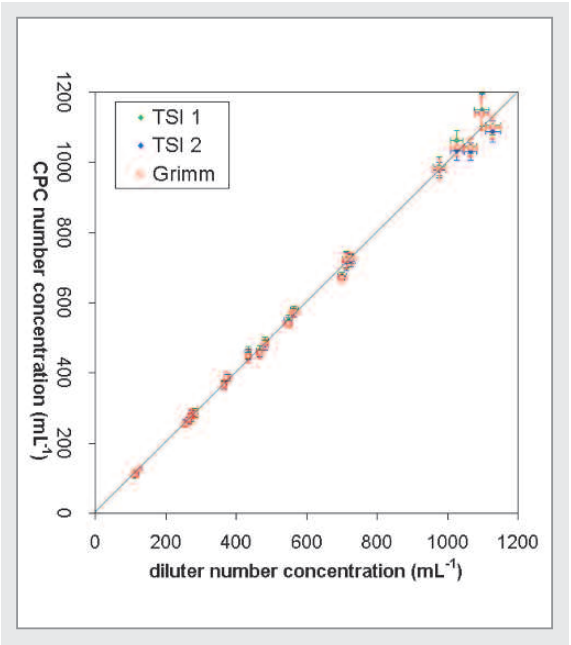


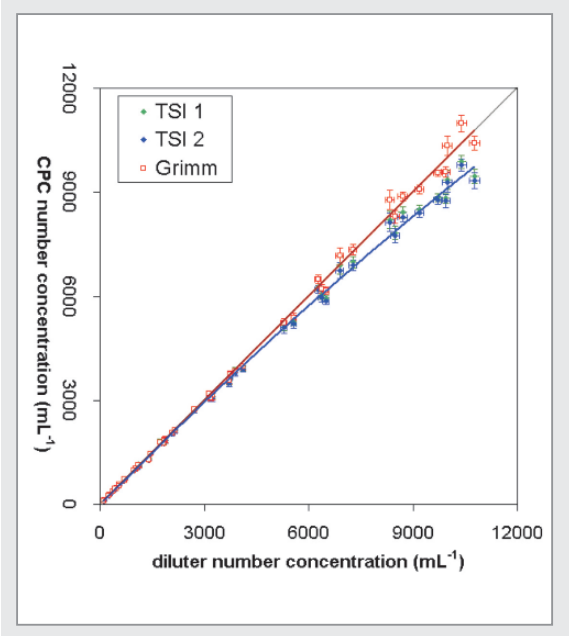
Screenshot of the software for nanoparticle instruments.

Performance

Comparison with other CPCs

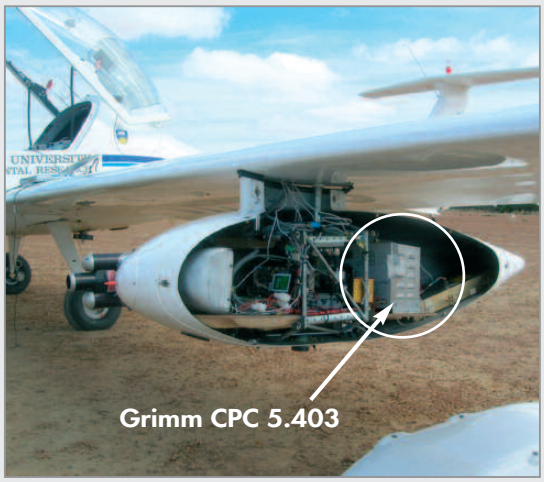
The results below were obtained in a recent study at METAS, Switzerland (Schlatter 2006). They show that the Grimm CPC follows a linear response whereas the two TSI CPCs deviate at higher concentrations.





Grimm refers to Grimm CPC model 5.403, TSI 1 & 2 refer to two TSI CPCs model 3022. The concentrations from the CPCs are shown as a function of the concentration from the diluter settings.

GRIMM – Be versatile with additional components ...



... even under extreme conditions!

The **mobile CPC model 5.403** has a built-in control unit for Scanning Mobility Particle Sizer (SMPS) measurements and also a pump for the sheath air of a Differential Mobility Analyzer (DMA).

The GRIMM **SMPS+C** system enables the measurement of particle size distributions between 5 and 1100 nm. Furthermore, a GRIMM Optical Particle Counter expands the SMPS+C system to a Wide Range Aerosol Spectrometer (WRAS) that measures size distributions up to a diameter of 30 µm.

For stationary applications (e.g. *laboratory experiments, long-term monitoring)* we offer our new stationary CPC product line consisting of the low-cost entry model, the all-in-one desktop model, or the 19" rack version. For more information see our datasheet for stationary CPCs.

Also, please refer to our **PMP-CPC** datasheet for information on our PMP-conform CPC that can be used for EURO 5 emission measurements in automotive applications.

Specifications

GRIMM Model 5.403 - Mobile Condensation Particle Counter

Particle Detection System	
Particle Size Range	4.5 nm (D50, verified with Tungsten oxide) to greater than 3 µm
Particle Concentration Range	0 to 14,000 particles/cm^3 (single particle counting with coincidence correction), to 10^7 particles/cm^3 with photometric mode
Particle Concentration Accuracy	5% (single particle counting), >10% (photometric mode)
Response Time	T90 = 3.9 s
False Counts	$<2 \times 10^{-4}$ particles/cm^3
Air Flow System	
Pumps	Pulse free carbon vane pumps
Flow Rates of Sample Air	Standard flow 0.3 L/min High Flow 1.5 L/min, of which 0.3 L/min sample flow and 1.2 L/min bypass flow [1])
Flow Rate of Sheath Air	3 L/min
Flow Control	Through differential pressure sensors across a heated orifice. Insensitive against variations in ambient temperature and pressure
Aerosol Carrier Gas	Air and inert gases
Liquid System	
Working Fluid	1-Butanol (Reagent-grade p.A.) for activation of hydrophobic and hydrophilic particles
Refill	Automatic refill of internal tank when refill bottle is connected
Condensate Removal	Continuous drain with a micro-pump into drain bottle for highest accuracy
Communications	
RS-232	9-pin D connector, ASCII based command set
Memory Card	PCMCIA SRAM 4MB
Status Indication	4 LEDs with 3 colors and messages on the digital display
Analog Inputs	Port for 3 optional analog climatic or gas sensors, plug and play
Operating Conditions	
Ambient Temperature	10 to 35°C (50 to 95°F)
Ambient Humidity	0 to 95% RH, noncondensing
Pressure	± 50 mbar to ambient pressure
Power Requirements	85-264 VAC wide range power supply, 47-440 Hz or 120-370 VDC
Dimensions (HxWxD)	22 x 26 x 30 cm (8.7 x 10.2 x 11.8 in)
Weight	13 kg (28.7 lbs)

[1]) High flow mode can not be used for SMPS measurements

Publications

M. Heim et al. 2005. Filtration Efficiency of Aerosol Particles Below 20 Nanometers. Aerosol Science and Technology, 39:782–789, 2005

J. Schlatter 2006. Comparison of Grimm and TSI Condensation Particle Counters. 10th ETH-Conference on Combustion Generated Particles, Zurich, 21 to 23 August 2006

M. D. Wright et al. 2007. Small-Ion and Nano-Aerosol Production During Candle Burning: Size Distribution and Concentration Profile with Time. Aerosol Science and Technology, 41:475–484, 2007

Dealer:

The European Leader in Particle Measurement Technology

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