A Harmonized Method for Monitoring the Number Concentration of Ultrafine Particles in Atmospheric Aerosol

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Ultrafine particles (UFP) and their impact on human health and our climate are areas of active research. UFPs can be present in large numbers due to sources such as traffic, residential heating, and other processes, yet they contribute very little to the mass of atmospheric particles. In order to assess their impact and provide guidance in future air quality regulations it is necessary to supplement gravimetric air quality measurements such as of $PM_{2.5}$ or PM_{10} with a time resolved measurement of particle number concentration.

As a first step of harmonizing the continuous measurement of UFPs in the atmosphere, the European Committee for Standardization (CEN) drafted Technical Specification CEN/TS 16976 which defines a set of requirements for the Condensation Particle Counter (CPC), its sampling system, the measurement procedure and the reporting of measurement results.

While CPCs have been used in ambient aerosol monitoring for many years (Hermann *et al.* (2007), Caldow *et al.* (1992)) the results were not always comparable (Yli-Ojanperä *et al* (2012)) due to the different cut-offs (D_{50}), operating conditions, working fluids (water, isopropanol, butanol), and sampling system setups (particle losses) used.

Recently, a new CPC with a dedicated sampling system, both of which are fully compliant with the proposed CEN/TS 16976, have been introduced (model 3772-CEN CPC, TSI Inc., Shoreview, USA).

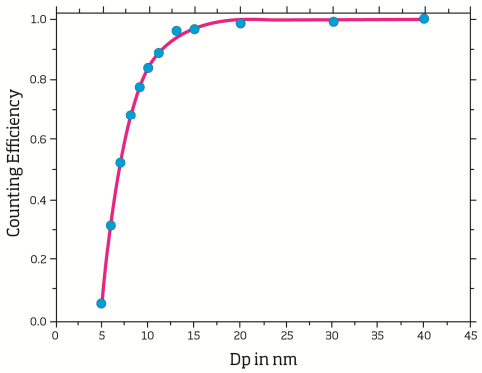

Figure 1: Counting efficiency of the 3772-CEN CPC for silver particles generated by evaporation/condensation method (courtesy of TROPOS, Leipzig)

As required by the proposed CEN/TS 16976, the 3772-CEN CPC is a laminar flow, butanol-based device that counts airborne ultrafine particles from 7 nm (Fig. 1) in diameter at an aerosol flow rate of 1.0 L/min. It uses an optimized coincidence and dead time correction method to count particles in single count mode up to concentrations of 50,000 particles/cm^{3}as shown in Fig. 2.

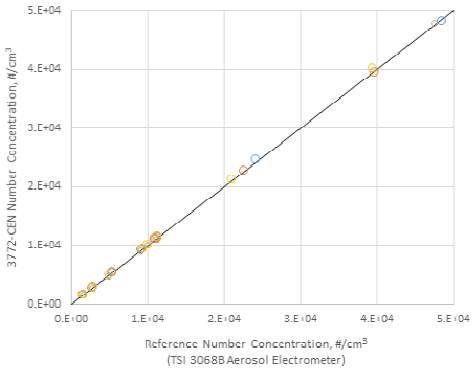

Figure 2: Linearity measured of the 3772-CEN CPC against an aerosol electrometer (model 3068B, TSI Inc.). Data points show data for four units. The black line is a 1:1 line to guide the eye.

Other advancements include a pulse height analyzer that monitors wick health, supersaturation state, and instrument status. This new CPC instrument is designed to easily integrate into centralized data acquisition systems and reports data in the data string format recommended by CEN.

We will show our detailed characterization of the 3772-CEN CPC and its dedicated sampling system, with laboratory and field data from selected sites.

CEN/TS 16976. Ambient air - Determination of the particle number concentration of atmospheric aerosol

Yli-Ojanperä, J., et al. (2012). Comparison of Three Particle Number Concentration Calibration Standards Through Calibration of a Single CPC in a Wide Particle Size Range, *Aerosol Science and Technology*, 46:11, 1163-1173.

Hermann, M., et al. (2007). Particle counting efficiencies of new TSI condensation particle counters. *Journal of Aerosol Science* 38, 674–682.

Caldow, R.C., et al. (1992). Performance of the TSI Model 3010 Condensation Particle Counter, AAAR, San Francisco, CA (TSI paper A83).