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## ULTRAFINE PARTICLES (UFP) - RECENT TRENDS AND REGULATORY ACTIVITIES

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For many years, mass-based particulate matter PM<sub>2.5</sub> and PM<sub>10</sub> measurements have been standardized (DIN EN 12341:2014) for the regulatory quantification and monitoring of particles in ambient air. These larger particles have been relatively easy to measure and there is evidence of an association between particulate mass and health effects. However, recent studies reported that ultrafine particles, which are defined as particles equal or smaller than 0.1 µm, seem to be a better indicator of harmful air pollution in urban areas. Therefore, the measurement of the particle number concentration (PNC) which is most representative of ultrafine particles (UFP) has gained much interest and importance.

Reports such as Clean Air Copenhagen from 2014 or Leipzig Environmental Zone from 2017 focusing on UFP and their harmful effects that have been made publicly available helped spread the word on the relevance of UFP monitoring. In 2019, a team of renown expert summarized the current knowledge on UFPs in a white paper on ambient ultrafine particles. This report has been cited by the World Health Organization in the WHO Global Air Quality Guidelines published in September 2021. For the first time, these guidelines mention the need to expand the common air quality monitoring networks by integrating UFP measurements. It recommends to include size-segregated particle size distributions (PSD) and real-time PNC measurements in addition to simultaneous measurements with other airborne pollutants and characteristics of PM. The WHO report from 2021 also offers guidance what low and high UFP concentrations are to guide decisions on the priorities of UFP source emission control.

In order to harmonize and standardize these measurements, the European Committee for Standardization (CEN) has published the technical specification CEN/TS 16976:2016 for PNC measurements in ambient air using a Condensation Particle Counter (CPC). Based on it, a German standard DIN EN 16976 'Ambient air Determination of the particle number concentration of atmospheric aerosol' is currently being finalized.

In addition, the CEN/TS 17434 technical specification for measuring the particle size distribution of ambient air by Scanning Mobility Particle Sizers (SMPS, or 'Mobility Particle Sizer Spectrometer', MPSS, in regulatory terms) was published in 2019.

Finally, the proposal for a Directive of the EU Parliament and of the Council on ambient air quality and cleaner air for Europe (COM/2022/542 final) was published in October 2022. The intention of this document is to align EU air quality standards much more closely with WHO the aforementioned recommendations. The proposal recommends UFP monitoring at supersites and states "Measurements at all monitoring supersites at urban background locations shall include fixed or indicative measurements of size distribution of ultrafine particles....".



**Fig.1.** CEN-compliant solution for UFP measurements of PSD and PNC including the dedicated sampling system.

Against the background of all these regulatory activities, we present the technical solution for reproducible sampling, conditioning and measurement of UFP as well as the necessary data handling. The complete measurement solution from TSI (see Fig. 1) enables the continuous monitoring of UFP compliant with the aforementioned CEN technical specifications and it meets all current requirements of the ACTRIS European Research Infrastructure Consortium. We will share and highlight exemplary results from UFP monitoring at representative measurement sites from across Europe.

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