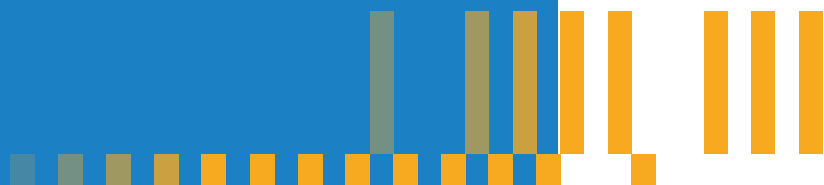




® Knowledge  
Beyond  
Measure.

# The Full Solution from TSI®

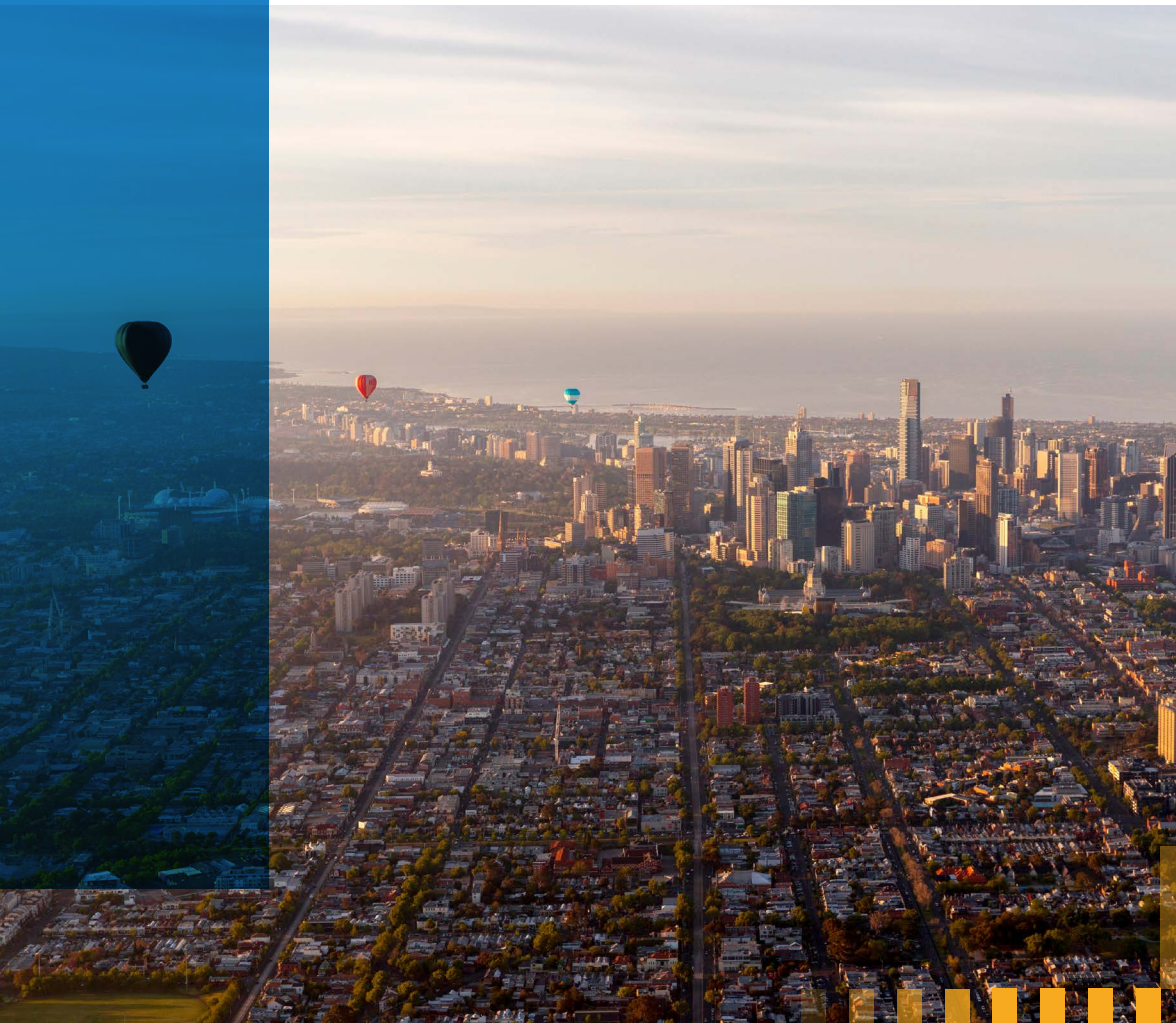
for CEN-Compliant  
Ultrafine Particle Monitoring



# Air Quality Monitoring is a Vital Part of Understanding the Environment Around Us – and Our Influence on It.

Measuring ultrafine particles (UFP) provides insight into health hazards and emissions sources, and is also relevant to climate change. High quality data is critical, and so is the ability to make useful comparisons. “Harmonized” measurement – using standardized measurement techniques, instruments, and parameters – permits such useful comparisons.

The technical specifications (TS) CEN/TS 16976:2016 and CEN/TS 17434:2020 describes the harmonized measurement of ultrafine particles in ambient air. These standards specify how to measure the particle number concentration (CEN/TS 16976) and particle size distribution (CEN/TS 17434) in the atmosphere. TSI® offers a full solution for sampling, conditioning, and measuring atmospheric particles in full compliance with both of these standards.





## Sampling

Sampling from ambient air is not trivial. Variable wind conditions, sample humidity, and unquantified diffusion losses are all obstacles to collecting representative data.

The Sampling System for Atmospheric Particles 3750200 is designed to deliver a representative sample of ambient ultrafine and fine aerosol to measurement instruments. The sampling system (also called 'sampling inlet') accomplishes this by using the following features:

- An omnidirectional PM10 sampling head to sample representatively
- A large primary sampling tube (1 1/4" ID), to permit a high flow rate
- An optional cyclone (PM2.5) to remove large particle
- A single-wall Nafion® membrane drier to reduce sample humidity to < 40%
- A flow splitter, to evenly divide the sample between measurement instruments

The sampler has < 30% diffusion losses for 7 nm particles, and is fully compliant with the requirements stated in both CEN/TS 16976 and 17434. The sampling system can be configured to supply aerosol to different particle counters and/or particle sizers.



# Particle Number Concentration Measurement

Mass-based measurements do not sufficiently capture the story of UFP: these particles are too small to contribute very much mass, but they can be large in number. Condensation Particle Counters (CPCs) are a proven technology for measuring the number concentration of atmospheric particles. In fact, CEN/TS 16976 requires the use of a CPC with butanol as its working fluid. The CPC 3750-CEN is fully compliant with all CEN requirements. This includes its calibration by a facility of the European Center for Aerosol Calibration and Characterization (ECAC), as an independent reference.



# Particle Size Distribution Measurement



Adding size information provides further characterization of the ultrafine particles, and is valuable information when considering source apportionment, health effects, or climate impacts. The TSI® Scanning Mobility Particle Sizer™ (SMPS™) has been used for decades to measure the size distribution of particles in ambient air. This technology is specified by CEN/TS 17434 for size distribution measurement; within the standard, it is referred to as 'MPSS', which stands for 'mobility particle size spectrometer'.

SMPS™ systems consist of several functions working in concert with each other:

- Neutralization: provides the incoming particles with a known distribution of electrical charge. The neutralization can be performed by either a radioactive or a non-radioactive (soft x-ray) aerosol neutralizer.
- Size classification: exposing the sample flow to an electric field segregates the particles by their electrical mobility. This is the appropriate way to determine the size of sub-micrometer particles as per ISO 15900. This size classification is performed by a Differential Mobility Analyzer (DMA).
- Concentration measurement: once the particles are size segregated, their concentration needs to be measured. An SMPS utilizes a CPC for this purpose.

By sweeping across the range of particle sizes to be measured, the SMPS builds a particle size distribution.

The SMPS 3938W50-CEN7 is fully compliant with all CEN requirements. This includes its calibration by a facility of the European Center for Aerosol Calibration and Characterization (ECAC), as an independent reference.





## Software and Data Retrieval

Once the data are collected, they need to flow from the selected hardware into your monitoring station system.

There are multiple options:

- Your integrator may already have a solution.
- You utilize TSI's extensive data auto-export, which includes the full range of available instrument status information, aerosol humidity and temperature, particle concentrations, and size distributions (as raw, as inverted concentration, or both).

## Accessories

### Aerosol Dilution

In some locations particle number concentrations can be elevated, such as near traffic junctions, airports, or seaports. Because of the high concentration, measuring particle number (PN) concentrations in such areas is desirable, but for the same reason can also be difficult, as concentrations can exceed instrument capabilities. In such cases, it's necessary to dilute the aerosol prior to introduction into the CPC.

The Aerosol Diluter 3333-10 dilutes the aerosol sample by a factor of 10, using an internally-controlled supply of particle-free air. The dilution ratio is accurate to within  $\pm 5\%$ . The diluter communicate the dilution factor and other status parameters to the CPC via a USB connection.

### Humidity Measurement

Ensuring that the sampled aerosol is sufficiently dry ( $RH < 40\%$ ) is a requirement of both CEN/TS 16976 and CEN/TS 17434. Measuring the humidity and temperature of the sample is easily accomplished with the Aerosol Humidity and Temperature Sensor RHT3000.

Designed to fit onto the instrument inlet, the RHT3000 connects to either the CPC or SMPST<sup>™</sup> using a USB-C cable. Relative humidity and temperature data for the sample are then stored alongside particle data.





## Pump

A pump is required to draw the air from the ambient environment through the sampling system and through the measurement instruments. The same pump can also draw the vacuum necessary to sufficiently dry the aerosol in the membrane (Nafion™) dryer. TSI® offers pumps suitable for use with the CEN UFP Monitoring solution. A compressor is unnecessary.

## Catalytic Vapor Filter

The CEN/TS specifications require a butanol-based CPC for number concentration measurements, and for use in the SMPST™ to collect size distribution measurements. The exhaust of the system(s) thus contains butanol vapor. Using a catalytic vapor filter (CVF) avoids venting butanol vapor into your monitoring station or nearby atmosphere, which might influence other aerosol or gas-phase measurements.

# Learn More

For more information, please visit [tsi.com/ultrafines](https://www.tsi.com/ultrafines). You can also find specifications for all instruments, a Buyer's Guide to CEN Compliance, and information on service options.

# Let's Configure Your Solution

Not all air quality monitoring stations are the same. From instrumentation to accessories, from installation to service, select from the above building blocks a CEN-compliant package that meets your needs. You are very welcome to contact us to get help setting up your TSI® Ultrafine Particle Monitoring solution.



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