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Ambient air - Determination of the particle number concentration of atmospheric aerosol

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 16976

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English Version

Ambient air - Determination of the particle number concentration of atmospheric aerosol

Air ambiant - Détermination de la concentration en nombre de particules de l'aérosol atmosphérique

Außenluft - Bestimmung der Partikelanzahlkonzentration des atmosphärischen Aerosols

This European Standard was approved by CEN on 19 May 2024.

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European foreword

This document (EN 16976:2024) has been prepared by Technical Committee CEN/TC 264 “Air quality”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2024, and conflicting national standards shall be withdrawn at the latest by December 2024.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN/TS 16976:2016.

In comparison with the previous edition, the following technical modifications have been made:

— 1: The lower limit of the measured particle size range is set to be 10 nm and thus identical to MPSS (Mobility Particle Size Spectrometers) measurements (see CEN/TS 17434). In air quality monitoring networks where MPSS will be used for determining the particle size distribution a CPC may be used for QA purposes for the MPSS data.

— 3: The parameter “calibration factor” has been introduced and defined. The terms and definitions for the various flow rates have been revised and rearranged.

— 5.1.2: Aerosol diffusion dryer based on silica is excluded, because diffusion losses are too high with this type of dryer.

— 6.2: Coincidence correction shall be applied. No other correction factors shall be applied unless a correction for the analysed flow rate is necessary.

— 6.3: All tests are carried out only at one temperature (between 20 °C and 30 °C).

— 6.4: Table 1: Criteria for several performance characteristics have been changed, the performance characteristic “calibration factor” has been included.

— 6.5: Some of the test procedures have been revised, a test procedure for the calibration factor has been added.

— 7.2: Two dilution factors are necessary: one for reducing the concentration, an additional one for drying.

— 7.5: The method of using tracer gas for the determination of the dilution factor of a dilution system has been removed. General criteria for dilution systems have been added.

— 9.2: The test “Determination of low size cut-off” has been removed, the “Number concentration check” has been substantially revised.

— The previous Annex C “Data reporting” has been removed.

— Annex D: The ambient particle number concentration values have been updated.

— Annex E: An example of the design of a dilution system and an example for the calculation of the uncertainty of the dilution factor have been added.

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— Annex G: The new Annex “Coincidence correction” has been added.

— Annex H: The new Annex “Results of an experimental comparison of different CPCs” has been added.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

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Introduction

There is a growing awareness of the significance of aerosol particles with diameters of $D < 1$ µm for human health as well as for their climatic impact. To assess air quality, it appears necessary to supplement gravimetrically determined mass concentrations such as $PM_{2,5}$ and PM_{10} (see EN 12341) with a measurement of the particle number concentration. Since ultrafine particles with diameters of $D < 0,1$ µm make an almost insignificant contribution to the mass of atmospheric aerosol particles, they can best be detected with counting measuring methods of sufficient sensitivity.

As particle measurement instrumentation allows determining either the particle number concentration or the particle number size distribution two documents are established:

— one dealing with the determination of the single parameter number concentration (a measure of "total" number concentration, this document)

— one dealing with the determination of number concentration within a limited number of size ranges (CEN/TS 17434).

Clauses 4 and 5 contain general information about the method and the expected properties of the aerosol to be measured.

Clause 6 sets out the performance criteria for CPCs. Specifically, these are the relevant performance characteristics of CPC instruments (without any sampling system), the respective criteria that need to be met, and a description of how the tests are to be carried out. In general, these tests are expected to be carried out by test houses or CPC manufacturers rather than users and could form the basis for type testing of CPCs in future.

Clause 7 sets out the performance criteria and test procedures for the sampling and conditioning system (e.g. dilution). These may be applied by manufacturers of sampling systems, test houses or users (network operators).

Clause 8 sets out requirements for the installation, initial checks and calibrations, and operation of a CPC and sampling system at a monitoring site, including routine maintenance, data processing (including use of QA/QC data) and reporting. In general, these will be the responsibility of users (network operators), though calibrations requiring test aerosols are only to be carried out by suitably qualified laboratories.

Clause 9 sets out Quality Assurance and Quality Control procedures, i.e. the ongoing checks and calibrations that are required on the CPC and sampling system during operation at a monitoring site. It is expected that these will be the responsibility of users (network operators), though calibrations requiring test aerosols are only to be carried out by suitably qualified laboratories. The main sources of measurement uncertainty are described.

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1 Scope

This document specifies a standard method for determining the particle number concentration in ambient air in a range up to about 10^7 cm^{-3} for averaging times equal to or larger than 1 min. The standard method is based on a Condensation Particle Counter (CPC) operated in the counting mode and an appropriate dilution system for concentrations exceeding the counting mode range. It also defines the performance characteristics and the minimum requirements of the instruments to be used. The lower and upper sizes considered within this document are 10 nm and a few micrometres, respectively. This document gives guidance on sampling, operation, data processing and QA/QC procedures including calibration parameters.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 27891:2015, *Aerosol particle number concentration — Calibration of condensation particle counters*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org

3.1 Aerosol properties

3.1.1
particle
small piece of matter with defined physical boundary

Note 1 to entry: The phase of a particle can be solid, liquid, or between solid and liquid and a mixture of any of the phases.

[SOURCE: ISO 27891:2015, modified]

3.1.2
aerosol
multi-phase system of solid and/or liquid particles suspended in a gas, ranging in particle size from 0,001 µm to 100 µm

3.1.3
number size distribution
frequency distribution of the particle number concentration represented as a function of particle size

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