SLOVENSKI STANDARD
oSIST prEN 12341:2022

01-julij-2022

Zunanji zrak - Standardna gravimetrijska metoda za določevanje masne koncentracije frakcije lebdečih delcev PM10 ali PM2,5

Ambient air - Standard gravimetric measurement method for the determination of the PM10 or PM2,5 mass concentration of suspended particulate matter

Außenluft - Gravimetrisches Standardmessverfahren für die Bestimmung der PM10- oder PM2,5- Massenkonzentration des Schwebstaubes

Air ambiant - Méthode normalisée de mesurage gravimétrique pour la détermination de la concentration massique MP10 ou MP2,5 de matière particulaire en suspension

Ta slovenski standard je istoveten z: **prEN 12341**

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English Version

Ambient air - Standard gravimetric measurement method for the determination of the PM10 or PM2,5 mass concentration of suspended particulate matter

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 264.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (prEN 12341:2022) has been prepared by Technical Committee CEN/TC 264 “Air quality”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 12341:2014.

Technical modifications which have been made in comparison with the previous edition are summarized in Annex I.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s) see the introduction.

Introduction

For air quality across the European Union to be assessed on a consistent basis, Member States need to employ standard measurement techniques and procedures. The aim of this document is to present a harmonized methodology for monitoring the mass concentrations of suspended particulate matter (PM_{10} and $PM_{2,5}$ respectively) in ambient air, following Directive 2008/50/EC on ambient air quality and cleaner air for Europe [1] which sets the parameters specific to the assessment of ambient concentration levels of particulate matter.

NOTE In principle, the methodology described in this document may also be used for measurement of mass concentrations of other PM fractions such as PM_1. However, this document does not describe standardized sampling inlets for such fractions.

The European Standard method described in this document is focused primarily on harmonization and improvement of the data quality of measurement methods used in monitoring networks with regard to avoiding unnecessary discontinuities with historical data. It is a method that is suited for practical use in routine monitoring, but not necessarily the method with the highest metrological quality.

There are no reference materials currently available to provide traceability for PM_{10} or $PM_{2,5}$ measurements in ambient air. Therefore, the standard method defines the measured quantity by convention, specifically by the sample inlet design and associated operational parameters covering the whole measurement process. This document contains:

— a description of a manual gravimetric standard measurement method for PM_{10} or $PM_{2,5}$ using sequential samplers or single-filter samplers;

— a summary of performance requirements of the method, together with associated type testing requirements for the sampler;

— requirements for suitability testing of facilities and equipment on initial application of the method;

— requirements for ongoing quality assurance / quality control when applying the method in the field;

— the assessment of measurement uncertainty of the results of this document method;

— criteria and test methods for the evaluation of the suitability of filters for application using this method.

The performance characteristics and requirements described in this document were partly determined in different comparative and validation trials. The trials were sponsored by the European Commission and the European Free Trade Association.

The requirements of this document are targeted firstly towards obtaining optimum results for the measurement of mass concentrations of PM_{10} or $PM_{2,5}$.

However, the filters collected for the purpose of determining the mass concentrations of PM_{10} or $PM_{2,5}$ can be used for further speciation, e.g. for the determination of concentrations of:

— heavy metals and polycyclic aromatic hydrocarbons (see EN 14902 [6] and EN 15549 [7]) in conformity with Directive 2004/107/EC [8], as amended by Directive 2015/1480/EU [26].

— constituents of PM2,5 (see EN 16909 [9] and EN 16913 [10]) to be used for source apportionment as required by Directive 2008/50/EC.

Additional requirements might have to be considered for those purposes (e.g. blank values of chemical constituents).

1 Scope

This document describes a standard method for determining the PM_{10} or $PM_{2,5}$ mass concentrations of suspended particulate matter in ambient air by sampling the particulate matter on filters and weighing them by means of a balance.

Measurements are performed with samplers with inlet designs as specified in Annex A, operating at a nominal flow rate of 2,3 m^3/h, over a nominal sampling period of 24 h. Measurement results are expressed in µg/m^3, where the volume of air is the volume at ambient conditions near the inlet at the time of sampling.

The range of application of this document is for 24 h measurements from approximately 1 µg/m^3 (i.e. the limit of detection of the standard measurement method expressed as its uncertainty) up to 150 µg/m^3 for PM_{10} and 120 µg/m^3 for $PM_{2,5}$.

NOTE 1 Although the European Standard is not validated for higher concentrations, its range of application could well be extended to ambient air concentrations up to circa 200 µg/m^3 when using suitable filter materials (see 5.1.5.2).

This document describes procedures and gives requirements for the testing and use of so-called sequential samplers, equipped with a filter changer, suitable for extended stand-alone operation. Sequential samplers are commonly used throughout the European Union for the measurement of concentrations in ambient air of PM_{10} or $PM_{2,5}$. However, this document does not exclude the use of single-filter samplers.

NOTE 2 Older versions of samplers, which conform to previous versions of EN 12341, can still be used to evaluate equivalence of candidate methods, using the procedures described in EN 16450 and in [11]. As newer versions of samplers tested under this document become available, discontinue the use of older reference samplers in EN 16450 and in [11]. Type testing reports of equivalent methods are still valid if they were commissioned prior to the availability of reference methods tested under this document.

This document also provides guidance for the selection and testing of filters with the aim of reducing the measurement uncertainty of the results obtained when applying this document.

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.

JCGM 100, *Evaluation of measurement data — Guide to the expression of uncertainty in measurement*

EN 15267-1:2009, *Air quality - Certification of automated measuring systems - Part 1: General principles*

EN 15267-2:2009, *Air quality - Certification of automated measuring systems - Part 2: Initial assessment of the AMS manufacturer's quality management system and post certification surveillance for the manufacturing process*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

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

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
ambient air
outdoor air in the troposphere, excluding workplaces where provisions concerning health and safety at work apply and to which members of the public do not have regular access

[SOURCE: Directive 2008/50/EC]

3.1.2
calibration
operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication

[SOURCE: JCGM 200 [13]]

3.1.3
combined standard uncertainty

standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or covariances of these other quantities weighted according to how the measurement result varies with changes in these quantities

[SOURCE: JCGM 100]

3.1.4
competent authority
organization which implements the requirements of EU Directives and regulates installations, which complies with the requirements of applicable European Standards

Note 1 to entry: In ambient air quality monitoring this is an authority that performs one or more of the tasks listed in Article 3 of Directive 2008/50/EC.

3.1.5
competent body
organization which can demonstrate its competence for a specific task to the competent authority in the Member State

3.1.6
coverage factor
numerical factor used as a multiplier of the combined standard uncertainty in order to obtain an expanded uncertainty

[SOURCE: JCGM 100]

3.1.7
expanded uncertainty
quantity defining an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand

Note 1 to entry: The fraction may be viewed as the coverage probability or level of confidence of the interval.

Note 2 to entry: To associate a specific level of confidence with the interval defined by the expanded uncertainty requires explicit or implicit assumptions regarding the probability distribution characterized by the measurement result and its combined standard uncertainty. The level of confidence that may be attributed to this interval can be known only to the extent to which such assumptions may be justified.

[SOURCE: JCGM 100]

3.1.8
field blank
filter that undergoes the same procedures of conditioning and weighing as a sample filter, including transport to and from, and storage in the field, but is not used for sampling air

Note 1 to entry: A field blank is sometimes also called a procedure blank.

3.1.9
limit value
level fixed on the basis of scientific knowledge, with the aim of avoiding, preventing or reducing harmful effects on human health and/or the environment as a whole, to be attained within a given period and not to be exceeded once attained

[SOURCE: 2008/50/EC]

3.1.10
monitoring station
enclosure located in the field in which a sampler has been installed to measure particulate matter in such a way that its performance and operation comply with the prescribed requirements

3.1.11
parallel measurement
measurements from measuring systems, sampling from the same air over the same time period

3.1.12
performance characteristic
one of the parameters assigned to a sampler in order to define its performance

3.1.13
performance criterion
limiting quantitative numerical value assigned to a performance characteristic, to which conformance is tested

3.1.14
period of unattended operation
time period over which the sampler can be operated without requiring operator intervention

3.1.15
PM_x
particulate matter suspended in air which is small enough to pass through a size-selective inlet with a 50 % efficiency cut-off at x µm aerodynamic diameter

Note 1 to entry: By convention, the size-selective standard inlet designs prescribed in this document – used at the prescribed flow rates – possess the required characteristics to sample the relevant PM fraction suspended in ambient air.

Note 2 to entry: The efficiency of the size selectiveness of other inlets used may have a significant effect on the fraction of PM surrounding the cut-off, and, consequently on the mass concentration of PMx determined.

3.1.16
reference method
RM

measurement method(ology) which, by convention, gives the accepted reference value of the measurand

3.1.17
reference sampler
sampling system which has been proved to be compliant to the requirements of the design and performance characteristics of this document

3.1.18
sampled air
ambient air that has been sampled through the sampling inlet and sampling system

3.1.19
sampling inlet
entrance to the sampling system where ambient air is collected from the atmosphere

3.1.20
standard uncertainty
uncertainty of the result of a measurement expressed as a standard deviation

[SOURCE: JCGM 100]

3.1.21
suspended particulate matter
SPM
notion of all particles surrounded by air in a given, undisturbed volume of air

3.1.22
time coverage
percentage of the reference period of the relevant limit value for which valid data for aggregation have been collected

3.1.23
type testing
examination of two or more samplers of the same model (identical in hardware and firmware) which are submitted by a manufacturer to a competent body for testing of performance requirements

3.1.24
uncertainty (of measurement)
parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand

[SOURCE: JCGM 100]

3.1.25
weighing room blank
filter that undergoes the same procedures of conditioning and weighing as a sample filter, but is stored in the weighing room

3.2 Symbols and abbreviations

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

- — φ Flow rate related to standard conditions
- — φ_a Flow rate related to ambient conditions (T_a, P_a)
- — ΔP Pressure difference determined for the time interval Δt (leak test)
- — Δt Time interval needed for the pressure rise (leak test)
- — C Concentration of PM (µg/m³) at ambient conditions
- — d day(s)
- — h hour(s)
- — k Coverage factor
- — m Filter mass
- — m_c Mass of blank conditioned filter
- — m_l Mass of sampled filter
- — m_s Mass of sampled and conditioned filter
- — m_u Mass of unsampled filter
- — min Minutes
- — P_0 Pressure at t = 0 (leak test)
- — P_a Ambient pressure
- — t Sampling time
- — T_a Ambient temperature
- — u Standard uncertainty
- — u_{bs} Between-sampler uncertainty
- — u_f Uncertainty of flow
- — u_{mfb} Uncertainty due to the effect of humidity on a blank filter

- u_{mh} Uncertainty due to hysteresis effects on mass of PM
- u_{m} Uncertainty of the mass of PM (ml – mu)
- u_{mb} Uncertainty due to buoyancy
- u_{mba} Uncertainty due to balance calibration
- u_{mc} Uncertainty due to contamination
- u_{mfe} Uncertainty due to lack of filter efficiency
- u_{mg} Uncertainty due to the interaction with gases
- u_{mhp} Uncertainty due to the effect of humidity on particulate matter
- u_{mip} Uncertainty due to inlet performance
- u_{ml} Uncertainty of the mass of a sampled filter
- u_{ms} Uncertainty due to static charging of the filter
- u_{mtl} Uncertainty due to losses of PM on transport and storage
- u_{mu} Uncertainty of the mass of an unsampled filter
- u_{mzd} Uncertainty due to balance zero drift
- φ_{L} Leak flow rate (leak test)
- V_{sys} Estimated total volume of the system (dead volume)
- w Relative uncertainty
- W Expanded relative uncertainty
- x_{i} Individual measurement result from a sampler
- u_{fc} Uncertainty due to flow calibration
- u_{fd} Uncertainty due to flow drift
- u_{t} Uncertainty of sample time

- EU European Union
- GDE Guide to the Demonstration of Equivalence of Ambient Air Monitoring Methods
- GUM Guide to the Expression of Uncertainty in Measurement
- JCGM Joint Committee for Guides in Metrology
- PM Particulate Matter
- POM Polyoxymethylene
- PTFE Polytetrafluoroethylene
- QA/QC Quality Assurance / Quality Control
- RH Relative Humidity
- RM Reference Method(ology)
- SPM Suspended Particulate Matter

4 Principle

4.1 Description of the standard measuring principle

Ambient air is passed through a size-selective inlet at a known, constant flow rate. The relevant PM fraction is collected on a filter for a known period of nominally 24 h. The mass of the PM material is determined by weighing the filter at pre-specified, constant conditions before and after collection of the particulate matter.

Key factors which can affect the result of the measurement, and which are addressed by the procedures prescribed within this document, include:

— (variations in) the design and construction of the size-selective inlet;

— the sampling flow rate;

— deposition losses of PM within the pipework between the inlet and the filter;

— uncontrolled losses within the pipework between the inlet and the filter, and on the filter due to volatilization of water and semi-volatile PM at any time between collection and weighing;

— changes in weight of the filters or PM due to, e.g. the behaviour of water and semi-volatile compounds on the filter and PM, spurious addition or loss of material, buoyancy, or static electricity.

In order to minimize the effects of these factors, this document gives requirements for a series of parameters that determine the magnitudes of these effects.

4.2 Initial use and procedures for ongoing QA/QC

QA/QC procedures are described for sample collection, filter transport and handling, and filter weighing.

The quality assurance/quality control (QA/QC) procedures within this document are separated into those activities typically carried out with each measurement, and those carried out less frequently.

QA/QC procedures which are used for each measurement, including filter handling and conditioning, weighing room conditions, proper functioning of the weighing instrument, and the use of blank filters, are described in Clause 6.

It is of particular importance that the facilities used for the weighing of the filters before and after sampling fulfil the requirements of this document. Consequently, a series of tests is described through which the user may ensure the proper operation of the facilities.

Additional QA/QC procedures which are used on a less frequent basis, including flow calibration, calibration of the weighing instrument, and maintenance (inlet cleaning) and leak testing of the sampling system, are described in Clause 7.

4.3 Evaluation of measurement uncertainty

Procedures for the user to evaluate the measurement uncertainty contributions are described in Clause 9.

5 Equipment, facilities and testing

5.1 Sampling system components and programme for type testing

5.1.1 General

This document describes the designs for the sampling systems to be used within the standard method.

This document represents an evolution of earlier European Standards (EN 12341:1998 and 2014, EN 14907:2005). New equipment procured shall comply fully with this document.

Older versions of these samplers, including those described in EN 12341:2014 Annex B, have a special status in terms of their use. These samplers can still be used for monitoring purposes and for ongoing quality control, provided that a well justified additional allowance is made to their uncertainties.

The determination of the concentration of PM_{10} or $PM_{2,5}$ in ambient air shall fulfil the requirement of a maximum uncertainty in the measured values, which is prescribed by Directive 2008/50/EC. In order to achieve an uncertainty less than (or equal to) this required uncertainty, the sampler shall fulfil all the criteria for a number of performance characteristics which are given in this standard. The values of the selected performance characteristics shall be evaluated by means of laboratory tests and field tests. By combining uncertainties derived from the values of the selected performance characteristics in the expanded uncertainty calculation, a judgement shall be made as to whether or not the sampler meets the criterion of maximum uncertainty prescribed by Directive 2008/50/EC.

This process of assessment of the values of the performance characteristics comprises laboratory tests and field tests and the calculation of the expanded uncertainty. Two samplers of the same model shall be tested in the laboratory and in the field tests. All samplers tested are required to pass their respective tests.

NOTE 1 Testing in the laboratory and field may use two samplers of the same model consecutively or separately with four samplers of the same model.

The type testing according to Clause 7 and subsequent QA/QC and verification procedures according to Clause 9 provide evidence that the defined requirements concerning data quality objectives laid out in relevant EU Directives can be satisfied. A competent body shall perform the type testing. The type testing shall be awarded by, or on behalf of, the competent authority of a Member State.

The type testing is based on the evaluation of performance characteristics determined under a prescribed series of tests. In this document, test procedures are described for the determination of the actual values of the performance characteristics for two samplers of the same model in a laboratory and in the field. The evaluation for type testing of the sampler includes the calculation of the expanded uncertainty of the measuring result based on the numerical values of the tested performance characteristics and then by comparison of this result with a prescribed maximum uncertainty.

Appropriate experimental evidence shall be provided by:

a) type testing performed under conditions of intended use of the specified method of measurement, and

b) calculation of expanded uncertainty of results of measurement.

In order to assess the performance of single or sequential samplers, it is necessary to undergo a series of laboratory and field tests. The requirements of these tests are given in Table 1, described further in the accompanying clauses. The requirements shall be assessed via a combination of laboratory and field tests, as prescribed in Table 1.