SLOVENSKI STANDARD
SIST EN 14907:2005

01-december-2005

Kakovost zunanjega zraka - Standardna gravimetrijska metoda za določ evanje masne frakcije PM2,5 lebdeč ih delcev

Ambient air quality - Standard gravimetric measurement method for the determination of the PM2,5 mass fraction of suspended particulate matter

Luftbeschaffenheit - Gravimetrisches Standardmessverfahren für die Bestimmung der PM2,5-Massenfraktion des Schwebstaubs

Qualité de l'air ambiant - Méthode normalisée de mesurage gravimétrique pour la détermination de la fraction massique MP2,5 de matiere particulaire en suspension

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13.040.20 Kakovost okoljskega zraka Ambient atmospheres

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EUROPEAN STANDARD

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EN 14907

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English Version

Ambient air quality - Standard gravimetric measurement method for the determination of the PM2,5 mass fraction of suspended particulate matter

Qualité de l'air ambiant - Méthode de mesurage gravimétrique de référence pour la détermination de la fraction massique PM 2,5 de matière particulaire en suspension

Luftbeschaffenheit - Gravimetrisches Standardmessverfahren für die Bestimmung der PM2,5-Massenfraktion des Schwebstaubs

This European Standard was approved by CEN on 22 July 2005.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This European Standard (EN 14907:2005) 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 March 2006, and conflicting national standards shall be withdrawn at the latest by March 2006.

This European Standard 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 informative annex ZA, which is an integral part of this European Standard.

As part of a continuous quality improvement, it is anticipated that this standard and EN 12341 (PM_{10}) may be reviewed by the Technical Committee in the near future.

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

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 European Standard is to present a harmonised methodology for monitoring the 2,5 µm mass fraction of suspended particulate matter ($PM_{2,5}$) in ambient air, following Community Directive 96/62/EC on ambient air quality assessment and management [1], and Council Directive 1999/30/EC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air [2], which sets the parameters specific to the assessment of particulate matter.

The standard method set out in this European Standard is focused primarily on harmonisation and improvement of the data quality of measurement methods used in monitoring networks, but is not necessarily best suited for practical use in routine monitoring.

There are no traceable reference standards for $PM_{2,5}$ measurements. Therefore, the standard method set out in this European Standard defines the measured quantity by convention, specifically by the sample inlet design and associated operational parameters covering the whole measurement process. The standard contains:

— manual gravimetric standard measurement method for $PM_{2,5}$ using single filters;

— summary of performance characteristics of the method, including measurement uncertainty;

— procedure for determining whether non-standard measurement methods (like other manual gravimetric or automatic monitoring methods) are equivalent to this standard method (Annex A).

The precision and performance characteristics described in this European Standard were determined in 9 different comparative and validation trials. The trials were performed at 9 different sites in northern, middle and southern European countries in order to cover a wide range of relevant ambient air conditions. The trials were sponsored by the European Commission and the European Free Trade Association.

In addition to the measurement procedure of the 2,5 µm mass fraction of suspended particulate matter ($PM_{2,5}$) in ambient air being described in this European Standard, there is European Standard EN 12341 [3] dealing with the measurement of PM_{10}.

1 Scope

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

Measurements are made over a sampling period of about 24 h, and in line with the Directive, are expressed as 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 the standard is from 1 µg/m^3 (i.e. the limit of detection of the standard measurement method expressed as its uncertainty) up to 120 µg/m^3 (i.e. the maximum concentration level observed during the field study undertaken by CEN/TC 264/WG 15 to validate the standard).

NOTE Although the standard is not validated for concentrations over 120 µg/m^3, its range of application could well be extended to commonly encountered ambient concentrations up to circa 200 µg/m^3 when using glass or quartz fibre filters. At these high concentrations and particulate mass loadings no filter clogging is to be expected. Also the flow rate can be easily maintained at the nominal setting.

The equivalence procedure in Annex A specifies two approaches, depending on whether the candidate method differs slightly or fundamentally from the standard method.

In the former case, involving only slight differences from the standard method ("variations on a theme") Annex A provides a restricted procedure to compare only the pertinent differences, instead of a full field test. This part of the annex serves to give practical guidance for determining equivalence for measurement methods commonly used in monitoring networks, and includes examples of common variations to the standard method, such as different filter storing or conditioning procedures and the variation of the standard method for the application as automated filter changer.

In the latter case, involving a full set of field tests, the procedure serves to determine equivalence only within the range of conditions under which the field tests are carried out. The equivalence can be shown to hold for conditions prevailing within European countries by carrying out the field test in situations covering a suitable range of relevant ambient parameters (such as concentration and composition of the suspended particulate matter, temperature, and humidity).

Although this European Standard does not explicitly address automatic monitoring methods for the measurement of the $PM_{2,5}$ mass fraction in ambient air, the equivalence test procedure in Annex A applies both to non-automatic and automatic methods.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ENV 13005, *Guide to the expression of uncertainty in measurements*

CR 14377, *Air quality – Approach to uncertainty estimation for ambient air reference measurement methods*

3 Terms, definitions and abbreviations

For the purposes of this European Standard, the following terms, definitions and abbreviations apply.

3.1 Terms and definitions

3.1.1
ambient air
outdoor air in the lower troposphere excluding workplace air

3.1.2
$PM_{2,5}$ automatic monitoring method
method intended for the automatic on-line determination of the $PM_{2,5}$ mass concentration of suspended particulate matter in ambient air

3.1.3
high volume sampling method
HVS
method for sampling particulate matter with a flow rate of 30 m^3/h

3.1.4
low volume sampling method
LVS
method for sampling particulate matter with a flow rate of 2,3 m^3/h

3.1.5
$PM_{2,5}$
fraction of suspended particulate matter which passes through a size-selective inlet with a 50 % cut-off efficiency at 2,5 µm aerodynamic diameter

NOTE By convention, the size-selective standard inlet design prescribed in 5.1.2, used at the flow rate given in 5.1.5, possesses the required characteristics in order to sample the $PM_{2,5}$ fraction in ambient air.

3.1.6
suspended particulate matter
SPM
notion of all particles surrounded by air in a given, undisturbed volume of air

3.1.7
uncertainty (of measurement)
parameter, associated with the result of a measurement, that characterizes the dispersion of the values that would reasonably be attributed to the measurand (see also ENV 13005)

3.1.8
nominal flow rate
flow rate at the point set

3.2 Abbreviations

3.2.1
CM
candidate method (non-standard measurement method)

3.2.2
DQO
EU data quality objectives

3.2.3
PM
particulate matter

3.2.4
QA
quality assurance

3.2.5
QC
quality control

3.2.6
RH
relative humidity

3.2.7
SM
standard measurement method

3.2.8
SPM
suspended particulate matter

4 Principle

4.1 Description of the standard measuring principle

Ambient air is passed through a $PM_{2,5}$ size-selective inlet, at a known, constant flow rate. The $PM_{2,5}$ fraction is collected on a filter for a known period of about 24 h. The mass of the $PM_{2,5}$ material is determined by weighing the filter at 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 European Standard, include:

— deposition losses of non-volatile $PM_{2,5}$ fraction within the pipework between the inlet and the filter;

— uncontrolled losses due to volatilisation of semi-volatile $PM_{2,5}$, both within the pipework between the inlet and the filter, and on the filter at any time between collection and weighing;

— possible changes in weight of the filters or $PM_{2,5}$ fraction due to adsorbed water, spurious addition or loss of material, buoyancy, or static electricity;

— flow rate.

4.2 Description of QA/QC procedures

The quality assurance/quality control (QA/QC) procedures within this European Standard 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.

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.

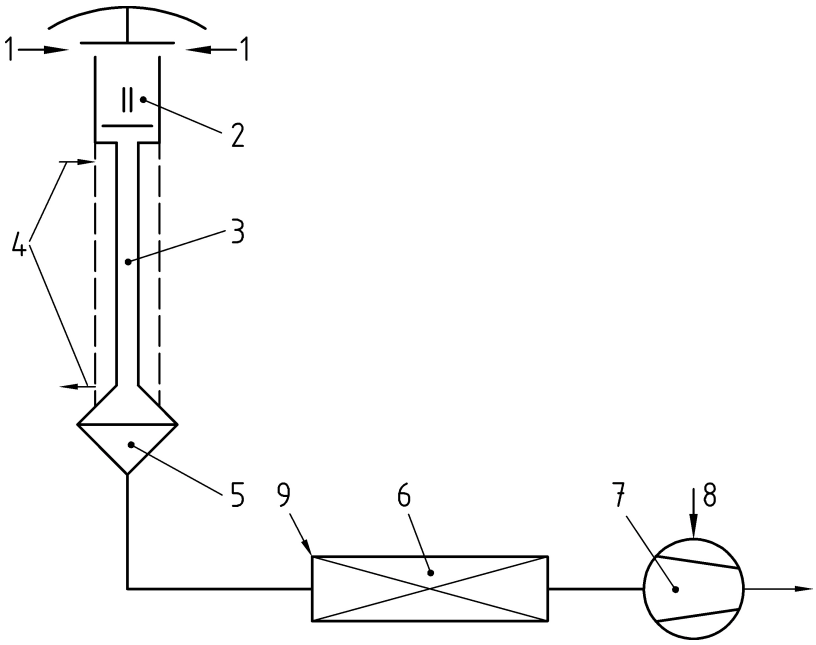
5 Equipment and facilities

5.1 Sampling system components

5.1.1 General

This European Standard contains two different designs for the sampling system to be used within the standard method. These designs operate at significantly different flow rates, and will be described throughout the text as the "low volume" or LVS and "high volume" or HVS designs.

The sampling system for the standard measurement method consists of the following elements, illustrated schematically in Figure 1.



Key

1 Air sample (T_a, p_a)
2 Impactor inlet
3 Connecting pipework
4 Sheath air (only LVS, see Note in 5.1.3)
5 Filter holder
6 Flow measuring device
7 Pump
8 Flow control system
9 Measurement of temperature T, pressure p and flow rate F

T_a Ambient temperature

p_a Ambient pressure

F_a Flow rate related to ambient conditions (T_a, p_a)

$$F_a = \frac{T_a \times p}{T \times p_a} \times F \quad (m^3/h)$$

Figure 1 – Scheme of $PM_{2,5}$ standard sampler

— size-selective inlet, whose design is prescribed in 5.1.2;

— connecting pipework between the inlet and the filter holder, described in 5.1.3;

— filter holder and filter, described in 5.1.4;

— flow control system, given by performance specifications in 5.1.5.

The sampling system shall be made of an inert, non-corroding, electrically conducting material such as preferably stainless steel or anodised aluminium or aluminium alloy.

Correct operation of the sampling system also requires calibration devices regarding flow rate, and ambient temperature and pressure sensors, with specifications given in Clause 7.

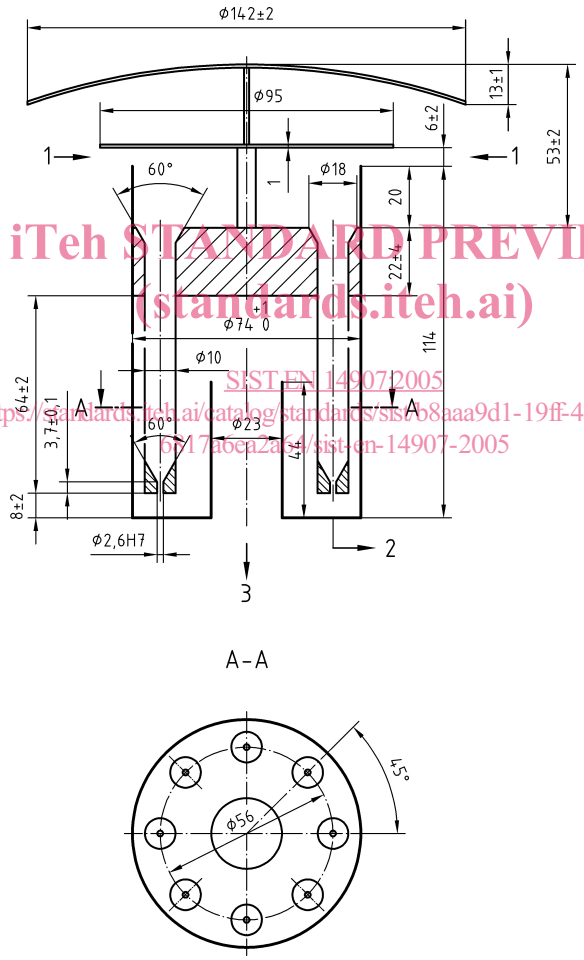
5.1.2 Standard inlet design

5.1.2.1 General

The critical dimensions of the inlet designs for LVS and HVS are given below in 5.1.2.2 and 5.1.2.3 respectively.

5.1.2.2 LVS standard inlet design

All measures in millimetres
Tolerance of all measures without tolerances: ± 0,2 mm respectively ± 0,5 °



Key

1 Air sample
2 Drainage for impacted water
3 To filter
H7 Manufacturing tolerance

Figure 2 – Design of 2,3 m³/h $PM_{2,5}$ LVS inlet