SLOVENSKI STANDARD

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Kakovost zunanjega zraka - Difuzijski vzorļ evalniki za doloļ evanje koncentracije plinov in par - Zahteve in preskusne metode ï 3. del: Vodilo za izbor, uporabo in vzdrģevanje

Ambient air quality - Diffusive samplers for the determination of concentrations of gases and vapours - Requirements and test methods - Part 3: Guide to selection, use and maintenance

Außenluftqualität - Passivsammler zur Bestimmung der Konzentrationen von Gasen und Dämpfen - Teil 3: Anleitung zur Auswahl, Andwendung und Handhabung

Qualité de l'air ambiant - Echantillonneurs par diffusion pour la détermination de la concentration des gaz et vapeurs - Partie 3: Guide pour la sélection, l'utilisation et la maintenance

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Ambient air quality - Diffusive samplers for the determination of concentrations of gases and vapours - Requirements and test methods - Part 3: Guide to selection, use and maintenance

Qualité de l'air - Echantillonneurs par diffusion pour la détermination de concentration des gaz et vapeurs - Exigences et méthodes d'essai - Partie 3: Guide pour la sélection, l'utilisation et la maintenance

Außenluftqualität - Passivsammler zur Bestimmung der Konzentrationen von Gasen und Dämpfen - Teil 3:Anleitung zur Auswahl, Andwendung und Handhabung

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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 Management Centre has the same status as the official versions.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 13528-3:2003) 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of an identical text or by endorsement, at the latest by June 2004, and conflicting national standards shall be withdrawn at the latest by June 2004.

This European Standard is a multi-part standard having the following parts:

EN 13528-1, *Ambient air quality - Diffusive samplers for the determination of concentrations of gases and vapours - Requirements and test methods - Part 1: General requirements.*

EN 13528-2, *Ambient air quality - Diffusive samplers for the determination of concentrations of gases and vapours - Requirements and test methods - Part 2: Specific requirements and test methods.*

EN 13528-3, *Ambient air quality - Diffusive samplers for the determination of concentrations of gases and vapours - Requirements and test methods - Part 3: Guide to selection, use and maintenance.*

Annexes A and B of this part of the European Standard are informative.

This document includes a Bibliography.

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

Introduction

This European Standard specifies requirements and test methods for the determination of performance characteristics of diffusive samplers used for the determination of concentrations of gases and vapours in ambient atmospheres.

With regard to air quality, the objectives fixed in the 5th Action Program of the European Union are for the effective protection of all people against recognised risks from air pollution and the establishment of permitted concentration levels of air pollutants, which should take into account the protection of the environment. These objectives include monitoring and control of concentrations with regard to standards.

Successive programs of action of the European Union on the protection of the environment have stressed the need to find a balance between the use of different tools: product standards, emission limits and environmental objectives/standards.

The implementation of existing Directives has highlighted the existence of various problems, which are being addressed in the Council Directive on Ambient Air Quality Assessment and Management [1]. These include:

— different monitoring strategies in comparable situations between and within Member States;

— harmonisation of measuring methods;

— quality of the measurements which depend on the calibration and quality assurance procedures.

Diffusive samplers used to measure air quality should fulfil some general requirements which are given in EN 13528-1. These requirements include unambiguity, selectivity and Data Quality Objectives, including uncertainty.

Such general requirements can also be appropriate for other measuring procedures used in the assessment of ambient air quality.

In addition, diffusive samplers used to measure ambient air quality should also fulfil some specific requirements in addition to those specified in EN 13528-1. These specific requirements are given in EN 13528-2. This part of EN 13528 gives guidance on the selection, use and maintenance of diffusive samplers used to measure ambient air quality.

It is the user's primary responsibility to choose appropriate procedures or devices that meet the requirements of this European Standard. One way of doing this is to obtain information or confirmation from the manufacturer. Type testing, or more generally, the assessment of performance criteria of procedures or devices, can be undertaken by the manufacturer, user, test house or research and development laboratory, as is most appropriate.

Although this standard specifically addresses ambient air, diffusive sampling is also relevant to the assessment of air quality in indoor air. Both pumped and diffusive sampling procedures are considered appropriate for such measurements, depending on circumstances (particularly any requirement for time resolution) [2]. prEN 14412 gives guidance on the selection, use and maintenance of diffusive samplers used to measure indoor air quality.

This part of EN 13528 is similar in content to EN 838 and EN 13528-1 is similar in content to EN 482. The series of standards on the use of diffusive samplers for ambient air has been created in addition to those for workplace air because the underlying European Directives are different and the consequent definitions and practical applications of the estimation of the uncertainty of measurements are different.

1 Scope

This part of the European Standard gives guidance on the selection, use and maintenance of diffusive samplers used to measure ambient air quality. It includes guidance on measurement objectives and strategies, both in support of European Community Policy and more generally, relevant to the use of such samplers. It also includes information on the operating principles of diffusive samplers and the factors that affect performance in the practical implementation of such policies. Advice is also given on ways to minimise any such adverse effects, e.g. by suggesting shelters that may protect against the effects of wind speed on the samplers, and on training and quality assurance considerations.

Annexes give further information on practical applications for particular environmental pollutants, including those specified by existing and anticipated European Daughter Directives.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

ENV 13005, *Guide to the expression of uncertainty in measurement.*

EN 13528-1:2002, *Ambient air quality - Diffusive samplers for the determination of concentrations of gases and vapours - Requirements and test methods - Part 1: General requirements.*

EN 13528-2:2002, *Ambient air quality - Diffusive samplers for the determination of concentrations of gases and vapours - Requirements and test methods - Part 2: Specific requirements and test methods.*

ISO 5725 (all Parts), *Accuracy (trueness and precision) of measurement methods and results.*

3 Terms and definitions

NOTE Attention is drawn to the fact that the terms Assessment, Limit Value and Pollutant are defined in Directive 96/62/EC [1].

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

3.1
ambient air
outdoor air in the troposphere, excluding indoor air and workplaces

3.2
averaging time
period of time for which the measuring procedure yields a single value [EN 482:1994]

3.3
diffusive sampler
device which is capable of taking samples of gases or vapours from the atmosphere at a rate controlled by a physical process such as gaseous diffusion through a static air layer or a porous material and/or permeation through a membrane, but which does not involve the active movement of air through the device

NOTE 1 Active normally refers to the pumped movement of air.

NOTE 2 This definition differs from that in EN 838 by the addition of the words "or a porous material".

3.4
diffusive uptake rate
rate at which the diffusive sampler collects a particular gas or vapour from the atmosphere, expressed in picograms per parts per billion[1] per minute (pg ppb^{-1} min^{-1}) or cubic centimetres per minute (cm^3 min^{-1})

NOTE 1 pg ppb^{-1} min^{-1} are equivalent to ng ppm^{-1} min^{-1}.

NOTE 2 This definition differs from that in EN 838 by the substitution of "picograms per parts per billion" for "nanograms per parts per million". The expression is numerically the same, but ambient concentrations are usually in the ppb range.

3.5
measuring procedure
procedure for sampling and analysing one or more pollutants in ambient air and including storage and transportation of the sample

3.6
selectivity
degree of independence from interferents

3.7
uncertainty (of measurement)
parameter, associated with the results of a measurement, that characterises the dispersion of values that could reasonably be attributed to the measurand

NOTE 1 The parameter can be, for example, a standard deviation (or given multiple of it), or the half width of an interval having a stated level of confidence.

NOTE 2 Uncertainty of measurement comprises, in general, many components. Some of these components can be evaluated from the statistical distribution of the results of a series of measurements and can be characterised by experimental standard deviations. The other components, which can also be characterised by standard deviations, are evaluated from assumed probability distributions based on experience or other information.

NOTE 3 It is understood that the result of a measurement is the best estimate of the value of a measurand, and that all components of uncertainty, including those arising from systematic effects, such as components associated with corrections and reference standards, contribute to this dispersion [ENV 13005].

3.8
validation
process of evaluating the performance of a measuring procedure and checking that the performance meets certain pre-set criteria

4 Symbols and abbreviations

A cross-sectional area of the diffusion path, or equivalent sorption surface, in square centimetres;

C observed concentration, in micrograms per cubic meter;

D diffusion coefficient of analyte, in square centimetres per minute;

D_1 diffusion coefficient of analyte 1, in square centimetres per minute;

D_2 diffusion coefficient of analyte 2, in square centimetres per minute;

d desorption efficiency;

k correction factor for non-ideal behaviour (see 7.1);

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[1] ppb is volume fraction, $(\phi)=10^{-9}$; ppm is volume fraction, $(\phi)=10^{-6}$.

l length of static air layer in sampler (or equivalent for permeation types), in centimetres;

M molar mass of analyte, in grams per mol;

m_b mass of the analyte which is desorbed from the blank sampler, in picograms;

m_d mass of the analyte which is desorbed from exposed samplers, in picograms;

m_s mass of the analyte which is sorbed by diffusion, in picograms;

P pressure of the sampled atmosphere during sampling, in kilopascals;

t exposure time, in minutes;

T temperature of the atmosphere sampled, in Kelvin;

U diffusive uptake rate, in cubic centimetres per minute;

U_1 diffusive uptake of analyte 1, in cubic centimetres per minute;

U_2 diffusive uptake of analyte 2, in cubic centimetres per minute;

U' diffusive uptake rate, in picograms per parts per billion per minute (pg ppb^{-1} min^{-1});

V volumetric flow of air, in cubic meters per minute;

δ bias;

ϕ delivered concentration in parts per billion (volume fraction = 10^{-9});

ρ delivered concentration, in micrograms per cubic meter;

ρ_1 concentration of the given analyte at the beginning of the diffusion layer (l = 0), in micrograms per cubic meter;

ρ_2 concentration of the given analyte at the end of the diffusion layer, in micrograms per cubic meter;

τ time constant of the diffusive sampler, in seconds.

5 Measurement objectives and strategy

5.1 Measurements in support of Community Policy

NOTE It is the responsibility of the user of the standard to check the latest developments of EU legislation.

5.1.1 Air Quality Directives

Different regimes of air quality assessment are possible for the implementation of the Council Directive on Ambient Air Quality Assessment and Management [1], and successive Daughter Directives, in which the measurement requirements are relaxed as the risk of exceeding the limit values decreases.

Measurements at fixed measuring stations, indicative measurement methods, emission inventories and air quality modelling, or a combination of techniques, may be used, depending on whether the pollutant concentration levels over a representative period are above or below one or more set percentages of the relevant limit value. Generally, the closer the concentration is to the limit value, the more demanding are the data quality objectives (see below). The percentages, for both the upper and lower assessment thresholds, as defined in EC-Directive 96/62/EC [1], are

given in the relevant daughter Directives, e.g. EC-Directive 99/30/EC [3], Annex V for sulphur dioxide, nitrogen dioxide and oxides of nitrogen; and Directive 2000/69/EC [4], Annex III for benzene and carbon monoxide.

Data quality objectives are set for each measurement type to guide quality assurance programmes. These data quality objectives include the required accuracy (uncertainty), the minimum time coverage and the percentage data capture of the assessment methods. Numerical values of the objectives are given in the relevant daughter Directives, e.g. EC-Directive 99/30/EC [3], Annex VIII for sulphur dioxide, nitrogen dioxide and oxides of nitrogen; Directive 2000/69/EC [4], Annex VI for benzene and carbon monoxide; and Directive 2002/3/EC [5], Annex VII for ozone.

The uncertainty (at a 95 % confidence interval) of the assessment methods will be evaluated in accordance with the Guide to the Expression of Uncertainty in Measurement (ENV 13005) and/or ISO 5725 or equivalent.

The diffusive sampling technique may be implemented under the Air Quality Directives for:

— classification of zones (Art. 8 and 9);

— preliminary assessment of ambient air quality (Art. 5);

— network design/optimisation (Art. 4.3);

— air quality monitoring in areas at no risk of exceeding limit values (Art. 6.3);

— determination of areas of homogeneous air quality;

— assessment of pollution in the vicinity of point sources (traffic, industry);

— assessment of pollution in ecosystems.

Further guidance on the potential of diffusive sampling in connection with Preliminary Assessment under EC Air Quality Directives is given in the report [6].

Detailed requirements for the assessment of concentrations of atmospheric pollutants, with special reference to the potential of diffusive sampling, have been developed by VDI [7].

5.1.2 Source-related assessment

Diffusive sampling is already established within industry for workplace monitoring [EN 482]; however the techniques have yet to be widely accepted for monitoring of ambient air within industrial areas.

In addition to the tasks mentioned in 5.1.1 diffusive sampling can be used for:

— environmental Impact Assessments studies needed to obtain exploitation permits;

— measurement campaigns for the identification of sources;

— surveys to monitor the environmental impact of industrial processes within plants;

— ground level air quality impact of factory sites by deployment at boundary fences;

— air quality monitoring campaigns with local authorities within communities and rural areas neighbouring major industrial complexes to demonstrate compliance with and maintenance of air quality objectives in EC Directives and national air quality standards.

Diffusive samplers are already available for various substances and/or can be designed to measure almost all gases emitted by industrial and other processes, including oxides of nitrogen and sulphur, ammonia and amines, chlorinated hydrocarbons, oxygenated species including solvents and aldehydes, halogen and acid gases, hydrogen sulphide and many others (annex A).

5.1.3 Forest Protection directives

Diffusive sampling is also relevant to the Council Regulation (EEC) No. 3528/86 (amended by Regulation (EEC) No. 2157/92) on the protection of the Community's forests against atmospheric pollution, and establishing a network of permanent observation sites for the intensive and continuous surveillance of forest ecosystems [8].

5.1.4 Protection of ecosystems

Diffusive sampling is also relevant to Proposal COM(99)125 final [5], in that Annex II (section III) establishes reference exposure levels relating to damage by ozone to materials and forests, and visible damage to crops.

5.1.5 Public awareness

The right of the public to be informed about its exposure to air pollutants and the state of its environment has become one of the priorities of the air quality policies. The cost effectiveness and simple operation of diffusive samplers make it an ideal tool for the organisation of campaigns for the information of the public. In particular the technique can be usefully implemented for the organisation of awareness raising campaigns and for didactic purposes.

5.2 Measurement in support of other policies

5.2.1 Measurement in support of national, regional or local policies

A limited number of local authorities in Member States have already taken pro-active measures to assess ambient air quality within their urban and rural environments. However, measurements methods used to date tend to be based on fixed point monitoring stations which are only partly representative of the spatial variations in ambient air quality. Determining the spatial location of such sites can be difficult. In addition, such techniques are expensive. Diffusive sampling provides an excellent tool for screening campaigns to estimate air quality at many locations simultaneously. An example is given in [9, 10; other examples available in literature]. Such campaigns complement data obtained from fixed stations such that a local authority can confidently assess local ambient air conditions and make decisions about network design for future campaigns.

5.2.2 Protection of special ecosystems

Special sensitive ecosystems such as natural reserves and mountain areas are not specifically covered by existing Community limit values or national air quality regulations but may be protected by particular and more stringent regulations. The simplicity of operation of the diffusive sampling technique and the lack of a requirement for electric power renders this technique well adapted to this scope, in particular for the assessment of integrated pollution levels over longer periods of time.

The technique can similarly be used for the protection of our cultural heritage (historical, monuments, paintings, etc.).

5.2.3 Particular research aspects

Diffusive samplers can be used in response to particular research needs, such as for:

— analysis of trends in air quality;

— study of the source/receptor relationship;

— validation of atmospheric dispersion models;

— evaluation of emission reduction measures;

— collecting exposure data for epidemiology or risk assessment.

5.3 Measurement strategy

The measuring strategy will depend on the objectives of the monitoring, and the pollutants to be assessed. It is necessary to specify where, how, and how often measurements shall be taken. The measuring effort will be dependent on:

— variation of pollutant concentrations in space and time;

— availability of supplementary information;

— accuracy of the estimate that is required.

A practical example of the development of a measurement strategy in connection with Preliminary Assessment under EC Air Quality Directives is given in the report [6].

6 Selection of the device

6.1 Sources of information

Important information on the performance characteristics of a diffusive sampler can be obtained from various sources. These include:

— manufacturer's instructions for use (EN 13528-2:2002, 5.12);

— published commercial technical information;

— technical and research publications;

— national and international standards [11-15];

— user groups, e.g. HSE/CAR/WG 5 (Health and Safety Executive / Committee on analytical Requirements/ Working Group 5), which issues The Diffusive Monitor, a newsletter produced since 1988[2].

6.2 Selection of a sampler and procedure

The selection of a diffusive sampler will depend on many factors. These include:

a) measurement task (clause 5); i.e.

   — mandatory measurements;

   — indicative measurements;

   — objective assessment;

   — measurements other than required by the Framework Directive[1];

b) specified measuring range required, with special reference to the sampling time, the detection limit, the uptake rate and the possibility of reaching the equilibrium saturation capacity of the sorbent medium of the sampler (see annex B);

c) time resolution required;

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[2] obtainable from the Health and Safety Laboratory, Broad Lane, Sheffield S3 7HQ, UK