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Izpostavljenost na delovnem mestu - Postopki za merjenje plinov in par z vzorļ evalniki s ļ rpanjem - Zahteve in preskusne metode

Workplace exposure - Procedures for measuring gases and vapours using pumped samplers - Requirements and test methods

Exposition am Arbeitsplatz - Messung von Gasen und Dämpfen mit pumpenbetriebenen Probenahmeeinrichtungen - Anforderungen und Prüfverfahren

Exposition sur les lieux de travail - Procédures pour le mesurage des gaz et vapeurs à l'aide de dispositifs de prélèvement par pompage - Exigences et méthodes d'essai

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Workplace exposure - Procedures for measuring gases and vapours using pumped samplers - Requirements and test methods

Exposition sur les lieux de travail - Procédures pour le mesurage des gaz et vapeurs à l'aide de dispositifs de prélèvement par pompage - Exigences et méthodes d'essai

Exposition am Arbeitsplatz - Messung von Gasen und Dämpfen mit pumpenbetriebenen Probenahmeeinrichtungen - Anforderungen und Prüfverfahren

This European Standard was approved by CEN on 1 November 2009.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 1076:2009) has been prepared by Technical Committee CEN/TC 137 “Assessment of workplace exposure to chemical and biological agents”, 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of an identical text or by endorsement, at the latest by June 2010, and conflicting national standards shall be withdrawn at the latest by June 2010.

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

This document supersedes EN 1076:1997.

The major technical changes between this European Standard and the previous edition are as follows:

a) adaptation of the framework for assessing the performance of procedures for measuring gases and vapours against the general requirements for the performance of procedures for measuring chemical agents in workplace atmospheres as specified in EN 482;

b) revision of the calculation model for the uncertainty of measurement to comply with EN 482 and ENV 13005;

c) modification of the classification scheme for sampler types;

d) deletion of the informative annexes on the evaluation of pumped samplers by means of field tests.

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

Introduction

This European Standard provides a framework for assessing the performance of procedures for measuring gases and vapours against the general requirements for the performance of procedures for measuring chemical agents in workplace atmospheres as specified in EN 482. It enables manufacturers and users of pumped samplers and developers and users of procedures for measuring gases and vapours to adopt a consistent approach to method validation.

1 Scope

This European Standard specifies performance requirements and test methods under prescribed laboratory conditions for the evaluation of pumped samplers used in conjunction with an air sampling pump and of procedures using these samplers for the determination of gases and vapours in workplace atmospheres.

This European Standard is applicable to pumped samplers and measuring procedures using these samplers in which sampling and analysis are carried out in separate stages.

This European Standard is not applicable to:

— pumped samplers which are used for the direct determination of concentrations, for example, length-of-stain detector tubes;

— samplers which rely on sorption into a liquid, and subsequent analysis of the solution (bubblers).

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 482:2006, *Workplace atmospheres — General requirements for the performance of procedures for the measurement of chemical agents*

EN 838, *Workplace atmospheres — Diffusive samplers for the determination of gases and vapours — Requirements and test methods*

EN 1232:1997, *Workplace atmospheres — Pumps for personal sampling of chemical agents — Requirements and test methods*

EN 1540:1998, *Workplace atmospheres — Terminology*

EN ISO 8655-2, *Piston-operated volumetric apparatus — Part 2: Piston pipettes (ISO 8655-2:2002)*

EN ISO 8655-6, *Piston-operated volumetric apparatus — Part 6: Gravimetric methods for the determination of measurement error (ISO 8655-6:2002)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 482:2006 and EN 1540:1998[1)] apply.

4 Symbols and abbreviated terms

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

NOTE See 8.4 and Annex B for symbols used in conjunction with uncertainty of measurement only.

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1) EN 1540:1998 is currently subject to revision. Until the revised EN is published the definitions given in EN 482:2006 take precedence.

LV limit value

m_{a1} mass of analyte desorbed from tube blank, in micrograms (µg)

m_{a2} mass of analyte desorbed from spiked tube, in micrograms (µg)

$m_{a,lt}$ maximum mass uptake of analyte in a leak test performed on a sealed sampler used for making measurements for comparison with a long-term limit value, in milligrams (mg)

$m_{a,st}$ maximum mass uptake of analyte in a leak test performed on a sealed sampler used for making measurements for comparison with a short-term limit value, in milligrams (mg)

$\dot{m}_1$ mass loss from permeation tube, in micrograms per minute (µg/min)

M_a molar mass of analyte, in grams per mole (g/mol)

n number of replicate samples

p_{at} actual pressure of the test atmosphere sampled, in kilopascals (kPa)

R recovery

R_{an} analytical recovery

RH relative humidity of the test atmosphere sampled, in percent (%)

t_H hold-up time of the unretained substance, in minutes (min)

t_s sampling time, in minutes (min)

T_{at} temperature of the test atmosphere sampled, in Kelvins (K)

V_0 volume of the test atmosphere sampled, in litres (l)

V_H gas hold-up volume (dead volume)

V_R uncorrected retention volume

$(V_R)'$ corrected retention volume

$\dot{v}$ flow rate into the exposure chamber, for example, in litres per minute (l/min)

v_a volumetric air flow rate, for example, in litres per minute (l/min)

β_a mass concentration of the analyte in the calibration gas mixture, in milligrams per cubic metre (mg/m³)

$\overline{\beta}_{a,R}$ mean mass concentration of the analyte recovered from the test gas atmosphere, in milligrams per cubic metre (mg/m³)

β_{cg} mass concentration of the calibration gas mixture, in milligrams per cubic metre (mg/m³)

ϑ_{at} temperature of the test atmosphere sampled, in degrees Celsius (°C)

K_V coefficient of variation (CV)[2)]

$\rho_{LV,lt}$ long-term limit value given as volume concentration, in milligrams per cubic metre (mg/m³)

$\rho_{LV,st}$ short-term limit value given as volume concentration, in milligrams per cubic metre (mg/m³)

ϕ_a volume fraction of the analyte, in microlitres per litre (µl/l)

5 Types of samplers

Samplers for gases and vapours can be divided into type A samplers and type B samplers:

Type A samplers rely on sorption onto a solid or onto a support impregnated with a reagent, desorption with solvent, and subsequent analysis of the desorbate. They are usually made of glass, are thermally sealed, and consist of two beds of sorbent in series, i.e. with a back-up section, and contain an active sorbent (e.g. activated carbon) or a support impregnated with reagent.

Type B samplers rely on sorption onto a solid or onto a support impregnated with a reagent, thermal desorption, and analysis of the desorbate. They are usually made of glass or metal, are sealed with removable fittings and consist of one or more beds of sorbent (e.g. porous polymer resin).

6 Requirements

NOTE If there is no procedure for measuring a particular chemical agent which meets the requirements of this European Standard, a procedure whose performance is nearest to the specified requirements should be used.

6.1 General

Some requirements (see 6.2) shall be verified once for each type of sampler. Other requirements (see 6.3) shall be verified for each combination sampler/chemical agent.

It is the responsibility of the manufacturer to meet the requirements specified in 6.2. It is also the responsibility of the manufacturer or the developer of the measuring procedure to meet the requirements specified in 6.3 when use of a sampler for measurement of a particular gas or vapour is claimed.

NOTE No useful performance requirements can be given for the effect of interferents (with the exception of water vapour). The effect of interferents is difficult to predict for a non-ideal sorbent without adsorption isotherm data on mixed systems which is normally unavailable.

6.2 Sampler requirements

6.2.1 Flow resistance

When tested in accordance with 8.2.1, at least 95 % of samplers shall have a back pressure less than the appropriate maximum value indicated in Table 1. A minimum of 20 samplers shall be tested.

2) The predecessor term "relative standard deviation" is deprecated. See also ISO 3534-1:2006, 2.38, Note 2.

Table 1 — Maximum back pressures

Type of sampler	Maximum back pressure kPa
Type A – sorbent tubes, solvent desorption	≤ 10
Type A – impregnated filters	≤ 10
Type B – sorbent tubes, thermal desorption	≤ 3,5

6.2.2 Sampler leak test (for Type B samplers)

When tested in accordance with 8.2.2, for substances with a long-term limit value the maximum leakage, i.e. the maximum mass uptake of analyte above the blank value (see 6.3.2.3), shall be less than $m_{a,lt}$ calculated according to Equation (1), in milligrams (mg), as follows:

$$m_{a,lt} = \frac{1}{3}(0{,}1\ \rho_{LV,lt} \times 240 \times 0{,}01 \times 10^{-3}) \quad (1)$$

where

$m_{a,lt}$ is the maximum mass uptake of analyte in a leak test performed on a sealed sampler used for making measurements for comparison with a long-term limit value;

$\rho_{LV,lt}$ is the long-term limit value of the substance given as volume concentration, in milligrams per cubic metre (mg/m³);

240 is the reference period, in minutes (min);

0,01 is the nominal minimum flow rate for type B samplers, in litres per minute (l/min);

10^{-3} is a factor applied to convert the nominal minimum flow rate from litres per minute (l/min) to cubic metres per minute (m³/min);

1/3 is a factor applied to calculate the maximum permitted leakage.

When tested in accordance with 8.2.2, for substances with a short-term limit value the maximum leakage, i.e. the maximum mass uptake of analyte above the blank value (see 6.3.2.3), shall be less than $m_{a,st}$ calculated according to Equation (2), in milligrams (mg), as follows:

$$m_{a,st} = \frac{1}{3}(0{,}5\ \rho_{LV,st} \times 15 \times 0{,}01 \times 10^{-3}) \quad (2)$$

where

$m_{a,st}$ is the maximum mass uptake of analyte in a leak test performed on a sealed sampler used for making measurements for comparison with a short-term limit value;

$\rho_{LV,st}$ is the short-term limit value of the substance given as volume concentration, in milligrams per cubic metre (mg/m³);

15 is the reference period, in minutes (min);

0,01 is the nominal minimum flow rate for type B samplers, in litres per minute (l/min);

10^{-3} is a factor applied to convert the nominal minimum flow rate from litres per minute (l/min) to cubic metres per minute (m^3/min);

1/3 is a factor applied to calculate the maximum permitted leakage.

6.2.3 Shelf life (for impregnated supports)

The manufacturer shall specify the shelf life of the sampler when stored in its original package. During this period the sampler shall fulfil all requirements.

6.2.4 Sample identification (for commercially available sorbent tubes and impregnated filters)

The sampler shall have a suitable area for sample identification by the user.

6.2.5 Marking

Samplers shall be marked with at least the following:

— manufacturer's name;

— product identification;

— indication of the direction of air flow, if necessary;

— batch identification;

— shelf life (if applicable);

— number of this European Standard.

If required due to limited space, the marking may be placed on the packaging of the sampler. However, the manufacturer's name, product identification and direction of air flow shall be indicated on the sampler.

6.2.6 Instructions for use

The instructions for use supplied with the sampler shall be in the language(s) of the country where the sampler is to placed on the market. They shall contain at least the following information:

a) designated use (general purpose for a number of gases and vapours or, specific, for a particular gas or vapour, see 6.1);

b) blank value (only when used for a particular gas or vapour, see 6.1);

c) directions for proper handling of the sampler, including opening and closing;

d) general information on the principle of use, for example, sorbent type, reaction of the reagent impregnated solid, desorption method;

e) information on storage and transport;

f) information on health or environmental hazards and method of disposal.

6.3 Measuring procedure requirements

6.3.1 Sampling procedure requirements

6.3.1.1 General

Sampling conditions (sample volume, flow rate and sampling time) shall be established according to the LV assigned to the compounds of interest, e.g. short-term limit value, long-term limit value or both.

6.3.1.2 Sample volume

The recommended sample volume shall be less than two-third of the breakthrough volume measured in accordance with 8.3.1.3.

6.3.1.3 Air flow rate

6.3.1.3.1 Impregnated filters

When tested according 8.3.1.4, the maximum air flow rate shall be 90 % of the flow rate at which the breakthrough volume drops by 5 %.

6.3.1.3.2 Thermal desorption samplers (Type B samplers)

A minimum air flow rate shall be established according to the test in 8.3.1.5.

6.3.1.4 Storage conditions after sampling

The storage conditions after sampling shall be specified. When tested in accordance with 8.3.1.6, the mean value of the recovery after storage shall not differ by more than 10 % from the value before storage.

6.3.2 Analytical procedure requirements

6.3.2.1 Analytical quantification limit

The quantification limit shall be lower than or equal to the calculated mass of analyte that would be collected for the minimum air sample volume specified in the measuring procedure at the following concentrations:

— 0,1 LV for substances with long-term limit value;

— 0,5 LV for substances with short-term limit value only.

6.3.2.2 Analytical recovery

When tested in accordance with 8.3.2.2, the analytical recovery R_{an} shall be:

— for Type A samplers: $R_{an} \geq 75$ % with $K_v \leq 10$ % at each loading;

— for Type B samplers: $R_{an} \geq 95$ % with $K_v \leq 10$ % at each loading.

6.3.2.3 Blank value

When tested in accordance with 8.3.2.3 the blank value shall be less than one-tenth of the calculated mass collected by the sampler during the recommended sampling time at the recommended air flow rate and at concentrations of:

— 0,1 LV for substances with long-term limit value;

— 0,5 LV for substances with short-term limit value only.

Where it is known that the blank value is significant and varies between batches of samplers, it shall be checked regularly.

NOTE 1 In order to eliminate any contamination which could occur during storage before use, Type B samplers should be cleaned by taking them through the thermal desorption procedure. This cleaning process should be carried out as close as possible to the time when the samplers will be used.

NOTE 2 In order to obtain acceptable values for the quantification limit of the method, the blank value of the sampling media should be as low as technically possible.

6.3.3 Expanded uncertainty

When tested in accordance with 8.3 the expanded uncertainty, calculated in accordance with 8.4, shall meet the requirements given in EN 482.

The expanded uncertainty requirement shall be met from 10 °C to 40 °C and at relative humidities from 20 % to 80 %.

6.3.4 Method description

6.3.4.1 Scope of the measuring procedure

The scope of the measuring procedure shall give information about the following:

a) principle of the method;

b) chemical agents covered by the measuring procedure;

c) analytical technique used;

d) working ranges;

e) chemical agents for which the measuring procedure is known to be adequate but not completely validated according to this European Standard, especially in case of compounds of the same chemical family or homologous series;

f) chemical agents for which the measuring procedure is known to be inadequate;

g) any known interferences.

6.3.4.2 Method performance

The measuring procedure shall give information about method performance, including the following:

a) the chemical agents for which measurement method has been shown to be effective;

b) the range of concentrations of chemical agents in air, sample volume and range of environmental conditions over which the measurement method has been shown to meet the performance criteria for expanded uncertainty prescribed in EN 482;

c) the quantification limit of the analytical method for chemical agents of interest;

d) full details of any known interferences, including suitable and sufficient information on how to minimise their effects.