SLOVENSKI STANDARD
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Zrak na delovnem mestu - Vodilo za uporabo postopkov za oceno izpostavljenosti kemičnim in biološkim agensom

Workplace atmospheres - Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents

Arbeitsplatzatmosphäre - Leitfaden für die Anwendung und den Einsatz von Verfahren und Geräten zur Ermittlung chemischer und biologischer Arbeitsstoffe

Atmosphères des lieux de travail - Guide pour l'application et l'utilisation de procédures permettant d'évaluer l'exposition aux agents chimiques et biologiques

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Workplace atmospheres - Guide for the application and use of procedures for the assessment of exposure to chemical and biological agents

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This European Standard was approved by CEN on 23 September 2002.

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 Management Centre 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 Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 14042:2003) has been prepared by Technical Committee CEN/TC 137 “Assessment of workplace exposure”, 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of an identical text or by endorsement, at the latest by October 2003, and conflicting national standards shall be withdrawn at the latest by October 2003.

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.

This document includes a Bibliography.

Introduction

Marking EN 14042 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of relevant European standards. The accuracy of the claim is therefore the responsibility of the person making the claim.

1 Scope

This European Standard provides guidance on the selection of procedures, and the installation, use and maintenance of devices for the determination of concentrations of chemical or biological agents in workplace atmospheres.

This European Standard is based on the guidance given in EN 689 and the requirements of EN 482.

Where appropriate, this European Standard specifies additional requirements specific to particular procedures or devices, or classes thereof.

It is the user's primary responsibility to choose appropriate procedures or devices that meet the requirements of relevant European Standards. 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 workplace air, many of the procedures or devices are also relevant to the assessment of air quality in ambient or indoor air.

Specific guides exist for electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours in workplace atmospheres (EN 45544-4) and for diffusive samplers for the determination of gases and vapours in ambient air (prEN 13528-3).

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).

EN 482:1994, *Workplace atmospheres — General requirements for the performance of procedures for the measurement of chemical agents.*

EN 689, *Workplace atmospheres — Guidance for the assessment of exposure by inhalation to chemical agents for comparison with limit values and measurement strategy.*

EN 838:1995, *Workplace atmospheres — Diffusive samplers for the determination of gases and vapours — Requirements and test methods.*

EN 1076:1997, *Workplace atmospheres — Pumped sorbent tubes for the determination of gases and vapours — Requirements and test methods.*

EN 1231:1996, *Workplace atmospheres — Short term detector tube measurement systems* — Requirements and test methods.

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

EN 12919, *Workplace atmospheres — Pumps for sampling of chemical agents with a volume flow rate of over 5 l/min — Requirements and test methods.*

EN 13098, *Workplace atmospheres — Guidelines for measurement of airborne micro-organisms and endotoxin.*

EN 13205, *Workplace atmospheres — Assessment of performance of instruments for measurement of airborne particle concentrations.*

prEN 13528-3, *Ambient air quality — Diffusive samplers for the determination of concentration of gases and vapours — Part 3: Guide to selection, use and maintenance.*

EN 13890, *Workplace atmospheres — Procedures for measuring metals and metalloids in airborne particles — Requirements and test methods.*

ENV 13936:2001, *Workplace atmospheres — Measurement of chemical agents present as mixtures of airborne particles and vapour — Requirements and test methods.*

EN 45544-4, *Workplace atmospheres — Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours — Part 4: Guide for selection, installation, use and maintenance.*

3 Terms and definitions

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

3.1
accuracy
closeness of agreement between a test result and the accepted reference value

[ISO 3534-1:1993]

3.2
averaging time
period of time for which the measuring procedure yields a single value

[EN 482:1994]

3.3
bias
consistent deviation of the measured value from the value of the air quality characteristic itself or the accepted reference value

[ISO 6879:1995]

NOTE In this European Standard “air quality characteristic” means the concentration of the pollutant in workplace air.

3.4
biological agent
micro-organisms, including those which have been genetically modified, cell cultures and human endoparasites which can cause any infection, allergy or toxicity or otherwise create a risk to human health

[EN 1540:1998]

3.5
chemical agent
any chemical element or compound, on its own or admixed as it occurs in the natural state or as produced by any work activity, whether or not it is produced intentionally and whether or not placed on the market

[EN 1540:1998]

3.6
desorption efficiency
ratio of the mass of analyte desorbed from a sampling device to that applied

[EN 838:1995]

3.7
detector tube measurement system
complete measurement system consisting of a detector tube and a detector tube pump

[EN 1231:1996]

3.8
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 sampler

NOTE 1 Adapted from EN 838:1995.

NOTE 2 Active normally refers to the pumped movement of air.

3.9
diffusive uptake rate
rate at which the diffusive sampler collects a particular gas or vapour from the atmosphere, expressed in nanograms per parts per million[1]) per minute (ng ppm^{-1} min^{-1}) or cubic centimetres per minute (cm^3 min^{-1})

[EN 838:1995]

3.10
inhalable fraction
mass fraction of total airborne particles which is inhaled through the nose and mouth

[EN 481:1993]

3.11
length of stain detector tube (in the following called “detector tube”)
glass tube containing chemical reagents in which a colour change can be produced when a sample of the atmosphere is drawn through it

NOTE The length of stain, relative to a graduated scale, provides a measure of the concentration of the specified chemical agent in air.

3.12
limit value (LV)
reference figure for the concentration of a chemical or biological agent in air

[EN 1540:1998]

3.13
measuring procedure
procedure for sampling and analysing one or more chemical or biological agents in the air and including storage and transportation of the sample

[EN 1540:1998]

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[1]) ppm is volume fraction, (ϕ)=10^{-6}.

3.14
overall uncertainty (OU) (of a measuring procedure or of an instrument)
quantity used to characterise as a whole the uncertainty of the result given by an apparatus or a measuring procedure. It is expressed, as a percentage, by a combination of bias and precision usually according to the formula:

$$\frac{\left|\bar{x} - x_{ref}\right| + 2s}{x_{ref}} \qquad (1)$$

where

$\bar{x}$ is the mean value of results of a number (n) of repeated measurements;

x_{ref} is the true or accepted reference value of concentration;

s is the standard deviation of measurements.

[EN 1540:1998]

3.15
particle/ vapour mixture
aerosol consisting of airborne particles and vapour

[ENV 13936:2001]

3.16
precision
the closeness of agreement between independent test results obtained under stipulated conditions

[ISO 3534-1:1993]

3.17
pumped sampler
device which is capable of taking samples of gases, vapours or particulates from the atmosphere and consisting of a sampling medium, such as a sorbent tube or filter, and an air sampling pump

3.18
respirable fraction
mass fraction of inhaled particles penetrating to the inciliated airways

[EN 481:1993]

3.19
selectivity
degree of independence from interferents

[EN 482:1994]

3.20
sorbent tube
tube, usually made of metal or glass, containing an active sorbent or reagent-impregnated support, through which sampled atmosphere is passed at a rate controlled by an air sampling pump

[EN 1076:1997]

3.21
specified measuring range
set of values of the concentration for which the overall uncertainty of a measurement procedure is intended to lie within specified limits

[EN 482:1994]

3.22
suspended matter
particles that remain airborne long enough to be detected by any physical means

[EN 1540:1998]

3.23
total airborne particles
all particles surrounded by air in a given volume of air

[EN 481:1993]

3.24
true value
value which characterises a quantity perfectly defined in the conditions which exist when that quantity is considered (or is the subject of a determination)

[ISO 3534-1:1993]

NOTE It is an ideal value which could be arrived at only if all causes of measurement error were eliminated and the population was infinite.

4 Measurement objectives and strategy

4.1 General

There are an extensive number of industrial processes and chemical and/or biological agents. An individual manufacturing stage can apply a number of conditions and a number of job functions can be necessary, each of which can result in different exposure conditions. Distance from an emission source and physical parameters (release rate, environmental conditions, ventilation) can also have a significant influence. Rapid fluctuations in concentration or large variations over small distances are commonplace; therefore the siting, timing and duration of sampling or direct measurement are of great importance.

A workplace monitoring strategy will involve various measuring procedures. The European Committee for Standardization (CEN), has introduced two standards dealing with "assessment of workers exposure". The first, EN 689, gives guidance for the assessment of workers exposure to chemical agents in workplace atmospheres including measurement strategy. The second, EN 482, specifies general performance requirements for procedures for determining the concentration of chemical agents in workplace atmospheres. The following clauses give a brief outline of the content of these two European Standards.

4.2 EN 689

4.2.1 General

The workers exposure assessment is based on an occupational exposure assessment and, if necessary, periodic measurements to check that the exposure conditions are unchanged. If the conditions are changed, a re-assessment is necessary.

4.2.2 Occupational exposure assessment

The occupational exposure assessment is used to identify potential exposure situations and assess the level of exposure through a sequence of stages with increasing sophistication (initial appraisal, basic survey, detailed survey). The assessment can be concluded at any stage. If a conclusion cannot be reached, the next stage of the assessment is undertaken.

The initial appraisal will indicate the likelihood of exposure. It is based on the list of chemical agents that are likely to be present in the workplace atmospheres and on several workplace factors likely to have an influence on the exposure level (e. g. tasks, work pattern and techniques, ventilation, emission sources). If the initial appraisal shows that the presence of an agent in the air at the workplace cannot for certain be ruled out, this agent needs to

be considered in the next stage. In practice this means that if an agent is introduced in the factory even as an impurity or is produced in the factory even as a side product or waste, it has to be considered in the basic survey.

The basic survey provides quantitative information about exposure. This information is based on earlier measurements, measurements from comparable installations or reliable calculations on relevant quantitative data. If the information obtained is insufficient to enable valid comparison to be made with the limit value, it has to be supplemented by workplace measurements. If the basic survey shows that the exposure is above the limit value, EN 689 requires that immediate action be taken to remedy the situation and a new assessment be conducted. If the basic survey shows that the exposure is well below the limit value and is expected to remain so on a long term basis taking in account the stability of conditions at the workplace and the arrangement of the workplace process, the assessment procedure may be stopped. In EN 689 no figure is associated with the concept 'well below the limit value'.

NOTE What is considered as “well below limit value” can be regulated by national law, but it is generally admitted that it concerns time weighted average concentrations less than 0,1 LV.

The detailed survey will provide validated and reliable information on exposure when the exposure is close to the limit value. The information is based on workplace measurements and will lead to the conclusion of the occupational exposure assessment.

According to EN 689 the occupational exposure assessment phase will be concluded with one of the three actions listed below:

a) When the exposure exceeds the limit value, control measure are taken to reduce the exposure and the exposure re-assessed.

b) When the exposure is well below the limit value, a re-assessment of the exposure level will be done at periodic intervals. The time interval between assessments will depend on how long the exposure level is likely to remain low.

c) When the exposure is between a) and b), a periodic measurement scheme should be established to monitor the exposure level.

4.2.3 Periodic measurements

The emphasis of periodic measurement is on longer term objectives such as checking that control measures remain effective. Information is likely to be obtained on trends or changes in pattern of exposure so that action can be taken before excessive exposure occurs. In this respect it is important to use a measurement method and strategy that makes it possible to detect trends at a sufficiently early stage.

4.2.4 Reassessment

At any time during the assessment and monitoring process, changes in the process or control measures could have a major impact on the exposure level. Therefore, such changes will require a re-assessment of the exposure.

4.2.5 Measurement strategy

The measurement strategy described is based on an approach which enables the efficient use of resources.

The measurement strategy gives instructions on the selection of the measurement task and procedure, the selection of the workers for the exposure measurements, the selection of the measurement conditions and patterns and gives some examples of data treatment.

EN 689 refers to the basic measurement tasks described in EN 482.

4.3 EN 482

4.3.1 The general requirements referred to in EN 482 apply to all measuring procedures, irrespective of the chemical nature or physical form of the agent, and irrespective of the sampling method or analytical method used. EN 482 is applicable to measuring procedures with separate sampling and analysis stages and to direct reading instruments. The performance requirements include unambiguity, selectivity and overall uncertainty (a combination of bias and precision) for minimum specified measuring ranges and averaging times. EN 482 is a basis for forthcoming standards for specific procedures and devices for workplace measurements (see clauses 5 and 6).

4.3.2 Five basic measurement tasks have been defined in the standard. These are:

a) Screening measurements of time weighted average concentration to provide relatively crude quantitative information on the exposure level in order to determine whether an exposure problem exists at all. These measurements can also be used to determine if the exposure is well below or well above the limit values.

b) Screening measurements of variation of concentration in time and/or space to provide information of the likely pattern of exposure and to identify locations and periods of "high" exposure. They can also be used to set the duration and frequency of sampling for measurements for comparison with limit values.

c) Measurements near an emission source to provide information on the location and the intensity of the source. In association with other information they can allow the elimination of a suspected source as a significant contributor to exposure.

d) Measurements for comparison with limit value to provide accurate and reliable information on the time-weighted average concentration of a specific agent in the air which can be inhaled.

e) Periodic measurements to check if the exposure conditions have changed since the last comparison with limit values, or whether the control measure remain effective.

4.3.3 EN 482:1994, annex A gives a list of measurement task referred to in EN 689 and involving a combination of the basic measurement tasks:

a) Worst case measurements

Screening measurements in time and space can clearly identify episodes where higher exposure occur, e.g. high emissions due to certain work activities. Sampling periods can be selected containing these episodes. This approach is called worst case sampling. Subsequently, monitoring can be required either as a screening measurement of time-weighted average concentration or for comparison with limit values.

This approach can allow a low cost exposure assessment when the results of a few worst case measurements are still below the limit value.

b) Fixed point measurements

Fixed point measurements can be used for comparison with limit values if the results are representative for the exposure concentration. In other uses, the initial measurement task is the same as for emission sources and any subsequent monitoring will be a screening measurement of time-weighted average concentration or a periodic measurement.

c) Short term peak measurements

Screening measurements of variation in time can find short term peaks. These measurements can be followed by screening measurements of time- weighted average concentration. Where the measurements are exposure concentration, these can be compared with limit values. Short term limit values can be important in these cases.

4.4 Other tasks

In addition, measuring procedures and devices can be used for other measurements tasks not included in EN 482 or EN 689. These include: