



# SLOVENSKI STANDARD

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### Izpostavljenost na delovnem mestu - Splošne zahteve za izvajanje meritev kemičnih agensov

Workplace exposure - General requirements for the performance of procedures for the measurement of chemical agents

Exposition am Arbeitsplatz - Allgemeine Anforderungen an die Leistungsfähigkeit von Verfahren zur Messung chemischer Arbeitsstoffe

Exposition sur les lieux de travail - Exigences générales concernant les performances des procédures de mesurage des agents chimiques

Ta slovenski standard je istoveten z: **EN 482:2012**

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EUROPEAN STANDARD

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## Workplace exposure - General requirements for the performance of procedures for the measurement of chemical agents

Exposition sur les lieux de travail - Exigences générales concernant les performances des procédures de mesure des agents chimiques

Exposition am Arbeitsplatz - Allgemeine Anforderungen an die Leistungsfähigkeit von Verfahren zur Messung chemischer Arbeitsstoffe

This European Standard was approved by CEN on 9 March 2012.

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## Contents

	Page
Foreword.....	3
Introduction .....	4
<b>1 Scope .....</b>	<b>5</b>
<b>2 Normative references .....</b>	<b>5</b>
<b>3 Terms and definitions .....</b>	<b>6</b>
<b>4 Classification.....</b>	<b>6</b>
4.1 General.....	6
4.2 Screening measurements of time weighted average concentration.....	6
4.3 Screening measurements of variation of concentration in time and/or space .....	6
4.4 Measurements for comparison with (occupational exposure) limit values and periodic measurements.....	6
<b>5 Performance requirements .....</b>	<b>6</b>
5.1 General.....	6
5.2 Screening measurements of time weighted average concentration.....	7
5.3 Screening measurements of variation of concentration in time and/or space .....	7
5.4 Measurements for comparison with limit values and periodic measurements .....	7
5.4.1 Unambiguity .....	7
5.4.2 Selectivity .....	7
5.4.3 Averaging time .....	7
5.4.4 Measuring range .....	7
5.4.5 Expanded uncertainty .....	8
5.5 Composite procedures.....	8
5.6 Transport and storage.....	8
5.7 Environmental conditions.....	8
5.8 Description of measuring procedure.....	9
5.9 Dimension of result .....	9
5.10 Additional requirements .....	9
<b>6 Test method.....</b>	<b>9</b>
<b>7 Validation report .....</b>	<b>10</b>
<b>Annex A (informative) Structure of a method description .....</b>	<b>11</b>
<b>Annex B (informative) Calculation of uncertainty of measurement.....</b>	<b>12</b>
B.1 General.....	12
B.2 Uncertainty associated with sampled air volume or mass uptake.....	13
B.3 Uncertainty associated with sampling efficiency.....	15
B.4 Uncertainty associated with sample storage and transportation.....	17
B.5 Uncertainty associated with method recovery for gases and vapours .....	17
B.6 Uncertainty associated with analytical recovery for airborne particles and mixtures of airborne particles and vapour .....	17
B.7 Uncertainty associated with method variability for gases and vapours.....	18
B.8 Uncertainty associated with analytical variability for airborne particles and mixtures of airborne particles and vapour .....	18
B.9 General equation for combination of uncertainty components.....	18
Bibliography.....	20

## Foreword

This document (EN 482:2012) 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 October 2012, and conflicting national standards shall be withdrawn at the latest by October 2012.

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 482:2006.

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

- a) The terms and definitions given in the previous edition have been replaced by a normative reference to EN 1540:2011.
- b) The maximum expanded uncertainty for mixtures of airborne particles and vapour has been changed from 30 % to 50 %, for concentration measurements between 0,5 times and 2 times the limit value.
- c) The former Annex A, regarding measurement categories described in EN 689 and involving a combination of measurement tasks, has been deleted.
- d) The former Annex C (now Annex B) has been revised to remove information already given in EN 838, EN 1076 and EN 13890.

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, Croatia, 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, Turkey and the United Kingdom.

## Introduction

National laws and regulations based on European Directives require the assessment of the potential exposure of a worker to chemical agents in workplace atmospheres. One way of assessing such exposure is to measure the concentration of a chemical agent in the air in the worker's breathing zone. The procedures used for such measurements should give reliable and valid results, so that when compared with set occupational exposure limit values, a correct decision can be made, for instance, as to whether the exposure level is acceptable or control measures need to be applied.

Because of their importance in the process of exposure assessment, it is required that the measurement procedures fulfil some general requirements which are given in this document. Specific European Standards have been prepared for different types of measuring procedures and measuring devices. These include European Standards for dust samplers (EN 13205), diffusive samplers (EN 838), pumped samplers (EN 1076), detector tubes (EN 1231), sampling pumps (EN 1232 and EN 12919), metals and metalloids (EN 13890), mixtures of airborne particles and vapour (ENV 13936<sup>1)</sup>) and direct reading instruments (EN 45544 (all parts)). In these specific European Standards, additional requirements have been included for the procedure or device in question, so that the general requirements of this document are not compromised. Where no specific European Standard exists, only the general requirements apply.

Performance requirements are given in this document for unambiguity, selectivity, averaging time, measuring range and expanded uncertainty for minimum specified measuring ranges. These requirements are intended to apply under environmental conditions present at the workplace. However, because a wide range of environmental conditions are encountered in practice, this document specifies requirements that have to be fulfilled by measuring procedures when tested under prescribed laboratory conditions.

It is the user's responsibility to choose the appropriate procedures or devices that meet the requirements of this document. One way of doing this is to obtain information or confirmation from the provider of a procedure or the manufacturer of a device. Type-testing or, more generally, assessment of the performance of procedures or devices, can be undertaken by the manufacturer, user, test house or research and development laboratory, as is most appropriate. A number of existing procedures for workplace measurements have either been tested over a part of the required minimum measuring range, but not over the entire range, or have not been tested for all environmental influences and potential interferences. If these partially validated procedures meet the performance requirements of this European Standard, they can be used at present. Nevertheless these procedures should be tested over the full ranges as soon as is reasonably practicable. If there is no measuring procedure for a chemical agent which meets the requirements of this document, a procedure should be used whose performance is closest to the specified requirements.

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1) A new edition of ENV 13936 is currently being elaborated and is foreseen to be published as EN 13936.

## 1 Scope

This European Standard specifies general performance requirements for procedures for the determination of the concentration of chemical agents in workplace atmospheres as required by the Chemical Agents Directive 98/24/EC (see reference [7]). These requirements apply to all measuring procedures, irrespective of the physical form of the chemical agent (gas, vapour, airborne particles), the sampling method and the analytical method used.

This European Standard is applicable to

- all steps of a measuring procedure,
- measuring procedures with separate sampling and analysis steps, and
- direct-reading devices.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 481, *Workplace atmospheres — Size fraction definitions for measurement of airborne particles*

EN 838, *Workplace exposure — Procedures for measuring gases and vapours using diffusive samplers — Requirements and test methods*

EN 1076, *Workplace exposure — Procedures for measuring gases and vapours using pumped samplers — Requirements and test methods*

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

EN 1232:1997<sup>2)</sup>, *Workplace atmospheres — Pumps for personal sampling of chemical agents — Requirements and test methods*

EN 1540, *Workplace exposure — Terminology*

EN 12919:1999<sup>2)</sup>, *Workplace atmospheres — Pumps for the sampling of chemical agents with a volume flow rate of over 5 l/min — Requirements and test methods*

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

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

EN 45544 (all parts), *Workplace atmospheres — Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours*

ISO 78-2, *Chemistry — Layouts for standards — Part 2: Methods of chemical analysis*

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2) A European Standard, EN ISO 13137, is being elaborated and is foreseen to replace this document.

**EN 482:2012 (E)****3 Terms and definitions**

For the purposes of this document, the terms and definitions given in EN 1540 apply.

**4 Classification****4.1 General**

In this document, measurements are classified according to their purpose. These classifications are based upon the measurement strategy laid down in EN 689.

**4.2 Screening measurements of time weighted average concentration**

Screening measurements of time weighted average concentration are performed to obtain relatively crude quantitative information on exposure levels. Such information is used to identify potential health hazards, and to estimate the risk to health based on the likely severity of harm and the probability of its occurrence. These measurements can also determine if the exposure is significantly below or significantly above the (occupational exposure) limit value.

**4.3 Screening measurements of variation of concentration in time and/or space**

Screening measurements of variation of concentration in time and/or space are used to:

- a) provide information on the likely pattern of the concentration of chemical agents in the air,
- b) identify locations and periods of elevated exposure,
- c) provide information on the location and intensity of emission sources, and
- d) estimate the effectiveness of ventilation or other technical measures.

**4.4 Measurements for comparison with (occupational exposure) limit values and periodic measurements**

Measurements for comparison with (occupational exposure) limit values are used to obtain results of known uncertainty for the average concentration of a chemical agent in the air in a worker's breathing zone.

Periodic measurements are used to determine whether exposure conditions have changed since the measurements for comparison with limit values were performed, or whether control measures remain effective.

NOTE Since the composition of the workplace atmosphere will have been investigated during the initial occupational exposure assessment, it might be appropriate for periodic measurements to use procedures with lower selectivity.

**5 Performance requirements****5.1 General**

Performance requirements for measuring procedures depend on the purpose for which they are used. The performance requirements for screening measurements are less stringent than for measurements for the comparison with limit values and periodic measurements. Therefore, the performance requirements for screening measurements in 5.2 and 5.3 are only given in general terms.



## 5.2 Screening measurements of time weighted average concentration

The measurement procedures shall have:

- a) adequate selectivity for the chemical agent (see 4.2),
- b) averaging time less than or equal to the limit value reference period,
- c) measuring range that includes the limit value, and
- d) expanded uncertainty that is fit for purpose (see 4.2).

## 5.3 Screening measurements of variation of concentration in time and/or space

The measuring procedures shall have:

- a) adequate selectivity for the chemical agent (see 4.3),
- b) short averaging time (for variation of concentration in time  $\leq 5$  min; for variation of concentration in space  $\leq 15$  min),
- c) measuring range that is fit for purpose (see 4.3), and
- d) expanded uncertainty that is fit for purpose (see 4.3).

## 5.4 Measurements for comparison with limit values and periodic measurements

### 5.4.1 Unambiguity

A measuring procedure shall produce an unambiguous result for the concentration of the chemical agent being measured in the specified measuring range, i.e. an analytically determined value shall correspond to one concentration only.

### 5.4.2 Selectivity

The measuring procedure shall contain appropriate information about the nature and magnitude of any interference.

**NOTE** Selectivity requirements vary from case to case, depending on what is known in advance about the workplace air. If the identity of all contaminants present is not known in advance then the measuring procedure will need to have a high selectivity. If the identity of all contaminants is known prior to measurement and there are no interferents present, then it might be possible to use a measurement procedure with a low selectivity.

Procedures for measuring chemical agents present as airborne particles shall prescribe a method for sampling the particle size fraction, as defined in EN 481, for which the limit value for the chemical agent is set.

If different limit values are set for different species of a chemical agent, then the measuring procedure shall determine the individual species concerned.

### 5.4.3 Averaging time

The averaging time is equal to the sampling time, which shall be less than or equal to the limit value reference period.

### 5.4.4 Measuring range

The measuring range of the procedure or instrument shall cover at least the concentrations from 0,1 times to 2

**EN 482:2012 (E)**

times the limit value for long-term measurements, and from 0,5 times to 2 times the limit value for short-term measurements.

NOTE For limit values see reference [8].

**5.4.5 Expanded uncertainty**

The requirements for expanded uncertainty are given in Table 1.

**Table 1 — Expanded uncertainty requirements for measurements for comparison with limit values and periodic measurements**

reference period	measuring range	relative expanded uncertainty	relative expanded uncertainty (mixtures of airborne particles and vapour)
short-term (e.g. 15 min)	0,5 times to 2 times limit value	≤ 50 %	≤ 50 %
long-term	0,1 times to < 0,5 times limit value	≤ 50 %	≤ 50 %
long-term	0,5 times to 2 times limit value	≤ 30 %	≤ 50 %

NOTE Variation of exposure to chemical agents in the workplace can be significantly greater than indicated by the uncertainty of a single measurement calculated according to this European Standard. This is due to the temporal and spatial variability of workplace exposure.

**5.5 Composite procedures**

SIST EN 482:2012

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The performance requirements detailed in 5.2, 5.3 and 5.4 shall be fulfilled for the whole measuring procedure even if the measuring procedure consists of several distinct steps, e.g. sampling, transport and storage, sample preparation and analysis. In the latter case, each step of the measuring procedure may be tested individually as an alternative to testing the measuring procedure as a whole.

**5.6 Transport and storage**

Transport and storage of samples, if appropriate, shall be carried out in such a way that the physical and chemical integrity is maintained between sampling and analysis.

**5.7 Environmental conditions**

The effect of environmental conditions (e.g. temperature, humidity, pressure) on the performance of the method shall be tested in the laboratory. Performance requirements concerning unambiguity, selectivity, expanded uncertainty, minimum measuring range and averaging time shall be fulfilled under the conditions likely to be encountered in the workplace.

NOTE It is not practicable to carry out a comprehensive evaluation of environmental influences in the field and therefore laboratory tests are specified in this document. However, field tests can provide valuable information on the performance of measurement methods.

The range of environmental conditions under which the performance requirements of 5.2 to 5.5 are fulfilled shall be specified in the measuring procedure.

## 5.8 Description of measuring procedure

The measuring procedure shall be documented in accordance with ISO 78-2.

An example for the structure of a method description is given in Annex A.

The description shall contain all necessary information to perform the measuring procedure, including information about the attainable expanded uncertainty, measuring range, averaging time, interferences and environmental or other conditions that can influence the performance of the measuring procedure.

If correction factors are applied, e.g. for a known and explainable bias due to environmental influences, these shall be justified in the measuring procedure.

## 5.9 Dimension of result

The final measurement result shall be expressed in the same units as those of the limit value. This can be achieved directly or by means of a suitable conversion.

This requirement is not obligatory for screening measurements of the variation of concentration in time and/or space.

## 5.10 Additional requirements

In addition to the requirements given in 5.2 to 5.9, further requirements specified in EN 838, EN 1076, EN 1231, EN 1232, EN 12919, EN 13205, EN 13890 and EN 45544 (all parts) shall be met for particular types of measuring procedures and devices, as appropriate. See also ENV 13936.

## 6 Test method

**6.1** Estimate the expanded uncertainty of results obtained using the measuring procedure by carrying out the tests prescribed in the relevant European Standard(s) specific to the type of procedure or device concerned, as listed in Clause 2. Carry out measurements at the lower and upper ends of the measuring range specified in Table 1, and for at least one intermediate concentration. Prepare at least six replicate samples for each set of tests and analyse the samples under repeatability conditions.

Calculate the expanded uncertainty, expressed as a percentage, according to the following procedure (see e.g. references [9], [10], [11] and ENV 13005):

- a) specify the measurand;
- b) identify all possible sources of uncertainty;
- c) quantify the random sampling uncertainty  $u_{s_r}$  and non-random sampling uncertainty  $u_{s_{nr}}$  ;
- d) quantify the random analytical uncertainty  $u_{a_r}$  and non-random analytical uncertainty  $u_{a_{nr}}$  ;
- e) calculate the combined random standard uncertainty  $u_{c_r}$  according to Formula (1) and the combined non-random standard uncertainty  $u_{c_{nr}}$  according to Formula (2):

$$u_{c_r} = \sqrt{u_{s_r}^2 + u_{a_r}^2} \quad (1)$$