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Izpostavljenost na delovnem mestu - Postopki za določevanje koncentracije kemičnih agensov - Osnovne zahtevane lastnosti

Workplace exposure - Procedures for the determination of the concentration of chemical agents - Basic performance requirements

Exposition am Arbeitsplatz - Verfahren zur Bestimmung der Konzentration von chemischen Arbeitsstoffen - Grundlegende Anforderungen an die Leistungsfähigkeit

Exposition sur les lieux de travail - Procédures pour déterminer la concentration d'agents chimiques - Exigences élémentaires relatives aux performances

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EUROPEAN STANDARD

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English Version

Workplace exposure - Procedures for the determination of the concentration of chemical agents - Basic performance requirements

Exposition sur les lieux de travail - Procédures pour déterminer la concentration d'agents chimiques - Exigences élémentaires relatives aux performances

Exposition am Arbeitsplatz - Verfahren zur Bestimmung der Konzentration von chemischen Arbeitsstoffen - Grundlegende Anforderungen an die Leistungsfähigkeit

This European Standard was approved by CEN on 8 February 2021.

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European foreword

This document (EN 482:2021) 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 document corresponds to ISO 20581:2016, published by the International Organization for Standardization (ISO) which contains a modified version of EN 482:2012+A1:2015.

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of an identical text or by endorsement, at the latest by September 2021, and conflicting national standards shall be withdrawn at the latest by September 2021.

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

This document supersedes EN 482:2012+A1:2015.

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

- a) standard title adapted to the wording used in the scope;
- b) 4.4, which comprised two subclauses, was revised;
- c) recommendation regarding exposure peaks inserted in 5.4.4;
- d) 5.4.7 reformulated to improve comprehensibility;
- e) new Table 2 with additional requirements for the testing parameters added to 5.10;
- f) Annex A specified more in detail;
- g) new subclause B.9 for blank subtraction added.

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

EN 482:2021 (E)**Introduction**

National laws and regulations require the assessment of the 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 provide reliable and valid results for the comparison purpose of exposure measurements with occupational exposure limit values (OELVs) and for the provision of acceptable control strategies.

This document introduces basic requirements to fulfil the measurement procedures in the process of quantitative exposure assessment. Specific European Standards and International Standards have been prepared for different types of measuring procedures and measuring devices. These include standards for airborne particle samplers (EN 13205, all parts), diffusive samplers (EN 838 and ISO 16107), pumped samplers (EN ISO 22065), short-term detector tubes (EN ISO 17621), personal sampling pumps (EN ISO 13137), metals and metalloids in airborne particles (EN ISO 21832), mixtures of airborne particles and vapour (EN 13936) and direct-reading instruments for toxic gases and vapours (EN 45544, all parts). In these specific documents, additional requirements have been included for the procedure or device in question, so that the basic requirements of this document are not compromised. Where no specific European Standard and/or International Standard exist, only the basic requirements apply.

Performance requirements given in this document 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, testing 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 document, they can be used at present. Nevertheless, these procedures should be tested over the full ranges as soon as is reasonably practicable.

1 Scope

This document specifies basic 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 [13]. These requirements apply to all steps of measuring procedures regardless of the physical form of the chemical agent (gas, vapour, airborne particles), measuring procedures with separate sampling and analytical methods, and direct-reading instruments.

This document specifies requirements that are fulfilled by measuring procedures when tested under prescribed laboratory conditions due to a wide range of environmental conditions encountered in practice.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 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 1540, *Workplace exposure - Terminology*

EN 13205 (all parts), *Workplace exposure - Assessment of sampler performance for measurement of airborne particle concentrations*

EN 13936, *Workplace exposure - Procedures for measuring a chemical agent present as a mixture of airborne particles and vapour - 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*

EN ISO 13137, *Workplace atmospheres - Pumps for personal sampling of chemical and biological agents - Requirements and test methods (ISO 13137)*

EN ISO 17621, *Workplace atmospheres - Short term detector tube measurement systems - Requirements and test methods (ISO 17621)*

EN ISO 21832, *Workplace air - Metals and metalloids in airborne particles - Requirements for evaluation of measuring procedures (ISO 21832)*

EN ISO 22065, *Workplace air - Gases and vapours - Requirements for evaluation of measuring procedures using pumped samplers (ISO 22065)*

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

ISO 16107, *Workplace atmospheres - Protocol for evaluating the performance of diffusive samplers*

EN 482:2021 (E)**3 Terms and definitions**

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

4 Classification**4.1 General**

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

4.2 Screening measurements of time-weighted average concentration

Screening measurements of time-weighted average concentration are performed to obtain semiquantitative 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 above the OELV. Apparatus intended for detection and concentration measurements of chemical agents, that meet the requirements of this document and is capable of reporting the time weighted average, can be used.

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 provide information on the likely pattern of the concentration of chemical agents in the air and to identify locations and periods of elevated exposure. The screening measurements also provide information on the location and intensity of emission sources and to estimate the effectiveness of ventilation or other technical measures. Apparatus intended for detection and concentration measurements of chemical agents, that meet the requirements of this document, can be used.

4.4 Measurements for comparison with OELVs

Provided the method meets established acceptable uncertainty criteria, measurements can be made for comparison with OELVs. Measurements can be taken to determine whether a worker's exposure exceeds the OELV initially and repeated after any significant change in working conditions, industrial process, products or chemicals or OELV.

4.5 Periodic measurements

Periodic measurements are used to determine whether exposure conditions have changed since the measurements for comparison with OELVs were performed, or whether control measures remain effective. The interval between measurements should be established based on the initial occupational exposure assessment or subsequent amendments to it.

NOTE Since the composition of the workplace atmosphere will have been investigated during the initial occupational exposure assessment and the composition is known not to vary over time, it can 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 purpose of these measurements is described in 4.2. The measuring procedures shall include the following:

- a) adequate selectivity for the chemical agent;
- 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.

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

The purpose of these measurements is described in 4.3. The measuring procedures shall include the following:

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

5.4 Measurements for comparison with limit values and periodic measurements

5.4.1 General

A measuring procedure for a given limit value which meets the requirements given in 5.4.2 to 5.4.6 is called compliant method.

5.4.2 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 within a known uncertainty.

5.4.3 Selectivity

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

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Requirements on selectivity 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 shall have a high selectivity. If the identity of all contaminants is known prior to measurement and there are no interferences present, then a measuring procedure with a low selectivity can be used.

Where a particle size fraction, as defined in EN 481, is specified for an OELV, procedures for measuring chemical agents present as airborne particles shall prescribe a method for sampling the specified particle size fraction.

NOTE In addition to samplers meeting the requirements of EN 481, there are samplers which themselves define the sample (see EN 13205 series).

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

5.4.4 Averaging time

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

NOTE A full shift average concentration, typically the 8 h time-weighted concentration, gives a representative description of the occupational exposure situation.

Exposure peaks that can occur systematically or randomly during the shift should fulfil the short-term exposure limit conditions (see 5.4.6), if any.

5.4.5 Measuring range

The measuring range of the procedure listed in Table 1 shall cover at least the concentrations from 0,1 times to 2 times the limit value for long-term measurements, and from 0,5 times to 2 times the limit value for short-term measurements.

NOTE Reference [9] provides a list of International limit values for chemical agents (Occupational exposure limits, OELs).

5.4.6 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 (for example, 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 document. This is due to the temporal and spatial variability of workplace exposure.

5.4.7 Chemical agents where compliant methods are not available

Limit values are determined by authorities independently from those developing measuring procedures. If a measuring procedure is not available for a given limit value which meets the requirements given in 5.4.5 and 5.4.6 a measuring procedure should be used whose performance is closest to the requirements. The method employed should clearly state its limitations when measuring at the exposure limit.

5.5 Composite procedures

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, for example, preparation of equipment, sampling, transport and storage, sample preparation and analysis. Each step of the measuring procedure may be tested individually and can be combined as a whole.

5.6 Transport, handling and/or storage

Transport, handling and/or 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 (for example, temperature, humidity, atmospheric pressure, and/or air speed) 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 Due to the time, cost, and effort involved, 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 (for example, interferences from nearby workplaces).

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. Any clause or subclause which is unnecessary in a particular case may be omitted, and others, if required, may be added in the most appropriate places. 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, for example, for a known and explainable bias due to environmental influences, these shall be justified in the measuring procedure.

NOTE An example for the structure of a method description based on ISO 78-2 is given in Annex A.

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.