SLOVENSKI STANDARD
SIST EN 13936:2014

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Izpostavljenost na delovnem mestu - Postopki merjenja kemičnih agensov, prisotnih kot zmesi lebdečih delcev in par - Zahteve in preskusne metode

Workplace exposure - Procedures for measuring a chemical agent present as a mixture of airborne particles and vapour - Requirements and test methods

Exposition am Arbeitsplatz - Messung eines als Mischung aus luftgetragenen Partikeln und Dampf vorliegenden chemischen Arbeitsstoffes - Anforderungen und Prüfverfahren

Exposition sur les lieux de travail - Mesurage de l'agent chimique sous forme de mélange de particules aériennes et de vapeur - Exigences et méthodes d'essai

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Workplace exposure - Procedures for measuring a chemical agent present as a mixture of airborne particles and vapour - Requirements and test methods

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 13936:2014) 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of an identical text or by endorsement, at the latest by July 2014, and conflicting national standards shall be withdrawn at the latest by July 2014.

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Introduction

EN 482 specifies general requirements for the performance of procedures that methods for the measurement of the concentration of chemical agents in workplace atmospheres should meet. These performance criteria include maximum values of expanded uncertainty achievable under prescribed laboratory conditions for the methods to be used. Chemical agents in workplace air are often present in both gaseous and non-gaseous phases at the same time and therefore validated methods are required that can measure the combined concentration of the chemical agent in both phases. Examples include: processes that generate aerosols of volatile or semi-volatile liquids or solids such a paint spraying, metalworking with coolants and lubricants, acid pickling etc. and hot processes which generate vapours of chemical agents that are normally in the liquid or solid phase under ambient conditions, e.g. road surfacing with bitumen.

For health-related sampling of mixed-phase aerosols, it is necessary to measure the mass concentration of the inhalable fraction of hazardous chemical agents, regardless of whether they are present as airborne particles or vapour. This generally means drawing air through two or more collection media in series. If a chemical agent is collected in the form of airborne particles and it has a significant vapour pressure under ambient conditions, it will wholly or partly volatilise during sampling. Subsequently the resulting vapour needs to be collected so that the total mass of the chemical agent can be measured; the chemical agent can also be lost from the collected airborne particles after sampling if it is not stabilised.

In some cases, it might also be necessary to measure the distribution of chemical agents between the particulate and vapour phases as well as the mass concentration of the inhalable fraction. For example, there can be compounds whose toxicology is known to differ significantly depending on whether they exist as airborne particles or vapour. In addition, control measures in the workplace can depend on which phase dominates. Exposure limits can be phase-specific. However, the separate quantification of airborne particles and vapour is technically complex and subject to error using existing sampling technologies. For this reason, this European Standard is not applicable to methods that differentiate between the sampled airborne particles and vapour.

1 Scope

This European Standard specifies performance requirements and test methods for the evaluation of procedures for measuring a chemical agent present as a mixture of airborne particles and vapour in workplace air.

This European Standard establishes general principles to enable developers and users of mixed-phase samplers and methods to adopt a consistent approach to method validation and provides a framework for the assessment of method performance in accordance with EN 482.

Annex A of this European Standard gives guidance on possible approaches to sample mixtures of airborne particles and vapour and Annex B gives information about their physical behaviour.

This European Standard is not applicable to methods that differentiate between the sampled airborne particles and vapour.

This European Standard is not applicable to a chemical agent present in different chemical and physical forms (for example, mercury in the form of Hg (0) and Hg (II)).

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

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

EN 1540:2011, *Workplace exposure - Terminology*

prEN 13205-1[1], *Workplace exposure — Assessment of sampler performance for measurement of airborne particle concentrations — Part 1: General requirements*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1540:2011 and the following apply.

3.1
single component aerosol
aerosol in which the airborne particles and vapour are composed of the same chemical agent

1) To be published.

3.2
multiple component aerosol
aerosol containing more than one chemical agent, each of which can be present in the form of airborne particles and/or vapour

3.3
vapour sampler
pumped sampler or diffusive sampler that is used to collect vapour

4 Requirements

4.1 General

Regardless of the combination of samplers used, the measurement procedure used shall comply with the requirements of EN 482 and with the requirements of EN 1076, EN ISO 13137, prEN 13205-1 and EN 13890, as appropriate.

It is the responsibility of the manufacturer or of those who assemble mixed-phase samplers to ensure that the method complies with the requirements for expanded uncertainty under the specified laboratory conditions given in this document, including the environmental influences that can be expected to affect performance.

4.2 Sampler requirements

Measurement procedures shall specify the use of a mixed-phase sampler designed to collect the inhalable fraction of airborne particles, as defined in EN 481, and vapours. The sampler shall comply with prEN 13205-1 and with the performance requirements for pumped samplers prescribed in EN 1076.

The back pressure of the mixed-phase sampler shall not exceed the maximum values specified in EN ISO 13137.

A mixed-phase sampler may comprise of an inhalable sampler in combination with one or more vapour samplers. In such circumstances, the dead volume of the sampling train shall be kept to a minimum and any connection shall be made of an inert material that does not retain the chemical agent of interest.

NOTE When a mixed-phase sampler comprises a vapour sampler in combination with an inhalable sampler and there are flow rate compatibility issues, it is possible to split the air flow from the inhalable sampler through more than one vapour sampler.

4.3 Pumps

Measurement procedures shall specify the use of pumps complying with EN ISO 13137.

4.4 Measurement procedure requirements for mixtures of airborne particles and vapour

4.4.1 Storage test

When tested in accordance with the procedure prescribed in 5.3, the mean analytical recovery after storage shall be at least 90 %.

4.4.2 Expanded uncertainty

The expanded uncertainty of the measurement procedure as a whole, including the measurement of airborne particles and vapour, shall comply with the requirements of EN 482.

4.4.3 Method description

The method description shall contain at least the following information:

a) a general description of the principles of the method, the approach followed to sample mixtures of airborne particles and vapour and any relevant assumptions;

b) a detailed description and identification of the system components, including all collection substrates and, for commercial devices, the name of the manufacturer(s) and the product identification(s);

c) if applicable, the recommended shelf life of the collection substrate(s);

d) the design flow rate and the pressure drop across the mixed-phase sampler at the design flow rate;

e) the recommended sampling time and, if applicable, the sampler capacity for a specific analyte;

f) methods for handling, transport and storage of samples, including storage times;

g) information on analytical methods to be applied and instructions as to whether and how wall deposits are to be included in the analysis of the collected sample;

h) the recovery efficiency for specific analytes, including the effects of concentration, loading, temperature and humidity, where applicable;

i) any known interference.

5 Test methods

5.1 Sample distribution between the collection substrate for airborne particles and the collection substrate for vapour

5.1.1 Calculate the mass of analyte to be loaded onto the collection substrates in the sample distribution tests for each combination of concentration and time prescribed in Table 1.

Table 1 — Concentration and time used for calculation of mass of analyte

Reference period	Concentration	Time
long-term	0,1 times limit value	8 h or recommended sampling time
	2 times limit value	
short-term	1 time limit value	e.g. 15 min

5.1.2 Perform sample distribution tests under each of the following two combinations of test conditions:

— relative humidity: (50 ± 5) %;

— temperature: (10 ± 2) °C and (40 ± 2) °C;

— flow rate: recommended flow rate.

NOTE One way to obtain air with the required conditions of temperature and relative humidity is to use a climatic test chamber as defined in EN 60068–3–11.

5.1.3 Set up at least six mixed-phase samplers per test and add a known mass of analyte to each collection substrate or, where the mixed-phase sampler includes more than one collection substrate, to each of the first collection substrates. Add the analyte using a micropipette or syringe, if necessary, with the analyte diluted in a non-interfering solvent.

5.1.4 Immediately after adding the analyte, draw air through the mixed-phase samplers under the prescribed test conditions.

5.1.5 Repeat 5.1.3 and 5.1.4 for each of the sample loadings calculated in 5.1.1 and under each of the two combinations of test conditions prescribed in 5.1.2.

5.1.6 Analyse each collection substrate immediately after sampling and, for each sampler, calculate the distribution coefficients for vapour and airborne particles according to Formulae (1) and (2):

$$\gamma_{d,p} = \frac{m_p}{m_v + m_p} \cdot 100 \quad (1)$$

$$\gamma_{d,v} = 100 - \gamma_{d,p} \quad (2)$$

where

$\gamma_{d,p}$ is the distribution coefficient for airborne particles, in percent;

$\gamma_{d,v}$ is the distribution coefficient for vapour, in percent;

m_p is the mass determined on the collection substrate for airborne particles, in milligrams;

m_v is the mass determined on the collection substrate for vapour, in milligrams;

Calculate the mean and the coefficient of variation of the replicate samples.

Consider the distribution coefficients between the collections substrates used:

— if, in all cases, $\gamma_{d,p} < 10$ % the collection substrate for airborne particles does not need to be analysed;

— if, in any case 10 % ≤ $\gamma_{d,p}$ ≤ 90 % the collection substrates for airborne particles and vapour shall be analysed.

— if, in all cases $\gamma_{d,p} > 90$ % only the collection substrate for airborne particles needs to be analysed;

5.2 Compliance with EN 1076

Perform the tests given in EN 1076 using the procedure described in 5.1.3 and 5.1.4 except for the storage test (see 5.3).

If it is not possible to generate a test atmosphere for a mixture of airborne particles and vapour, the best approach is to use the spiking method but with the spike applied to the collection substrate of the inhalable sampler rather than the vapour sampler. The spike should be distributed as even as possible on the collection substrate.

5.3 Storage

Perform storage tests on samples that have been stabilised as prescribed in the sampling method and verify that the analytical recovery determined from the combined results from the collection substrate for airborne particles and the collection substrate for vapour meets the requirements of 4.4.1.

NOTE For a chemical agent present as a mixture of airborne particles and vapour, sampled airborne particles cannot normally be stored without sample loss unless stabilised. See A.4 and B.3.2.