SLOVENSKI STANDARD
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Zrak na delovnem mestu - Sistem za kratkotrajno vzorčenje z detekcijskimi cevkami - Zahteve in preskusne metode

Workplace atmospheres - Short term detector tube measurement systems - Requirements and test methods

Arbeitsplatzatmosphäre - Kurzzeitprüfröhrchen- Meßeinrichtungen - Anforderungen und Prüfverfahren

Air des lieux de travail - Systemes de mesurage par tube détecteur a court terme - Exigences et méthodes d'essai

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English version

Workplace atmospheres - Short term detector tube measurement systems - Requirements and test methods

Air des lieux de travail - Systèmes de mesurage par tube détecteur à court terme - Exigences et méthodes d'essai

Arbeitsplatzatmosphäre - Kurzzeitprüfröhrchen-Meßeinrichtungen - Anforderungen und Prüfverfahren

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
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Foreword

This European Standard 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of an identical text or by endorsement, at the latest by June 1997, and conflicting national standards shall be withdrawn at the latest by June 1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

0 Introduction

In connection with EN 482 a need has been identified to produce a standard for the detector tube method of determining the concentration of chemical agents in workplace air.

A short term detector tube measurement system consists of a detector tube connected to a compatible detector tube pump. When workplace air containing a particular chemical agent is drawn through the tube, a colour change, corresponding to the concentration, takes place.

Short term detector tube measurement systems have many applications. This European Standard refers to detector tubes used for workplace air monitoring. These tubes may be used for the measurement tasks laid down in EN 482 namely "Measurement for comparison with limit value" and "Periodic measurements", provided that the limit value of the chemical agent of interest is covered by the measuring range of the individual detector tube and the requirements for overall uncertainty are complied with for that measuring range. The other measurement tasks as described in EN 482, having different requirements, for overall uncertainty may be treated accordingly.

NOTE: This European Standard may be used to assess the performance of detector tube measurement systems used for other applications such as emission measurements and compressed air or technical gas analysis.

To cover the measuring range in accordance with EN 482, a combination of two detector tubes with restricted but complementary and overlapping measuring ranges may also be used.

It is the user's primary responsibility to choose appropriate procedures or devices that meet the requirements in this European Standard. One way of doing this is to obtain information or confirmation from the manufacturer.

Materials used in the construction of the detector tube pump should be such that it remains functional for a period of at least three years when used in accordance with the manufacturer's instructions.

This European Standard will enable manufacturers, test houses, certification bodies and users to adopt a consistent approach to the assessment of performance. It is the manufacturer's primary responsibility to ensure that detector tubes meet the performance requirements under specified laboratory conditions.

1 Scope

This European Standard specifies performance requirements and test methods under prescribed laboratory conditions for length-of-stain detector tubes and their associated pump (detector tube measurement system) used for short term measurements of the concentration of specified chemical agents in workplace air.

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 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.

EN 482	Workplace atmospheres - General requirements for the performance of procedures for the measurement of chemical agents
EN 50014	Electrical apparatus for potentially explosive atmospheres - General requirements
ISO 7504	Gas analysis - Vocabulary

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 chemical agent, overall uncertainty, specified measuring range, true value

Definitions for these terms are as in EN 482.

3.2 length of stain detector tube (in the following called "detector tube"): A glass tube containing chemical reagents in which a colour change may be produced when a sample of the atmosphere is drawn through it. The length of the stain produced, relative to a graduated scale, provides a measure of the concentration of a specified chemical agent in air.

3.3 short term detector tube: A detector tube that provides a means of obtaining a rapid measurement (typically up to 15 min) of the concentration of a specified chemical agent in air.

3.4 detector tube measurement system: A complete measurement system consisting of a detector tube (see 3.2) and a detector tube pump.

3.5 interferent: Any component of the air sample, excluding the analyte(s), affecting the detector tube reading.

3.6 calibration gas mixture: A gas mixture of known composition P, generally comprising one or more calibration components and a complementary gas [ISO 7504].

3.7 complementary gas: Generally the most abundant component (pure or gas mixture) which makes up the mixture intended for the calibration [ISO 7504].

4 Requirements

NOTE: A functional detector tube measurement system consists of a detector tube and an appropriate pump. Usually the detector tube measurement system is calibrated and supplied by the same manufacturer.

4.1 Detector tubes

4.1.1 Overall uncertainty

At the lower limit of the specified measuring range, the relative overall uncertainty shall be ≤ 50 %; at 20 % and above of the specified measuring range the relative overall uncertainty shall be ≤ 30 %.

4.1.2 Specified measuring range

The manufacturer shall specify the measuring range in which the detector tube complies with the requirements for the overall uncertainty given in 4.1.1. The marking of the specified measuring range on the detector tube shall correspond with the range(s) indicated in the manufacturer's operating instruction. Where the specified measuring range can be extended this shall be clearly stated in the operating instructions.

4.1.3 Reusable tubes

For reusable detector tubes the manufacturer shall specify the time period during which the detector tube can be used for a subsequent measurement if the previous used gave zero reading. For this period of time the detector tube shall fulfil the requirements of 4.1.1 and 4.1.5.

4.1.4 Scale

The scale shall have a minimum of three lines perpendicular to the axis of the tube and shall be marked with concentration values or equivalent. The lines shall have a maximum width of 0,7 mm (with the exception of the line at the beginning of the indicating layer); the minimum length of a line shall be 3 mm and the size of printing a minimum of 1,5 mm.

The requisite number of pump strokes or sample volume for a particular scale shall be marked.

Detector tube scales shall be graduated either in volume per unit volume or mass per unit volume or shall be accompanied by a calibration graph in the same units.

4.1.5 Evaluation of the stain

The stain shall remain constant and clearly visible for a minimum period of 2 min after the measurement of the contaminated atmosphere.

At 20 % of the measuring range and above, the maximum variation of stain length around the circumference of the tube at the interface between the stained and unstained indicating layer shall not exceed 25 % of the stain length (measured in millimetres) when measured at its point of maximum length.

4.1.6 Shelf life

The shelf life of the detector tube, when stored in accordance with the manufacturer's instructions, shall be clearly indicated on the tube packet. At the end of the shelf life the detector tube shall comply with the requirements of 4.1.1 and 4.1.5.

4.1.7 Mechanical strength

Following the tests in 6.1.7 the detector tubes shall maintain their integrity and shall comply with the requirements of 4.1.1 and 4.1.5.

4.1.8 Temperature stability

After storage of the detector tubes at - 5 °C for 24 h and subsequently at + 60 °C for 24 h the tubes shall, after stabilising to ambient temperature, meet the requirements of 4.1.1 and 4.1.5.

4.1.9 Packing of the detector tubes

If the box contains more than one tube it shall be re-closable.

If the manufacturer indicates that the tubes shall be protected from light, this shall be ensured by the box.

Following the tests in 6.1.7 the box containing the detector tubes shall maintain its integrity.

4.1.10 Interferences

Information on the influence of typical interferences shall be provided by the manufacturer in the instructions for use (see 4.1.13.c).

Information shall be given on interferences likely to suppress the full development of the stain.

4.1.11 Overloading

When the detector tube is tested at a concentration ten times the upper limit of the specified measuring range, the detector tube shall clearly indicate an overload, lasting at least 2 min.

4.1.12 Climatic influences

The manufacturer shall state the range of temperature and humidity for which the specified measuring range is valid. The temperature range shall be at least from 10 °C to 30 °C and the range of relative humidity shall be between at least 20 % and 80 %.

Outside these ranges the requirements of 4.1.1 and 4.1.5 may be fulfilled by the use of correction factors (see 6.1.12).

4.1.13 Instruction for use

The instruction for use supplied with each box of detector tubes shall be in the language(s) of the country where the detector tube is to be marketed. It shall contain at least the following information:

a) directions for proper handling of a tube including opening and fitting it into the pump;

b) a statement that the detector tube pump shall be tested for leakage before each use;

c) general information on the reaction and colour change involved in the system and the levels at which other typical gases and vapours, including water, are likely to interfere to the extent of increasing the overall uncertainty above the level specified in this European Standard;

d) a statement that additional information on possible interferences can be provided on request;

e) if applicable, information about reagents and reactions that are hazardous;

f) where the contents of tubes present a disposal hazard, a warning to that effect shall be given together with advice that national regulations for disposal of hazardous waste should be followed;

g) a statement on the time required for the completion of one pump stroke;

h) a statement about the limitations of reuse;

i) information on the evaluation of the reading including calculation of results and correction factors for temperature and pressure, if applicable;

j) reference to the operating instructions of the detector tube pump(s);

k) specification of the detector tube pump(s);

l) information on storage and transport.

4.2 Detector tube pump

4.2.1 Stroke volume

When tested in accordance with 6.2.1, the pump shall sample a volume of air within (100 ± 5) ml per stroke.

4.2.2 Leakage

The detector tube pump with the closed detector tube connection shall be tight, so that during the first minute of a pump stroke the leakage rate does not exceed 3 ml/min.

4.2.3 Time and end of stroke

The time of stroke of a detector tube pump, when used against a flow control, typical for the detector tube (see 5.5) shall be within ± 20 % of the mean value.

The end of stroke duration shall be clearly recognizable. The criteria shall be given in the instructions for use.

4.2.4 Mechanical strength

After the test given in 6.2.4, the pump shall meet the requirements in 4.2.1, 4.2.2 and 4.2.3.

4.2.5 Mechanical function

The pump shall meet the requirements of 4.2.1, 4.2.2 and 4.2.3 after the execution of 5000 strokes when fitted with the resistance in 5.5.

4.2.6 Explosion hazard (electrically driven pumps only)

If the pump is claimed by the manufacturer to be suitable for use in areas subject to explosion hazard, it shall fulfil the requirements of EN 50014.

4.2.7 Instructions for use

The instructions for use supplied with the pump shall be in the language(s) of the country where the pump is to be marketed. It shall contain at least the following information:

a) operating instructions;

b) instructions for testing for leakage before each use;

c) maintenance instructions;

d) reference to the operating instructions of the detector tube;

e) stroke volume;

f) the criterion for the end of one stroke.

5 General test conditions

NOTE: Parts of the detector tube measurement system which have already been tested to this European Standard are not required to be tested again.

5.1 Reagents

Calibration gas mixtures shall be prepared according to ISO standards or other accepted methods (see annex B for corresponding ISO standards).

5.2 Apparatus

5.2.1 Usual laboratory apparatus and resources.

5.2.2 An exposure chamber constructed of inert materials such as glass or PTFE, through which the generated atmosphere is passed.

5.2.3 Provisions for measuring, controlling and varying systematically the rate of air flow through the generating system and the composition, temperature and relative humidity of the calibration gas mixture (see annex B for corresponding ISO Standards).

5.3 Independent method

An independent validated method shall be used to verify the composition of the calibration gas mixture used.

The composition of the calibration gas mixture and the uncertainty shall be given in the test report.

5.4 Test conditions for detector tubes

Unless otherwise stated, the test procedures are run at the following climatic conditions:

- temperature: (22 ± 3) °C;
- humidity: (10 ± 2) g/m^3;
- pressure: (1013 ± 30) hPa.

At a pressure outside of the stated range, the measured values have to be corrected to a pressure of 1013 hPa.

5.5 Test conditions for pumps

One pump shall be tested. Tests according to 6.2.1, 6.2.3 and 6.2.5 are carried out with a resistance, typical for detector tubes when connected to the pump, with a pressure drop of either

a) (140 ± 10) hPa, flow rate 500 ml/min or

b) (430 ± 30) hPa, flow rate 100 ml/min.

6 Test methods

6.1 Detector tubes

6.1.1 Overall uncertainty

Prepare three test concentrations of the appropriate calibration gas mixture at the lower and upper limit and at 20 % of the specified measuring range. Calculate the relative overall uncertainty, expressed as a percentage, using the following formula (see EN 482):

$$\frac{|\bar{x} - x_{ref}| + 2s}{x_{ref}} \times 100$$

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 n measurements.

For detector tubes with two specified measuring ranges, the test procedure is performed for each range.

NOTE: The uncertainty of the calibration gas mixture concentration should be considered when assessing the overall uncertainty of the detector tube system using appropriate statistical calculations.

6.1.2 Specified measuring range

Determine whether the measuring range specified in the instruction for use and on the detector tube are complete and identical.

6.1.3 Reusable tubes

Test ten detector tubes with complementary gas up to the maximum volume stated in the user's instruction. Then determine the overall uncertainty according to 6.1.1 at a concentration between 20 % and 30 % of the specified measuring range. For detector tubes with several measuring ranges perform the test for the lowest one.