

SLOVENSKI STANDARD

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Zrak na delovnem mestu - Električne naprave za neposredno odkrivanje in neposredno merjenje koncentracije strupenih plinov in hlapov - 1. del: Splošne zahteve in preskusne metode

Workplace atmospheres - Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours - Part 1: General requirements and test methods

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Arbeitsplatzatmosphäre - Elektrische Geräte für die direkte Detektion und direkte Konzentrationsmessung toxischer Gase und Dämpfe - Teil 1: Allgemeine Anforderungen und Prüfverfahren

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Atmosphères des lieux de travail - Appareillage électrique utilisé pour la détection directe des vapeurs et gaz toxiques et le mesurage direct de leur concentration - Partie 1: Exigences générales et méthodes d'essai

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13.320	Alarmni in opozorilni sistemi	Alarm and warning systems

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Workplace atmospheres - Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours - Part 1: General requirements and test methods

Atmosphères des lieux de travail - Appareillage électrique utilisé pour la détection directe des vapeurs et gaz toxiques et le mesurage direct de leur concentration - Partie 1: Exigences générales et méthodes d'essai

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EN 45544-1:2015 (E)**Foreword**

This document (EN 45544-1:2015) has been prepared by CEN/CENELEC Joint Working Group Continuous Measuring Instruments (JWG CMI).

The following dates are fixed:

- latest date by which this document has to be (dop) 2015-11-24
implemented at national level by publication of
an identical national standard or by
endorsement
- latest date by which the national standards (dow) 2017-11-24
conflicting with this document have to
be withdrawn

This document supersedes EN 45544-1:1999.

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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.

EN 45544, *Workplace atmospheres – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours*, consists of the following parts:

- *Part 1: General requirements and test methods;*
- *Part 2: Performance requirements for apparatus used for exposure measurement;*
- *Part 3: Performance requirements for apparatus used for general gas detection;*
- *Part 4: Guide for selection, installation, use and maintenance.*

EN 45544 series is based on EN 482 which specifies general performance requirements for procedures for measuring the concentration of chemical agents in workplace atmospheres. These performance 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.

EN 45544-2 details the performance requirements outlined in EN 482 specifically for electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours intended for exposure measurement.

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EN 45544-3 details the performance requirements for general gas detection apparatus, e.g. safety warning, leak detection. The measuring range will be defined by the manufacturer. In general, the requirements for accuracy will be higher for EN 45544-2 apparatus than for EN 45544-3 apparatus.

The same apparatus may be used for applications covered by EN 45544-2 and EN 45544-3.

EN 45544 series will help manufacturers, test laboratories and users of apparatus to adopt a consistent approach to, and provide a framework for, the assessment of performance criteria. It is the manufacturer's primary responsibility to ensure that the apparatus meets the requirements laid down in this European Standard, including environmental influences, which can be expected to affect performance.

For a given measurement task, the range over which the requirements for the relative expanded uncertainty have to be met depends on the limit value. However, for most chemical agents the limit values have not been harmonized at the European level. Therefore, it was decided to use a reference value (standard test gas concentration) instead of the limit value for the performance tests. The list of standard test gas volume fractions is given in Annex A. The values chosen are equal to or close to the limit values used in different European countries but are intended to be used only for type testing apparatus without any legal implications.

Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours generate readings in clean air (zero readings), which vary with environmental conditions and time. This standard therefore includes test methods and requirements for acceptable variations in zero readings which are additional to the general requirements of EN 482.

EN 45544-1:2015 (E)**1 Scope**

This European Standard specifies general requirements and test methods for the determination of the performance characteristics of personal, portable, transportable and fixed, continuous duty electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours in workplace atmospheres.

This European Standard is applicable to apparatus whose primary purpose is to provide an indication, alarm and/or other output function to give a warning of the presence of a toxic gas or vapour in the atmosphere and, in some cases, to initiate automatic or manual protective actions. It is applicable to apparatus in which the sensor automatically generates an electrical signal when gas is present.

This European Standard is not applicable to apparatus:

- used for the measurement of oxygen;
- used only in laboratories for analysis or measurement;
- used only for process measurement purposes;
- used in car parks or tunnels;
- used in the domestic environment;
- used in environmental air pollution monitoring;
- used for the measurement of combustible gases and vapours related to the risk of explosion.

It also does not apply to open-path (line of sight) area monitors.

For apparatus used for sensing the presence of multiple gases this standard applies only to the detection of toxic gas or vapour.

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

EN 45544-2:2015, *Workplace atmospheres - Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours - Part 2: Performance requirements for apparatus used for exposure measurement*

EN 45544-3:2015, *Workplace atmospheres - Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours - Part 3: Performance requirements for apparatus used for general gas detection*

EN 50270, *Electromagnetic compatibility - Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen*

EN 50271, *Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen - Requirements and tests for apparatus using software and/or digital technologies*

EN 60068-2-6, *Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)* (IEC 60068-2-6)

EN 60079-0, *Explosive atmospheres - Equipment - General requirements* (IEC 60079-0)

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories* (ISO/IEC 17025)

3 Terms and definitions

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

3.1

toxic gas

general term for any gas or vapour that can be harmful to human health toxic. The term “gas” is used for both gases and vapours

3.2

clean air

air that is free of gases or vapours which the sensor is sensitive to or which influence the performance of the sensor

3.3

ambient air

normal atmosphere surrounding the apparatus

3.4

poisons

substances that lead to temporary or permanent change of performance, particularly loss of sensitivity, of the sensing element

3.5

standard test gas

test gas with a composition specified for each apparatus and gas to be used for all tests unless otherwise stated

3.6

mask for calibration and test

device that can be attached to the apparatus to present a test gas to the sensor in a reproducible manner

3.7

volume fraction (V/V)

quotient of the volume of a specified component and the sum of the volumes of all components of a gas mixture before mixing

Note 1 to entry The volume fraction and volume concentration take the same value if, at the same state conditions, the sum of the component volumes before mixing and the volume of the mixture are equal. However, because the mixing of two or more gases at the same state conditions is usually accompanied by a slight contraction or, less frequently, a slight expansion, this is not generally the case.

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3.8

limit value

occupational exposure limit of the time-weighted average of the concentration of a chemical agent in the air within the breathing zone of a worker in relation to a specified reference period

[SOURCE: Council Directive 98/24/EC Art. 2(d) [1]]

Note 1 to entry Limit values are mostly set for reference periods of 8 h, but can also be set for shorter periods or concentration excursions, e.g. short-term exposure limit (STEL). Limit values for gases and vapours are stated in terms independent of temperature and air pressure variables in ml/m^3 and in terms dependent on those variables in mg/m^3 for a temperature of 20 °C and a pressure of 101,3 kPa.

3.9

time weighted average (TWA) concentration

concentration of gas in air integrated over time and divided by the specified reference period

3.10

fixed apparatus

apparatus which is intended to have all parts permanently installed

3.11

transportable apparatus

apparatus not intended to be a portable apparatus, but which can readily be moved from one place to another

3.12

portable apparatus

apparatus that has been designed to be readily carried from place to place and to be used whilst being carried

Note 1 to entry Portable apparatus is generally battery powered.

3.13

personal apparatus

portable apparatus attached to a person, that monitors the atmosphere in their breathing zone so that their exposure to toxic gases or vapours can be determined

Note 1 to entry Also known as a personal monitor.

3.14

continuous duty apparatus

apparatus that is powered for long periods of time, but may have either continuous or intermittent sensing

3.15

gas detection transmitter

fixed gas detection apparatus that provides a conditioned electronic signal or output indication to a generally accepted industry standard, intended to be utilized with separate control units, or signal processing data acquisition, central monitoring and similar systems which typically process information from various locations and sources including, but not limited to, gas detection apparatus

EXAMPLE An example of a generally accepted industry standard for an electronic signal or output indication is 4–20 mA.

3.16

control unit

apparatus intended to provide display indication, alarm functions, output contacts and/or alarm signal outputs when operated with remote sensor(s)

3.17**separate control unit**

control unit intended to be utilized with gas detection transmitter(s)

3.18**apparatus with integral sensor(s)**

apparatus intended to provide display indication, alarm functions, output contacts and/or alarm signal outputs where the sensor is an integral part of the apparatus

3.19**diffusion apparatus**

apparatus in which the transfer of gas from the atmosphere to the gas sensor takes place without aspirated flow

3.20**aspirated apparatus**

apparatus which samples the atmosphere by drawing it to the sensor

EXAMPLE A hand operated or electric pump can draw gas to the sensor

3.21**automatically aspirated apparatus**

aspirated apparatus with an integral pump

3.22**alarm-only apparatus**

apparatus having an alarm but not having a display or other device to indicate the measured gas concentration

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3.23**sensing element**

part of the sensor which is sensitive to the gas/vapour to be measured

3.24**sensor**

assembly in which the sensing element is housed and which can also contain associated circuit components

3.25**measuring principle**

type of physical or physico-chemical detection principle and the measurement procedure to determine the measured value

3.26**remote sensor**

sensor which is not an integral part of the apparatus. A remote sensor is connected to a control unit or to a gas detection transmitter

3.27**alarm set point**

setting of the apparatus at which the measured concentration will cause the apparatus to initiate an indication, alarm or other output function

EN 45544-1:2015 (E)**3.28****TWA alarm set point**

setting of the apparatus at which the measured time weighted average concentration will cause the apparatus to initiate an indication, alarm or other output function

3.29**latching alarm**

alarm that, once activated, requires deliberate action for deactivation

3.30**fault signal**

audible, visible or other type of output, different from the alarm signal which permits, directly or indirectly, a warning or indication that the apparatus is not working satisfactorily

3.31**sample line**

means by which the gas being sampled is conveyed to the sensor including accessories

EXAMPLE (of accessories) Filter, water trap

3.32**sampling probe**

separate sample line which is attached to the apparatus as required

Note 1 to entry It can be supplied with or without the apparatus. It is usually short (e.g. of the order of 1 m) and rigid, although it can be telescopic. It can also be connected by a flexible tube to the apparatus.

3.33**field calibration kit**

means of calibrating or adjusting the apparatus

EXAMPLE This can be a mask for calibration and test (see 3.6).

Note 1 to entry The field calibration kit can also be used for verifying the operation of the apparatus.

3.34**special tool**

tool required to gain access to or to adjust the apparatus controls

Note 1 to entry The design of the tool is intended to discourage unauthorized interference with the apparatus.

3.35**stabilization**

state when three successive observations taken at 1 min intervals in clean air or test gas under constant conditions indicate no changes greater than \pm lower limit of measurement for EN 45544-2 apparatus or $\pm 1\%$ of the specified measuring range for EN 45544-3 apparatus

3.36**final indication**

indication given by the apparatus after stabilization

3.37**indication range**

range of measured values of gas concentration over which the apparatus is capable of indicating

Note 1 to entry See Figure 1.

3.38**zero scale indication**

smallest value of the measured quantity within the indication range

Note 1 to entry This is typically zero.

Note 2 to entry See Figure 1.

3.39**full scale indication**

largest value of the measured quantity within the indication range

Note 1 to entry See Figure 1.

3.40**measuring range**

range of measured values of gas concentration over which the accuracy of the apparatus lies within specified limits

Note 1 to entry For apparatus conforming to EN 45544-2, the requirements for expanded uncertainty in Table 1 of EN 482 are met. For apparatus conforming to EN 45544-3, the requirements for accuracy in EN 45544-3 are met. The measuring range is a subset of the indication range.

Note 2 to entry See Figure 1.

3.41**lower limit of measurement**

smallest value of the measured quantity within the measuring range

Note 1 to entry See Figure 1.

3.42**upper limit of measurement**

largest value of the measured quantity within the measuring range

Note 1 to entry Indications below the lower limit of measurement or above the upper limit of measurement will not necessarily meet the uncertainty requirements of this standard.

Note 2 to entry See Figure 1.

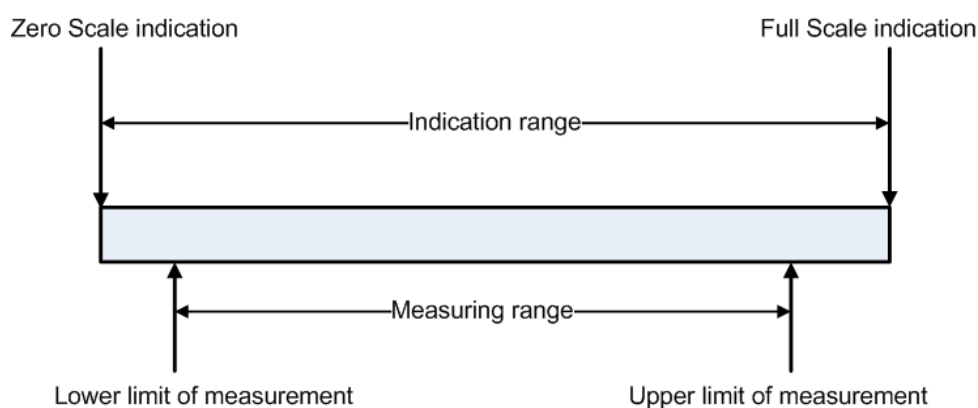


Figure 1 — Instrument scale showing ranges, indications and limits

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3.43**expanded uncertainty**

quantity defining an interval around a result of a measurement, expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand

3.44**coverage factor (k)**

numerical factor used as a multiplier of the combined standard uncertainty in order to obtain an expanded uncertainty

Note 1 to entry EN 482:2012 specifies $k = 2$.

3.45**non-random uncertainty**

uncertainty associated with non-random errors

3.46**random uncertainty**

uncertainty associated with random errors

3.47**zero uncertainty**

quantity defining an interval about the zero that might be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurement in clean air

In Figure 2, the mean value of the measured values in clean air is not equal to the zero scale indication to illustrate that there can be an offset due to drift. The mean value can be above or below the zero scale indication

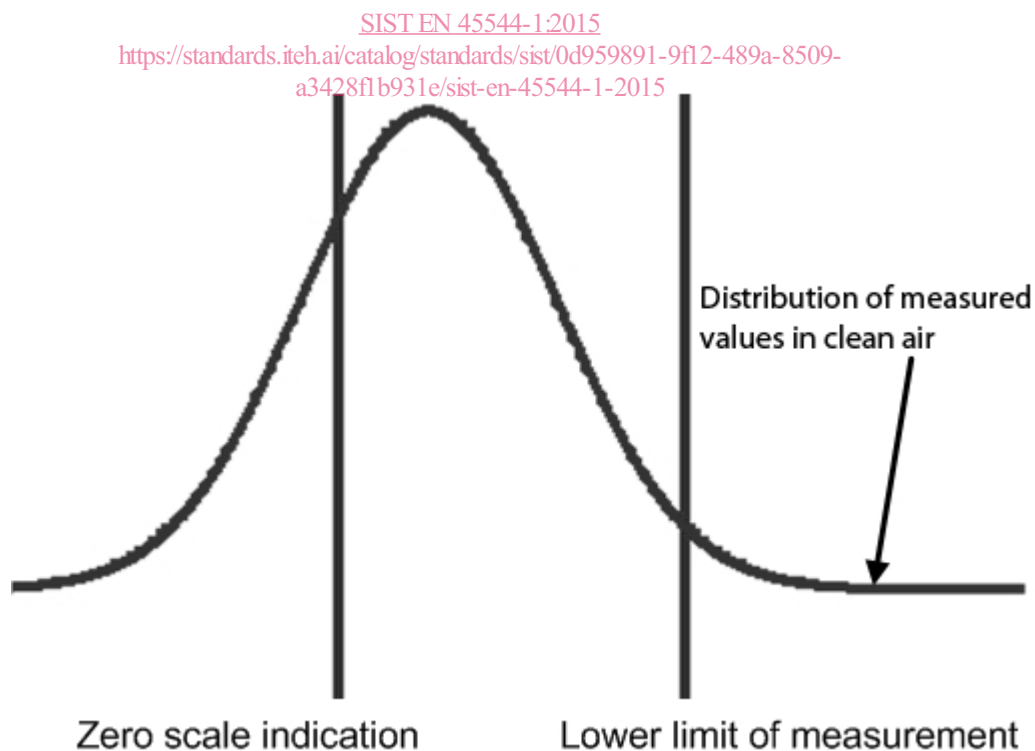


Figure 2 — Example of zero uncertainty

3.48**drift**

variation in the apparatus indication with time at any fixed gas volume fraction under constant ambient conditions

3.49**time of recovery (t_x)**

time interval, with the apparatus in a warmed-up condition, between the time when an instantaneous decrease in volume fraction is produced at the apparatus inlet and the time when the response reaches a stated indication of x % of the initial indication

Note 1 to entry For alarm only apparatus the stated indication can be represented by the de-activation of the alarm set at a stated value.

3.50**time of response (t_x)**

time interval, with the apparatus in a warmed-up condition between the time when an instantaneous increase in volume fraction is produced at the apparatus inlet and the time when the response reaches a stated indication of x % of the final indication

Note 1 to entry For alarm only apparatus the stated indication can be represented by the activation of the alarm set at a stated value.

3.51**warm-up time**

time interval, with the apparatus in a stated atmosphere, between the time when the apparatus is switched on and the time when the indication reaches and remains within the stated tolerances

Note 1 to entry See Figure 3.

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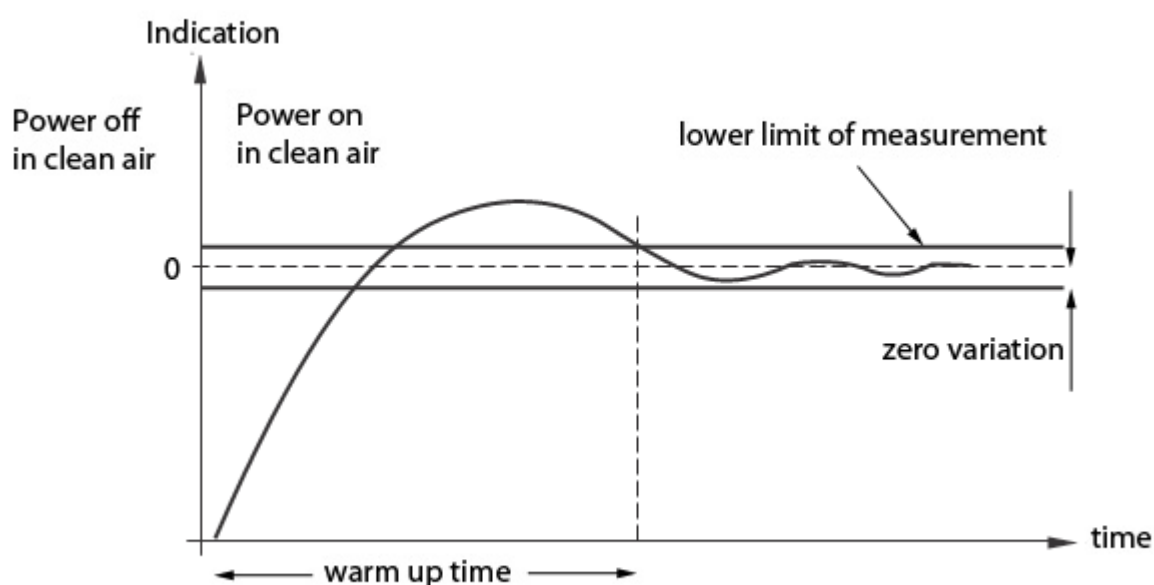


Figure 3 — Example of warm-up time in clean air