SLOVENSKI STANDARD
SIST EN 13098:2019

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Nadomešča:
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Izpostavljenost na delovnem mestu - Ugotavljanje prisotnosti mikroorganizmov v zraku in merjenje njihovih metabolitov - Splošne zahteve

Workplace exposure - Measurement of airborne microorganisms and microbial compounds - General requirements

Exposition am Arbeitsplatz - Messung von Mikroorganismen und mikrobiellen Bestandteilen in der Luft - Allgemeine Anforderungen

Exposition sur les lieux de travail - Mesurage de microorganismes et en suspension dans l'air - Exigences générales

Ta slovenski standard je istoveten z: **EN 13098:2019**

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13.040.30	Kakovost zraka na delovnem mestu	Workplace atmospheres

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EUROPEAN STANDARD
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Supersedes EN 13098:2000

English Version

Workplace exposure - Measurement of airborne microorganisms and microbial compounds - General requirements

Exposition sur les lieux de travail - Mesurage de microorganismes et en suspension dans l'air - Exigences générales

Exposition am Arbeitsplatz - Messung von luftgetragenen Mikroorganismen und mikrobiellen Bestandteilen - Allgemeine Anforderungen

This European Standard was approved by CEN on 10 June 2019.

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European foreword

This document (EN 13098:2019) 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of an identical text or by endorsement, at the latest by March 2020, and conflicting national standards shall be withdrawn at the latest by March 2020.

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 13098:2000.

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

a) document title changed;

b) list of measurable bioaerosol compounds extended;

c) new measuring techniques added;

d) new definitions for “allergen”, “cell count of microorganisms”, “glucan”, “microbial compound”, “mycotoxin”, and “RFc-recombinant” added;

e) existing definitions technically revised, where necessary;

f) terms and definitions already referred to in EN 1540 deleted;

g) 5.3 on “Measurement strategy” improved by providing more details;

h) Annex A updated with regard to new techniques and methods;

i) Annex B updated with new compounds that can be measured;

j) Annex C updated with regard to new counting strategies and identification methods;

k) new Annex E on “Formula and calculation examples for colony counting” added;

l) Bibliography updated and divided in informative references and other information resources;

m) whole document editorially and technically revised.

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.

Introduction

Representative assessment of occupational exposure to airborne microbial organisms or compounds is challenging. However, because of potential health consequences following exposure, it is important to be able to evaluate and control exposure. The sampling equipment used can introduce its own critical limitations, such as the assessment of the health-related aerosol fractions. Some sampling equipment is capable only of measuring culturable microorganisms, while others allow the characterization of both, the total number of microbial cells and the culturable fraction. Both preservation of samples and analytical procedures can induce difficulties and uncertainties due to changes of microbial population and/or unwanted interferences. However, by adhering to the principles outlined in this European Standard for choice of sampling and analytical procedures, these uncertainties can be reduced and controlled, allowing comparable and representative measurements to be made.

1 Scope

This document specifies general requirements for the measurement of microorganisms and microbial compounds.

This document provides also guidelines for the assessment of workplace exposure to airborne microorganisms including the determination of total number and culturable number of microorganisms and microbial compounds in the workplace atmosphere.

This document does not apply to the measurement of viruses.

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

EN 1540, *Workplace exposure — Terminology*

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 and the following 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 http://www.iso.org/obp

3.1
actinomycetes
filamentous Gram-positive, aerobic or anaerobic bacteria belonging to the phylum *Actinobacteria*

Note 1 to entry: Filamentous actinomycetes form a branching network of thin filaments called a mycelium. Most actinomycetes replicate by conidia-like spores which can easily be made airborne.

3.2
allergen
substance that can cause an allergic reaction in sensitized person

Note 1 to entry: Allergens from microbiological origin are usually proteins or glycoproteins derived from fungi or bacteria.

3.3
bacteria
large group of prokaryotic microorganisms with one chromosome in a nuclear region and which replicate only asexually by cell division

Note 1 to entry: Different cell-wall chemistry is used for the classification of Gram-positive and Gram-negative bacteria. Morphological criteria divide into spheres (cocci) and rods bacilli. Some species produce endospores as survival units.

3.4
biological preservation efficiency
capability of a sampler to maintain the viability of airborne microorganisms during collection and also to keep the microbial products intact

3.5
cell count of microorganisms
number of microorganisms determined as single organisms (or a corresponding measure)

Note 1 to entry: Both the viable and the non-viable micro-organisms are included.

3.6
colony forming unit
CFU
unit by which the *culturable number* (3.7) is given

Note 1 to entry: One colony forming unit can originate from one single microorganism, an aggregate of many microorganisms or from one or many microorganisms attached to one particle.

Note 2 to entry: The number of outgrown colonies can depend on cultivation conditions.

3.7
culturable number
number of microorganisms, single cells or aggregates able to form colonies on a solid nutrient medium

3.8
elevated level
level above normal background level of microorganisms in a specified environment

3.9
endotoxin
constituent of the external membrane of Gram-negative bacteria (lipopolysaccharide), consisting of a complex lipid, lipid A, which is covalently bound to a polysaccharide

Note 1 to entry: “Free endotoxin” is liberated after cell death and by budding from living cells. Lipid A is the active (toxic) part and is a potent pro-inflammatory substance and can induce febrile, bronchial and other symptoms in exposed workers. The composition and the toxicity of endotoxin differ between species.

3.10
endotoxin unit
unit standardized against the defined reference material, reference standard endotoxin

3.11
filtration
collection of particles suspended in gas or liquid by flow through a porous medium

3.12
fungi
diverse group of eukaryotic microorganisms with membrane-bound nucleus comprising several chromosomes

Note 1 to entry: Multiplication is mainly asexual but several groups replicate also by sexual spores. Filamentous fungi (moulds) grow in lengthy hyphae and form compact tufts called mycelia. Asexual spores (conidia) are easily made airborne. Yeasts are usually unicellular, of spherical shape and their cells multiply sexually or asexually by budding.

3.13
glucan
polysaccharide molecule present in the cell walls of eukaryotes and prokaryotes including most molds, upper fungi, yeasts, algae and certain bacteria

Note 1 to entry: Glucan is also referred as (1,3)-β-D-glucan.

3.14
impaction
collection of airborne particles accelerated through a nozzle or orifice on a surface by inertia effect

3.15
impingement
combination of impaction onto a surface and subsequent dispersion into a liquid medium

3.16
***Limulus* Amoebocyte Lysate**
enzymes extracted from the blood cells of the horse shoe crab (*Limulus polyphemus*) that are activated by endotoxin and other molecules (glucans etc.)

3.17
microbial compound
cell or cell wall component or metabolite of microbial origin

Note 1 to entry: Endotoxins, glucans, mycotoxins and enzymes are examples of microbial compounds. Microbial DNA is also included in this definition.

3.18
microorganism
microbiological entity of any type, cellular or non-cellular, capable of replication or of transferring genetic material, or entities that have lost these properties

Note 1 to entry: The term microorganism covers the term “biological agent” defined in EN 1540.

3.19
mycotoxin
toxic secondary metabolite produced by fungi

Note 1 to entry: One fungal species can produce many different mycotoxins, and several species can produce the same mycotoxin.

3.20
physical sampling efficiency
capability of the sampler to collect particles with specific sizes suspended in workplace air

3.21
RFc-recombinant
synthetic version of Factor C, an element found in the blood cells of horseshoe crabs

Note 1 to entry: Factor C is the essential biological component of bacterial endotoxin testing.

3.22
sieve sampler
multi-orifice impactor

3.23
total sampling efficiency
product of *physical sampling efficiency* (3.20) and *biological preservation efficiency* (3.4)

3.24
viable number of microorganisms
number of microorganisms having a potential for metabolic activity

Note 1 to entry: A viable microorganism is not necessarily culturable (also called "viable but not culturable"), which means that the number of culturable microorganisms is often only part of the viable number.

4 Symbols and abbreviations

ATP	adenosine triphosphate
CFU	colony forming unit
CV	coefficient of variation
DNA	desoxyribonucleic acid
ELISA	enzyme-linked immunosorbent assay
EU	endotoxin unit
GSD	geometric standard deviation
LAL	Limulus Amoebocyte Lysate
LPS	lipopolysaccharide
PCR	polymerase chain reaction
SEM	scanning electron microscope

5 Measurement of microorganisms and microbial compounds

5.1 Biological agents and biological properties

Bioaerosols can contain different microorganisms and/or microbial compounds originating from these. Microorganisms can be classified in different taxonomic groups including bacteria, fungi, protozoa, algae and viruses. These can be further classified to family, genus or species level. Immunologic reactions (e.g. allergic) and/or toxic reactions as well as infections can result from exposure to microorganisms and microbial compounds.

5.2 Aim of measurement

The measurement of microorganisms and microbial compounds in the workplace air has two objectives:

a) to assess workers' exposure, and/or

b) to assess the biological characteristics of air at different locations and/or at different times and over different time periods.

It is essential to state the purpose of the measurement and how the results will be interpreted.

NOTE 1 Measurement tasks can be to locate sources emitting microorganisms and/or microbial compounds, to measure a worker's exposure during work shift, to identify peaks in exposure, to test the efficiency of control measures, or to control actions taken to diminish the exposure.

NOTE 2 It can be useful to be able to measure both, viable and non-viable bioaerosols.

5.3 Measurement strategy

5.3.1 General

The measurement strategy describes the action plan that allows for interpretation of measurement data. The action plan shall consist of the following:

a) specification of the objectives for measurement (see 5.3.2);

b) specification of the measurement task (see 5.3.3);

c) collection of background information (see 5.3.4);

d) sampling strategy (see 5.3.5).

5.3.2 Specification of the objectives for measurement

The objectives for measurement shall be given and a strategy settled that is adapted to the objectives. It is also to be considered that no OELs are available for the interpretation of measurement data.

5.3.3 Specification of the measurement task

Examples for measurement tasks are to

— locate the sources emitting microorganisms and/or microbial compounds,

— measure a worker’s exposure during work shift (e.g. task- or process-related),

— identify peak exposure,

— control actions taken to diminish the exposure,

— test the efficiency of control measures.

5.3.4 Collection of background information

Background information should comprise

— the identification of potential onsite sources,

— expected biological agents, route of exposure and potentially exposed persons,

— expected concentrations or exposure levels of biological agents,

— the variability of the biological agents in space, time and particle size.

5.3.5 Sampling strategy

The sampling strategy shall specify the design of a sampling plan, which describes what should be measured, and where, when and how measurement should be done.

The sampling plan usually includes:

— the definition of the target biological agent(s) and the corresponding analytical method(s),

— the determination of the sampling method(s) (sampling device, collection substrate, flow rate, etc.),

— the type of sampling (static sampling/personal sampling),

— the setting of sampling parameters (location, number, frequency and duration),

— requirements on sample transportation.

NOTE 1 It can be useful to know the environmental conditions (e.g. relative humidity, temperature, wind speed), especially when extreme environmental conditions are to be expected.

NOTE 2 Passive methods (e.g. surface swabs, electrostatic dust collectors) can be applied to complement air sampling information.

For assessment of measuring results reference samples, such as outdoor air, non-exposed workplace air (e.g. from another office in the same workplace area) or workplace air before starting of work activity, shall be taken, if background exposure is not known.

It is essential to verify that the sampling strategy is representative to exposure and that sampling and analysis correspond to the assessment objectives and to the search for the targeted component of the bioaerosol (see 5.1).

5.4 Measurement options

The following approaches can be used to measure microorganisms and microbial compounds:

— direct counting of microbial cells by microscopy including culturable, non-culturable but viable and non-viable ones;

— enumeration of microbial cells and cell aggregates by culturing on agar media (the culturable number);

— quantification of cellular components of microorganisms, from viable, non-viable or disintegrated microorganisms, for example, constituents of cell structure such as endotoxin, glucans and ergosterol;