



SLOVENSKI STANDARD
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[Not translated]

Workplace exposure - Measurement of airborne micro-organisms and microbial compounds - General requirements (Revision of EN 13098:2000)

Exposition am Arbeitsplatz - Messung von luftgetragenen Mikroorganismen und mikrobiellen Bestandteilen - Allgemeine Anforderungen (Überarbeitung von EN 13098:2000)

Exposition sur les lieux de travail - Mesurage des micro-organismes et des composés microbiens en suspension dans l'air - Exigences générales (révision de l'EN 13098:2000)

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Workplace exposure - Measurement of airborne micro-organisms and microbial compounds - General requirements (Revision of EN 13098:2000)

Exposition am Arbeitsplatz - Messung von
luftgetragenen Mikroorganismen und mikrobiellen
Bestandteilen - Allgemeine Anforderungen
(Überarbeitung von EN 13098:2000)

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 137.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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prEN 13098:2018 (E)**European foreword**

This document (prEN 13098:2018) 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 is currently submitted to the CEN Enquiry.

This document will supersede 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;
- m) whole document editorially and technically revised.

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.

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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. 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

prEN 13098:2018 (E)**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

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 might only be 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
<i>GSD</i>	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 Gram-positive and Gram-negative bacteria, actinomycetes, 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, 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:

- n) To assess workers' exposure, and/or
- o) 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 Measurement tasks can be to locate sources emitting microorganisms and/or microbial compounds, to measure a worker's daily or work shift exposure, to identify peaks in exposure, to test the efficiency of control measures, or to control actions taken to diminish the exposure. It is essential to verify that the sampling and analysis corresponds to the assessment objectives and to the search for the targeted component of the bioaerosol (see 5.1). 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 daily or work shift exposure,
- 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,
- 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.

It is essential to verify that the sampling and analysis corresponds 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 and glucans;