EESTI STANDARD

EVS-EN ISO 13138:2012

Air quality - Sampling conventions for airborne particle deposition in the human respiratory system (ISO 13138:2012)

EESTI STANDARDIKESKUS
ESTONIAN CENTRE FOR STANDARDISATION

EESTI STANDARDI EESSÕNA	**NATIONAL FOREWORD**
See Eesti standard EVS-EN ISO 13138:2012 sisaldab Euroopa standardi EN ISO 13138:2012 ingliskeelset teksti.	This Estonian standard EVS-EN ISO 13138:2012 consists of the English text of the European standard EN ISO 13138:2012.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
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Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

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English Version

Air quality - Sampling conventions for airborne particle deposition in the human respiratory system (ISO 13138:2012)

Qualité de l'air - Conventions de prélèvement de particules aéroportées en fonction de leur dépôt dans les voies respiratoires humaines (ISO 13138:2012)

Luftbeschaffenheit - Probenahmekonventionen für die Abscheidung luftgetragener Partikel im menschlichen Atmungssystem (ISO 13138:2012)

This European Standard was approved by CEN on 14 January 2012.

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

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Foreword

This document (EN ISO 13138:2012) has been prepared by Technical Committee ISO/TC 146 "Air quality" in collaboration with 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of an identical text or by endorsement, at the latest by July 2012, and conflicting national standards shall be withdrawn at the latest by July 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO 13138:2012 has been approved by CEN as a EN ISO 13138:2012 without any modification.

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Introduction

Aerosols comprise disperse systems of particles, liquid or solid, inorganic or organic, anthropogenic or natural in origin. They are found in all working and living environments, indoors or outdoors. The range of aerosol types is vast. Many can be hazardous to humans when exposure occurs by inhalation, leading to a wide range of diseases, depending on where inhaled particles are deposited in the respiratory tract. Many specific diseases such as asthma, bronchitis, emphysema, pneumoconiosis (including coal workers' pneumoconiosis, silicosis and asbestosis), and lung cancer are all known to be associated with aerosol exposures by inhalation. Protection of workers and the general public therefore requires meaningful standards by which such exposures may be regulated. The emergence of such standards goes back to the beginning of the 1900s, and has accelerated in the decades running up to the publication of this International Standard with increasing awareness of the associations between exposures and disease, along with better understanding of the nature of aerosols and exposures to them. Even very early on, the particle-size role in the penetration of particles into, and deposition within, the respiratory tract has been acknowledged. Based on a large body of research that has been conducted since 1960 and before, understanding of the role of particle size in the distribution of and deposition of particles in the various regions of the respiratory tract has led to the stipulation of particle size-selective curves that provide guidelines for the performance of sampling instruments, of the type widely used by occupational and environmental hygienists, that may be used to measure exposures in a way that is directly relevant to any of the health effects of interest.

The original conventions, based on experimental data from carefully controlled inhalation studies with human volunteers, were expressed as curves describing *penetration* to the region of interest as a function of particle size, latterly (since the 1960s) in terms of the metric known as *particle aerodynamic diameter* in the size range extending from 0,5 µm to 100 µm. These conventions led to the emergence of samplers for collecting the inhalable, thoracic, and respirable mass fractions of ambient airborne particles, in both working and living environments, although the conventions are not restricted solely to mass sampling. The conventions were deliberately set up conservatively in view of the large inter- and intra-person variation and with full acknowledgement that the actual deposition of particles (and hence true exposure) differs from penetration, e.g. to or within the alveolar region of the lung and other scenarios, especially when there are particularly fine aerosols. From the outset, therefore, it was to be expected that correlations between disease and exposure might be somewhat limited. However, such an approach readily paved the way for aerosol scientists to develop reasonably simple samplers or monitors whose performance could adequately match the conventions of interest.

With the current availability of large amounts of information on aerosol particle deposition in the human respiratory tract, with ongoing development of more advanced and truly representative sampling instruments, and with research into health-effect determinants such as deposited particle surface area (as opposed to mass), the establishment of conventions that allow for more direct estimations of actual deposition is now justified. This International Standard provides conventions for samplers intended to represent fractions of inhaled aerosol particles actually *depositing* in specific areas of the respiratory system. The particle size range is extended below 0,1 µm where deposition is dominated by diffusion (Brownian motion).

Whether these new conventions will in fact lead to significantly improved correlation between exposure and disease is, at the time of publication, still an open question. Nonetheless, deposition is likely to be a more relevant potentially causative factor than one that includes exhaled particles that do not interact with the body. Whereas the earlier conventions have already been adopted in many legal schemes for determining compliance with exposure levels deemed safe, the newer conventions are expected to be applied initially in forthcoming health effects research. Eventually, however, it is possible that compliance standards themselves will be revised if suitable samplers come into use, and correlation between exposure measurements and health effects are in fact found to be significantly improved.

Air quality — Sampling conventions for airborne particle deposition in the human respiratory system

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This International Standard specifies sampling conventions to define idealized samplers for estimating the deposition of non-volatile, non-hygroscopic, non-fibrous aerosols in five specific loci of the respiratory tract. The five loci consist of the anterior and posterior areas of the nasal passages, the ciliated and non-ciliated parts of the tracheobronchial area, and the alveolar (gas exchange) region.

The conventions are separated into three independent sampling efficiencies defined in terms of thermodynamic diameter characterizing the diffusive (Brownian) motion of sub-micrometre particles and four efficiencies in terms of aerodynamic diameter >0,1 µm characterizing deposition by impaction, interception or gravitational settling. Each conventional curve has been developed as an average of 12 deposition curves corresponding to 12 breathing conditions ranging from sitting to heavy exercise, male vs female, and breathing mode (mouth vs nasal breathing).

NOTE Deposition is computed according to a model developed by the International Commission on Radiological Protection (ICRP, Reference [3]).

2 Normative references

The following referenced documents are indispensable for the application 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.

ISO 7708, *Air quality — Particle size fraction definitions for health-related sampling*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

EN 481, *Workplace atmospheres — Size fraction definitions for measurement of airborne particles*

EN 13205, *Workplace atmospheres — Assessment of performance of instruments for measurement of airborne particle concentrations*

3 Terms and definitions

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

3.1
aerodynamic diameter
d_{ae}
diameter of a sphere of density $\rho_0 = 10^3$ kg m^{-3} = 1 g cm^{-3} with the same terminal velocity due to gravitational force in calm air as the particle, under the prevailing conditions of temperature, pressure and relative humidity within the respiratory tract

NOTE 1 Adapted from ISO 7708:1995, 2.2.

NOTE 2 The aerodynamic diameter is applicable to any particle, but it is dependent on the density, shape and porosity of the particle.