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Air quality — Particle size fraction definitions for health-related sampling

*Qualité de l'air — Définitions des fractions de taille des particules pour
l'échantillonnage lié aux problèmes de santé*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 7708 was prepared by Technical Committee ISO/TC 146, *Air quality*.

This first edition cancels and replaces the Technical Report ISO/TR 7708:1983, of which it constitutes a technical revision.

Annexes A, B and C of this International Standard are for information only.

Introduction

The fraction of airborne particles which is inhaled into a human body depends on the properties of the particles, the speed and direction of air movement near the body, the rate of breathing, and whether breathing is through the nose or mouth. Inhaled particles can then deposit somewhere in the respiratory tract, or can be exhaled. The site of deposition, or probability of exhalation, depends on the properties of the particles, respiratory tract, breathing pattern and other factors.

Liquid particles or soluble components of solid particles can be absorbed by the tissues wherever they deposit. Particles can cause damage close to the deposition site if they are corrosive, radioactive, or capable of initiating some other type of damage. Insoluble particles can be transported to another part of the respiratory tract or body, where they can be absorbed or cause a biological effect.

There is a wide variation from one person to another in the probability of particle inhalation, deposition, reaction to deposition, and clearance. Nevertheless, it is possible to define conventions for size-selective sampling of airborne particles when the purpose of sampling is health-related. These are relationships between the aerodynamic diameter and the fractions to be collected or measured, which approximate to the fractions penetrating to regions of the respiratory tract under average conditions. Measurement conducted according to these conventions will probably yield a better relationship between measured concentration and risk of disease. For further information on the factors affecting inhalation and deposition and their application in standards, see Stuart et al. [12], Phalen et al. [9], Lippmann et al. [5], Heyder et al. [3], Miller et al. [7], Rudolph et al. [10], Vincent [13], Ogden and Birkett [8] and Soderholm [11].

Air quality — Particle size fraction definitions for health-related sampling

1 Scope

This International Standard defines sampling conventions for particle size fractions for use in assessing possible health effects of airborne particles in the workplace and ambient environment. Conventions are defined for the inhalable, thoracic and respirable fractions; extrathoracic and tracheobronchial conventions may be calculated from the defined conventions. (The inhalable fraction is sometimes called inspirable — the terms are equivalent. The nomenclature of the fractions is discussed in annex A.) Assumptions are given in clause 4. The convention chosen will depend on the region of effect of the component of interest in the airborne particles (see clause 3). In this International Standard, conventions are expressed in terms of mass fractions, but they may also be used when the intention is to evaluate the total surface area or the number of particles in the collected material. The conventions should not be used in association with limit values defined in other terms, for example for limit values of fibres defined in terms of their length and diameter.

2 Definitions

For the purposes of this International Standard, the following definitions apply.

2.1 sampling convention: Target specification for sampling instruments which approximates to, for each particle aerodynamic diameter,

- in the case of the inhalable convention, the ratio of the mass concentration of particles entering the respiratory tract to the corresponding mass concentration in the air before the particles are affected by the presence of the exposed individual and by inhalation;

- in the case of other conventions, the ratio of the mass concentration of particles entering the specified region of the respiratory tract to the mass concentration of particles entering the respiratory tract. (These other conventions can also be expressed as ratios to the mass of total airborne particles.)

2.2 particle aerodynamic diameter: Diameter of a sphere of density 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 (see clause 4).

NOTE 1 For particles of aerodynamic diameter less than $0,5 \mu\text{m}$, the particle diffusion diameter should be used instead of the aerodynamic diameter. The particle diffusion diameter means the diameter of a sphere with the same diffusion coefficient as the particle, under the prevailing conditions of temperature, pressure and relative humidity.

2.3 inhalable fraction: Mass fraction of total airborne particles which is inhaled through the nose and mouth.

NOTE 2 The inhalable fraction depends on the speed and direction of the air movement, on the rate of breathing and other factors.

2.4 inhalable convention: Target specification for sampling instruments when the inhalable fraction is the fraction of interest.

2.5 extrathoracic fraction: Mass fraction of inhaled particles which fail to penetrate beyond the larynx.

2.6 extrathoracic convention: Target specification for sampling instruments when the extrathoracic fraction is of interest.

2.7 thoracic fraction: Mass fraction of inhaled particles which penetrate beyond the larynx.