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**Protective clothing for use against solid  
particulates —**

Part 2:

**Test method of determination of inward  
leakage of aerosols of fine particles into  
suits**

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*Vêtements de protection à utiliser contre les particules solides —*

*Partie 2: Méthode d'essai pour la détermination de la fuite vers  
l'intérieur d'aérosols de fines particules dans des combinaisons*

ISO 13982-2:2004

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

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

ISO 13982-2 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 162, *Protective clothing including hand and arm protection and lifejackets*, in collaboration with Technical Committee ISO/TC 94, *Personal safety – Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 13982 consists of the following parts, under the general title *Protective clothing for use against solid particulates*:

- *Part 1: Performance requirements for chemical protective clothing providing protection to the full body against airborne solid particulates (type 5 clothing)*
- *Part 2: Test method of determination of inward leakage of aerosols of fine particles into suits*

# Protective clothing for use against solid particulates —

## Part 2:

# Test method of determination of inward leakage of aerosols of fine particles into suits

## 1 Scope

This part of ISO 13982 specifies a test method to determine the barrier efficiency of chemical protective clothing against aerosols of dry, fine dusts.

## 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/TR 11610, *Protective clothing — Vocabulary*

EN 136:1998, *Respiratory protective devices — Full face masks — Requirements, testing, marking*

EN 340, *Protective clothing — General requirements*

## 3 Terms, definitions, symbols and abbreviated terms

### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions of ISO/TR 11610 and the following apply.

#### 3.1.1

##### **aerosol**

suspension of solid, liquid or solid and liquid particles in gaseous medium, having a negligible falling velocity

NOTE “Negligible falling velocity” is generally considered to be less than 0,25 m/s.

### 3.2 Symbols and abbreviated terms

#### 3.2.1

$L_{ijmn}$

inward leakage for a given test subject ( $i$ ), suit ( $j$ ), exercise ( $m$ ) and sampling position ( $n$ )

#### 3.2.2

$C_{ijmn}$

concentration of aerosol measured at the sampling point inside the suit for a given test subject ( $i$ ), suit ( $j$ ), exercise ( $m$ ) and sampling position ( $n$ )

**3.2.3**

$L_S$   
total inward leakage per suit (average over all exercises and sampling positions)

**3.2.4**

$L_H$   
total inward leakage per human test subject (average over all exercises, sampling positions and suits worn by that test subject)

**3.2.5**

$L_E$   
total inward leakage per exercise (average over all suits and sampling positions)

**3.2.6**

$L_P$   
total inward leakage per sampling position (average over all suits and exercises)

**3.2.7**

$L_{EP}$   
total inward leakage per sampling position and per exercise (average over all suits)

**3.2.8**

$\bar{L}$   
mean total inward leakage (average over all test subjects, suits, exercises and sampling positions)

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**4 Principle**

A standard aerosol of sodium chloride particles is generated inside a test chamber in which a test subject, wearing the protective suit under test, carries out a predetermined sequence of test exercises. The inward leakage at each sampling position inside the suit is measured by means of flame photometry.

The percentage inward leakage at each sampling position ( $L_{ijmn}$ ), the total inward leakage per suit ( $L_S$ ) and per test subject ( $L_H$ ), the total inward leakage per exercise ( $L_E$ ) and per sampling position ( $L_P$ ) and the mean total inward leakage ( $\bar{L}$ ) are calculated.

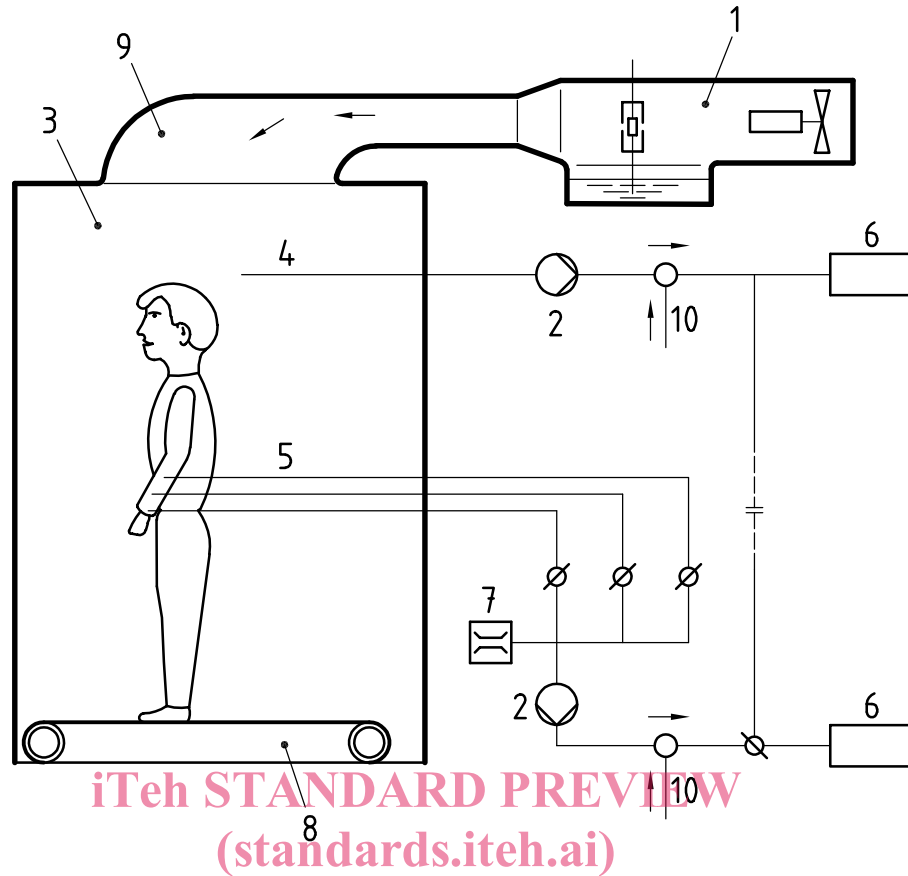
NOTE The test method is based on a testing principle similar to the inward leakage test principle for respiratory equipment, for type 1 and type 2 chemical protective clothing and for protective clothing against radioactive contamination. The method provides a measure of the inward leakage into protective clothing by dry aerosol particles (generated from a sodium chloride solution) having a mass-median aerodynamic diameter of 0,6  $\mu\text{m}$ .

**5 Apparatus**

**5.1 Aerosol generator, flame photometer(s)**, one or two, and a **test chamber**, as described in EN 136.

**5.2 Level treadmill**, capable of operating at  $(5 \pm 0,5)$  km/h, which is installed inside the chamber.

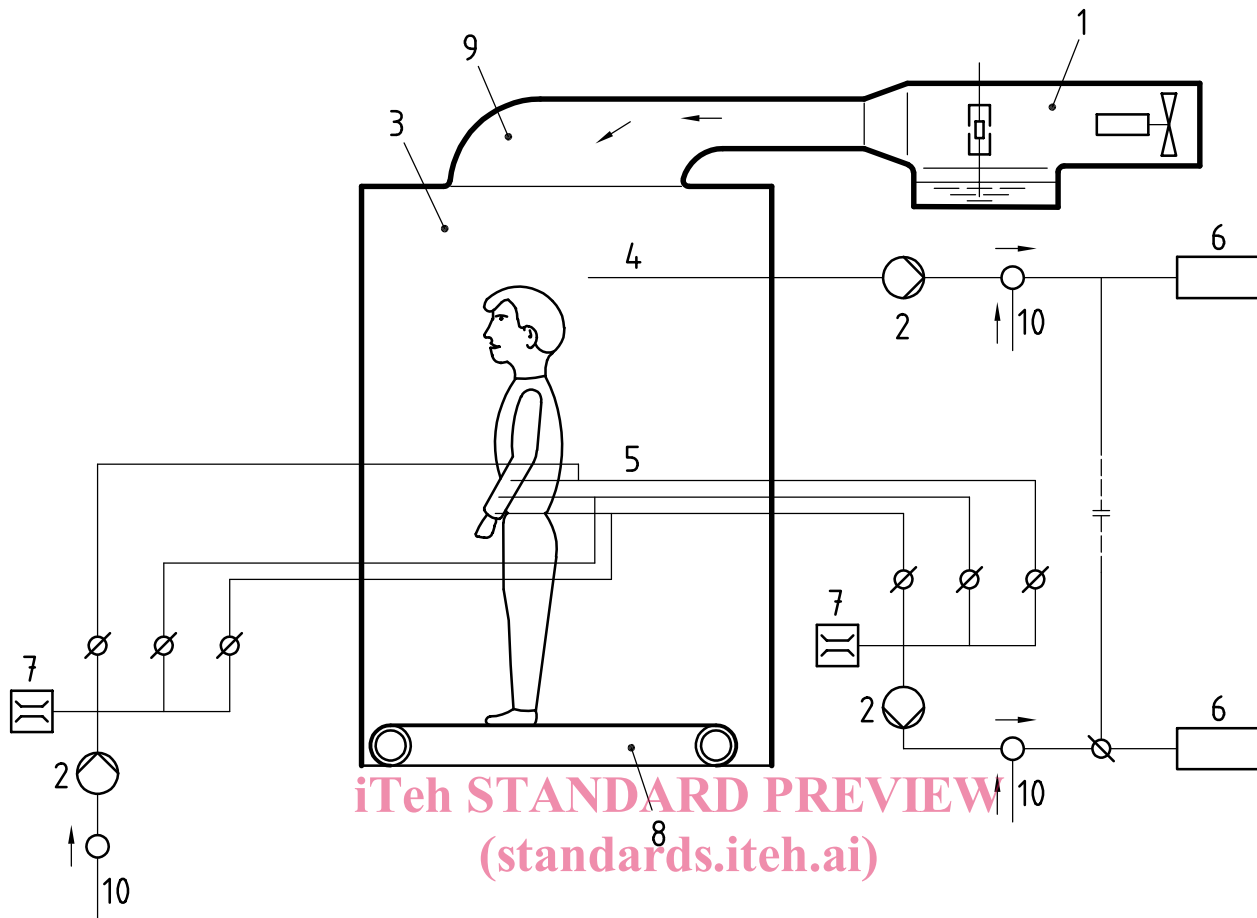
The test arrangement used for the determination of inward leakage is shown schematically in Figures 1 and 2.

**Key**

- 1 atomizer
- 2 pump
- 3 chamber
- 4 challenge sample
- 5 air lines to and from the suit (both sampling and feeding lines)
- 6 photometer
- 7 flow meter
- 8 treadmill
- 9 ducting and baffle
- 10 addition of dry, clean air

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**Figure 1 — Test arrangement (schematic)**



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**Figure 2 — Modified test arrangement for feeding additional dry, clean air into tubes close to the sampling probes (schematic)**

**5.3 Sodium chloride aerosol test agent**, with a particle-size distribution, mean test-agent concentration and distribution inside the chamber as described in EN 136.

**5.4 Adjustable pump and air lines**, used for sampling air from the suit under test.

This pump is adjusted to deliver a sampling flow rate from inside the suit in the range of  $(2 \pm 0,5)$  l/min. The flow shall be kept constant within  $\pm 0,2$  l/min. Depending on the type of photometer, it may be necessary to dilute the sample air with clean air. There shall be no condensation in tubes during testing. Condensation in the tubes can be avoided by feeding dry, clean air directly into the tubes upstream of where condensation occurs (see Figure 2), by heating of the tubes or by any other suitable means. One should take the dilution into account when calculating the concentration at the sampling point.



**5.5 Sampling probes**, four, constructed as shown in Figure 3, one which shall be used to measure the challenge concentration and three, the concentration inside the suit.

Each probe is fitted onto a length of suitable transparent plastic tube with an internal diameter of 4,0 mm.

Dimensions in millimetres

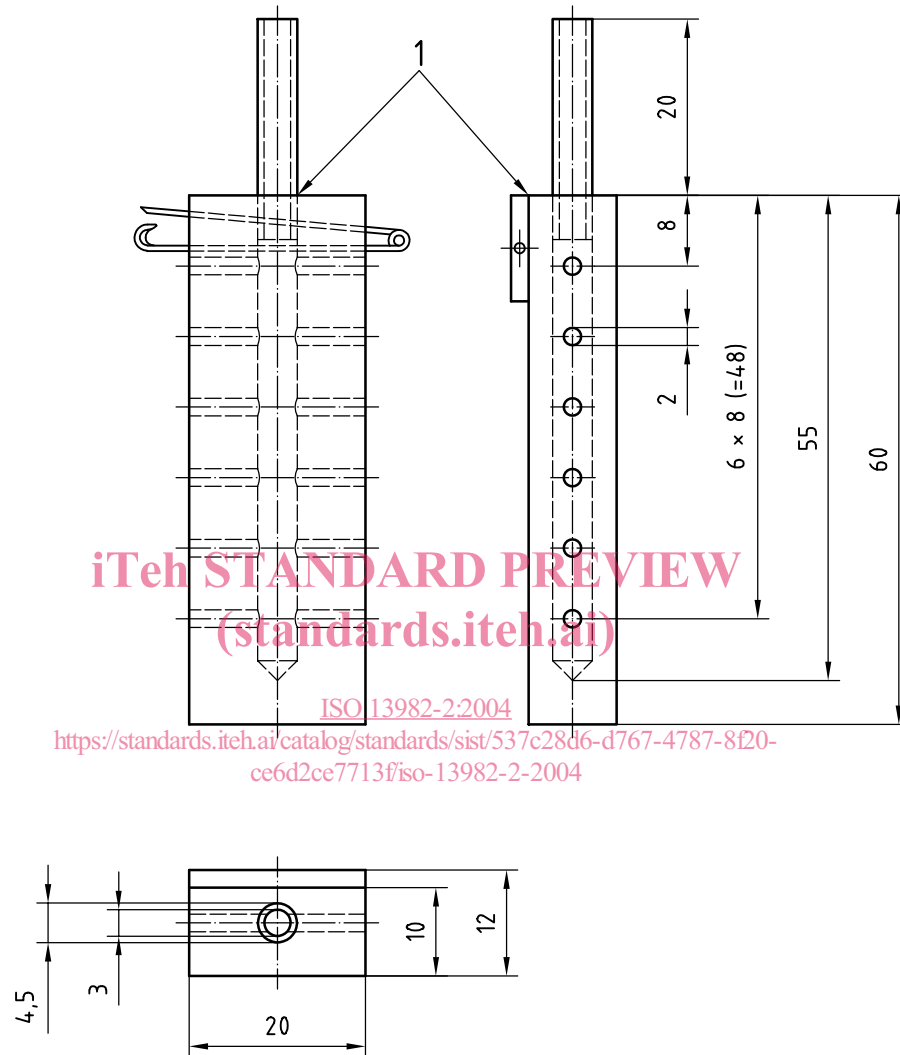


Figure 3 — Sampling probe