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Wildland firefighting personal protective equipment — Requirements and test methods —

Part 9: Firehoods

Équipement de protection individuelle pour la lutte contre les feux d'espaces naturels — Exigences et méthodes d'essai —

Partie 9: Capuches anti-feu

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Foreword

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This document was prepared by Technical Committee ISO/TC 94, *Personal safety — Protective equipment*, Subcommittee SC 14, *Firefighters personal equipment.*

A list of all parts in the ISO 16073 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document provides minimum performance requirements for wildland firefighters' personal protective equipment (PPE) firehoods, designed for use for extended periods during wildland firefighting.

Wildland firefighting involves work carried out mostly in summer temperatures and for many hours, during which the firefighter can develop high levels of metabolic heat. As a consequence, the PPE is required to be of low mass, flexible and commensurate with the risks to which the firefighter can be exposed in order to be effective without introducing excessive heat stress to the wearer.

Firefighters should be trained in the selection, use, care and maintenance of the PPE covered by this document, including an understanding of its limitations.

It is intended that a risk assessment be undertaken to determine if the PPE covered by this document is suitable for its intended use and the expected exposure.

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Wildland firefighting personal protective equipment — Requirements and test methods —

Part 9: Firehoods

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1 Scope

This document specifies the minimum performance requirements and methods of test for firehoods that cover the head and neck and are used for wildland firefighting. An optional requirement has been included to provide limited protection against particulate contaminants

This document covers the general design of the PPE, the minimum levels of performance for the materials employed and the methods of test used. This PPE is not intended to provide protection during fire entrapment.

This document does not cover firehoods for structural firefighting (see ISO 11999-9). This document only applies in situations when compatible protective clothing, helmet, and when necessary respiratory protection devices are also worn.

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.

ISO 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 3146, *Plastics — Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods*

ISO 3175-1, *Textiles — Professional care, drycleaning and wetcleaning of fabrics and garments — Part 1: Assessment of performance after cleaning and finishing*

ISO 5077, *Textiles — Determination of dimensional change in washing and drying*

ISO 6330, *Textiles — Domestic washing and drying procedures for textile testing*

ISO 6942, *Protective clothing — Protection against heat and fire — Method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat*

ISO 9151, *Protective clothing against heat and flame — Determination of heat transmission on exposure to flame*

ISO 11092, *Textiles — Physiological effects — Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded-hotplate test)*

ISO 13688, *Protective clothing — General requirements*

ISO 13938-1, *Textiles — Bursting properties of fabrics — Part 1: Hydraulic method for determination of bursting strength and bursting distension*

ISO 15025, *Protective clothing — Protection against flame — Method of test for limited flame spread*

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ISO 17493, *Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven*

ISO/TR 19591, *Personal protective equipment for firefighters — Standard terms and definitions*

NFPA 1971:2018, *Standard on protective ensembles for structural firefighting and proximity firefighting*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO/TR 19591 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 General design requirements

4.1 General

Materials used in the construction of the firehood shall meet all requirements of ISO 13688, including specifically the requirements for innocuousness in 4.2.

4.2 Firehood flexibility and facial opening

The firehood shall have flexibility to take up the shape of the wearer's head without discomfort and shall not restrict head movement.

The firehood shall fit around, when possible, the respiratory protection devices for which compatibility is claimed by the manufacturer without reducing the field of view or interfering with the breathing function of the mask and give no discomfort to the wearer.

NOTE 1 Firehoods do not fit around P2 masks, check compatibility.

The design requirements specified shall be verified by visual inspection during the procedures in Annex A.

NOTE 2 For more information on compatibility, see ISO/TS 11999-2.

4.3 Yoke interface area

The firehood shall have a yoke creating an interface area with protective clothing (see ISO 15384), the integrity of which shall be maintained.

NOTE For more information on compatibility, see ISO/TS 11999-2.

4.4 Sizing

The firehood may be manufactured in various sizes. It shall be sufficiently elastic to be compatible with various head sizes and shapes. Assess by visual inspection.

NOTE 1 Overstretching will reduce the heat protective performance of the firehood and is to be avoided by design. Excess material in the construction of the firehood can hamper the wearer and compromise the wearing of other personal protective equipment.

NOTE 2 The yoke is not always symmetrical on the back, upper shoulders and front (upper chest).

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4.5 Seam construction

Seams shall be constructed to give minimum loss of strength and protection and to maintain the temperature resistance and the integrity of the fire hood meeting the requirements of 6.2 and 6.7. Also assess by visual observation as detailed in Annex A.

4.6 Labels

The label(s) for the marking requirement shall be positioned in the area defined as the yoke of the firehood. Assess by visual inspection.

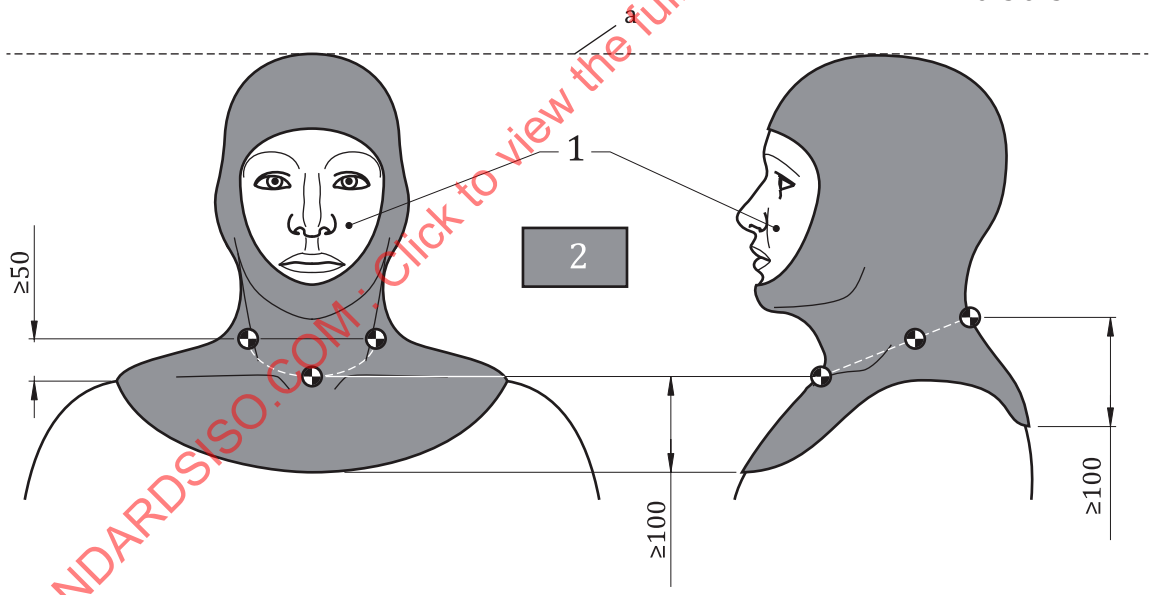
4.7 Particulate protection (Optional)

The firehood shall meet the requirements in 6.9 and the requirements in this sub-clause.

The particulate protection surface shall include from the top of the head to at least the areas from 50 mm below the side neck point, 100 mm below the front neck point and 100 mm below the back neck point (neck points as defined in ISO 8559-1) (see Figure 1).

The elastic and stitching around the facial opening shall be permitted to exclude particulate blocking material specifically for meeting the requirements of 4.2 for a distance of 20 mm from the leading edge of the firehood face opening to the innermost row of stitching. The distance shall be measured in at least six locations with the firehood lying on a flat surface with the face opening facing upwards.

Dimensions in millimetres



Key

1 face opening

2 particulate protected area

[a] Top head.

Figure 1 — Firehood with particulate protection area (shaded)

If the requirements of this subclause are met, add on the label wording equivalent to “This firehood provides limited particulate protection" [see also 7.3 h)].

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5 Sampling and pre-treatment

5.1 Sampling

A sample shall be taken, which is representative of the materials used to construct the firehood taking into account whether 4.7 applies.

5.2 Pre-treatment by cleaning

Where required in this standard, tests shall be carried out after five cleaning cycles (a cleaning cycle is one wash and one dry cycle), cleaning shall be performed in accordance with ISO 6330 using the front-loading horizontal drum machine and reference detergent 3 (ECE reference detergent 98).

Washing shall be carried out in accordance with ISO 6330 procedure 6N (60 ± 3) °C and drying by procedure F (machine Type A1) exhaust temperature normal (minimum 40 °C, maximum 80 °C), unless otherwise specified in the care labelling.

Materials that are labelled as dry cleanable only shall be dry cleaned five times in accordance with ISO 3175-1.

A laundry bag shall not be used.

For single use firehoods, pre-treatment by cleaning is not required.

5.3 Conditioning

Unless otherwise specified in the specific test methods, prior to all tests and after having performed the pretreatment specified in 5.2 condition the specimens in accordance with ISO 139 with the following modification: conditioned for a minimum of 24 h by exposure to a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %. Test the specimens within 5 min following their removal from the conditioning atmosphere.

6 Performance requirements

The performance requirements shall be met after preconditioning in accordance with all requirements of Clause 5 and its sub-clauses.

6.1 Flame resistance — Face ignition

Carry out the flame spread test in accordance with ISO 15025 procedure A (face ignition) using a flame application time of 10 s.

For seams, three specimens containing a structural seam shall be tested. Specimens shall be oriented with the seam running up the centreline of the outer surface of the test specimen so that the burner flame impinges directly upon the seam. Seams shall not separate.

The requirements in Table 1 shall be satisfied.

Table 1 — Limited flame spread performance requirements ISO 15025, procedure A

Properties	Requirement
Flame spread	No specimen shall permit any part of the lowest boundary of any flame to reach the upper or either vertical edge.
Flaming debris	No specimen shall give flaming or molten debris.
Hole formation	No specimen shall give hole formation of 5 mm or greater in any direction, except for an inner layer that is used for specific protection other than flame or heat protection.
NOTE This table is taken from ISO 14116:2015.	

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Table 1 *(continued)*

Properties	Requirement
Afterglow	Afterglow time shall be ≤2 s. A glowing inside the charred area is defined in ISO 15025 as afterglow without combustion and for the purpose of this clause is not regarded as afterglow.
Afterflame	Afterflame time shall be ≤2 s.
NOTE This table is taken from ISO 14116:2015.	

6.2 Sewing thread thermal stability

All yarns and sewing threads utilized in the construction of the protective fabrics and firehood, when tested in accordance with ISO 3146 at a temperature of (260 ± 5) °C, shall not melt.

6.3 Heat resistance

When tested in accordance with ISO 17493 at a temperature of (260 ± 5) °C, no firehood material shall melt, drip, ignite or shrink by more than 10 % in length or width.

6.4 Heat transfer — Flame exposure

When tested in accordance with ISO 9151, the hood shall achieve the performance given in Table 2.

Table 2 — Heat transfer — Flame exposure

Heat transfer index	Result
HTI_{24}	≥8

6.5 Heat transfer — Radiant exposure

When tested in accordance with method B of ISO 6942 at a heat flux density of 20 kW/m^2, the hood shall achieve the result given in Table 3.

Table 3 — Heat transfer — Radiant exposure

Heat transfer	Result
$RHTI_{24}$	≥11
$RHTI_{24-12}$	≥4

6.6 Residual burst strength of material following radiant heat exposure

Three specimens taken from the firehood or from equivalent material or assembly shall have a burst strength ≥200 kPa, after pretreatment of the specimen by method A of ISO 6942 at a heat flux density of 10 kW/m^2, when tested in accordance with ISO 13938-1 using a test area of 7,3 cm^2.

6.7 Seam burst strength

The average of 3 specimens of each seam type used in the construction of the firehood shall have a burst strength ≥450 kPa when tested in accordance with ISO 13938-1 using a test area of 7,3 cm^2.

6.8 Dimensional change

The material or component assembly shall have a dimensional change ≤5 % when tested in accordance with ISO 5077.

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6.9 Particulate protection

6.9.1 General

When applying particulate protection (see 4.7), particulate penetration of the firehood assembly shall be ≤10 % (particulate filtration efficiency of ≥90 %) when tested according to one of the two test methods in 6.9.2 (see Annex B) or 6.9.3 (see Annex C) (comparative results in Annex D).

A minimum specimen size of 100 mm × 100 mm is to be used and five samples shall be tested based on the size requirements of the two test methods. The test shall be conducted at a relative humidity of ≤40 % and at a temperature of (22 ± 3) °C.

6.9.2 Test method 1

The method is fully described in Annex B.

NOTE This method is derived from EN 13274-7.

6.9.3 Test method 2

The test method is described in Annex C.

NOTE This method is derived from NFPA 1971.

6.10 Water vapour resistance

The firehood assembly shall have a mean water vapour resistance when tested in accordance with ISO 11092 of <5 m^2Pa/W.

The firehood assembly including a particulate barrier according to 4.7 and 6.9, shall have a mean water vapour resistance when tested in accordance with ISO 11092 of <10 m^2 Pa/W.

7 Marking and labelling

7.1 General

Any labels or accessories shall not adversely affect the performance of any item to which they are attached or present a hazard to the wearer.

Marking requirements shall be as specified in ISO 13688 and in this clause.

7.2 Label durability and legibility

After being exposed to the following treatments, the labels shall remain legible when examined by a person with either 6/6 or 20/20 vision or vision corrected to 6/6 or 20/20, at a distance of 300 mm in a well-lit:

a) laundering as specified in 5.2;

b) flame resistance as specified in 6.1;

c) abrasion for 200 cycles in accordance with ISO 12947-2, with a 12 kPa pressure and using a wetted felt abrasive.

Label shall remain legible for the life of firehood.

Marking requirements shall meet those specified in ISO 13688 and in this clause.

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7.3 Compliance marking requirements

Each item of PPE for which compliance with this document is claimed, shall have a marking permanently and conspicuously attached, upon which information required in ISO 13688 and the following information is printed in letters at least 2,0 mm high:

a) designation of the type as appropriate;

b) name, trademark or other means of identifying the manufacturer;

c) style/model designation;

d) size;

e) reference to this document, i.e. ISO 16073-9:2020;

f) material composition;

g) the pictogram given in Figure 2 (ISO 7000-3636) printed as shown;

Figure 2 — Personal protective equipment for wildland firefighting

h) if the requirements of 4.7 are met, add on the label wording equivalent to “This firehood provides limited particulate protection”.

8 Information supplied by the manufacturer

The personal protective clothing shall be supplied to the end user accompanied by instructions written at least in the official languages of the country of destination.

The information to be supplied by the manufacturer shall be as specified in ISO 13688. The manufacturer shall give as much information as possible on known factors of durability, especially on durability to cleaning.

In the case that applying a finish can restore the protective properties, the maximum number of cleaning cycles before re-application of the finish shall be clearly indicated in the information notice.

The following information shall be provided:

a) the name and address of the manufacturer or its authorized representative;

b) the intended use of the product;

c) a reference to this document, i.e. ISO 16073-9:2020

d) tests to be carried out by the user before use, if necessary;

e) the instructions explaining how to don and doff the firehood, if necessary;

f) the limits of use (e.g. scale of temperatures);

g) the storage and maintenance instructions;

h) the instructions for cleaning and/or decontamination;

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i) the method of drying;

j) a warning against problems which might arise, if necessary;

k) any illustrations, if these might be useful;

l) the type of packaging suitable for transport;

m) the manufacturer shall give advice as to how the firehood shall be worn. The information shall identify compatible designs of respiratory protection face mask, and other relevant items of PPE.

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Annex A
(normative)

Donning, doffing and shape retention test

A.1 The test shall be conducted differently depending whether the firehood can be worn above and potentially underneath the facemask. Please follow the steps (A.2 to A.12) in the order (and potentially repetitions) indicated in Table A.1 depending on the manufacturer's instruction of the firehoods.

Table A.1 — Procedures for shape retention

Firehood above or below facemask	Firehood below facemask	Firehood above facemask
A.2, A.3, A.5, A.6, A.7, A.9, A.5, A.6, A.11, A.12	A.2, A.3, A.4, A.5, A.6, A.7, A.8, A.11, A.12	A.2, A.3, A.4, A.9, A.10, A.11, A.12

A.2 Examine the overall shape and construction of the firehood.

A.3 A medium size headform complying with EN 168 which has an internal core covered by a nominal 12 mm thick layer of polyurethane of hardness (50 ± 5) IRDH shall be used.

A.4 If the test is conducted with the firehood above the facemask, go directly to A.9.

A.5 Don the firehood into the user position on the headform.

A.6 Mount the breathing apparatus facemask on the headform above the firehood according to the facemask's manufacturer's instructions. Examine whether there is integrity of the interface area between the firehood and the breathing apparatus facemask, e.g. no gaps in the intended area of protection and there shall be no folds in the firehood fabric.

A.7 Remove facemask. Position the firehood so that it is around the neck of the headform with the neck and head area of the headform protruding through the facial opening of the firehood.

A.8 If the firehood is only worn underneath the facemask, repeat A.5 to A.7 for 50 cycles. Remove firehood, and allow the firehood to relax for 1 min, and go to A.11.

A.8 Position the firehood on the headform so that the firehood is around the neck area of the headform with the neck and head area of the headform protruding through the facial opening of the firehood, and then don and doff for 50 cycles, passing the facial opening of the firehood up and over the headform to the in-use position and then passing the firehood down over the headform to the starting position. For firehoods with a manually adjusted facial opening an adjustment is to be made during each cycle, after donning and before doffing.

A.10 Remove the facemask and the firehood from the headform, and allow the firehood to relax for 1 min.

A.11 Examine the firehood including shape, seams and any elastic/manually adjusted closure systems for distortion, stretching, damage or similar changes, in comparison with the observations made in A.2.

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A.12 Don the firehood and respiratory protection facemask following the order A.3, A.5 and A.6 and examine for any gap in the interface area between the firehood and the respiratory protection facemask to ensure it is unchanged from A.5 and A.6 or A.9.

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Annex B
(normative)

Particulate test method 1

B.1 Introduction

Sodium Chloride test aerosol are used for measurement of filter penetration. The test aerosol is fed into the test chamber, where the particle filtering device under test is mounted in a leak tight manner on a suitable adaptor. Aerosol is passed through the device and the aerosol concentration is measured immediately before and after the particle filtering device by the photometer.

Laboratories should give consideration to the following factors:

— Test chamber should be designed to minimize air velocity variations across the surface of the filter under test.

— Localized high air velocity ("jets"), can result in artificially high filter penetration.

B.2 Principle

An aerosol of sodium chloride particles is generated by atomising an aqueous solution of the salt and evaporating the water. The concentration of this aerosol is measured before and after the filter under test by means of flame photometry. Accurate determinations shall be possible in the range <0,001 % to 100 % filter penetration.

B.3 Test equipment

The apparatus is shown schematically in Figure B.1. The test apparatus consists of four modules:

a) sodium chloride aerosol generator;

b) flow control module;

— use an air flow (7,0 ± 1) l/min

c) filter test chamber;

d) flame photometer aerosol detector.

The test aerosol produced by the generator is polydisperse and shall have the following properties:

— the number median of the particle size distribution is between a diameter of 0,06 µm and 0,10 µm with a geometric standard deviation between 2,0 and 3,0;

— the aerosol concentration is within the range 12 mg/m^3 to 20 mg/m^3;

— the variation of the concentration over a period of 5 min is not greater than ±3 % and is not greater than ±10 % during the exposure test;

— the relative humidity is 40 % or less at (22 ± 3) °C.

The aerosol mass concentration, particle size distribution and humidity shall be measured within the filter test chamber.

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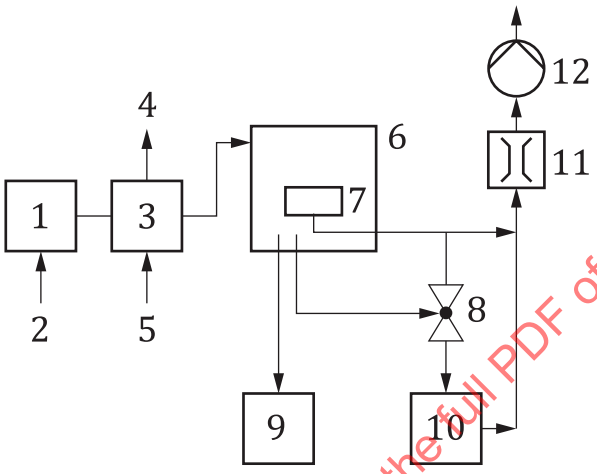
It is recommended that an electrical mobility method be used to determine the particle size distribution. Additional information on electrical mobility measurements can be found in ISO 15900.

The sodium chloride solution shall be completely replaced and not replenished in order to maintain the correct solution concentration.

The sodium chloride aerosol is detected before and after the filtering device under test by flame photometry. Sodium chloride particles in air passing through the flame tube are vaporized giving the characteristic sodium emission at 589 nm. The intensity of this emission is proportional to the concentration of sodium in the air flow.

The photometer used for this analysis can be any suitable instrument having the required sensitivity.



Key

1 aerosol generator
2 compressed air supply
3 flow control module
4 air bleed (test flows less than the output of the generator)
5 make-up air (test flows greater than the output of the generator)
6 filter test chamber
7 filter under test
8 two-way sample selection valve
9 second aerosol detection photometer (optional)
10 aerosol detection photometer
11 flow meter
12 suction pump

Figure B.1 — Schematic example of sodium chloride aerosol test apparatus

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B.4 Procedure

The test aerosol is fed into the test chamber, where the filter under test is fixed. A specified flow of 7 l/min is passed through the filter and the aerosol concentration is measured immediately before and after the filter by the photometer at each determination of filter penetration.

Where the specified flow is less than 7 l/min, a bleed shall be incorporated to reduce the flow through the filter to the required rate.

Where the specified flow through the filter is greater than 7 l/min, a supply of clean air of less than 40 % relative humidity shall be added to the output of the aerosol generator so as to obtain the required

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flow rate. The air shall be added prior to the test chamber so as to ensure a homogeneous aerosol concentration within the test chamber. This procedure will also have the effect of reducing the aerosol concentration before the filter which shall be taken into account when calculating the filter penetration in accordance with B.5, [Formula (1)].

B.5 Calculation of the penetration

$$P = \frac{C_2 - C_0}{C_1 - C_0} \times 100\ \% \tag{1}$$

where

P is the penetration;

C_1 is the sodium chloride aerosol concentration in front of the filter;

C_2 is the sodium chloride aerosol concentration behind the filter;

C_0 is the sodium chloride aerosol photometer reading for clean air.

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