SLOVENSKI STANDARD
SIST EN 368:1996

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Zaščitna obleka - Zaščita pred učinki tekočih kemikalij - Preskusna metoda: Odpornost materialov na penetracijo tekočin

Protective clothing - Protection against liquid chemicals - Test method: Resistance of materials to penetration by liquids

Schutzkleidung - Schutz gegen flüssige Chemikalien - Prüfverfahren: Widerstand von Materialien gegen die Durchdringung von Flüssigkeiten

Vetements de protection - Protection contre les produits chimiques liquides - Méthode d'essai: Résistance des matériaux a la pénétration des liquides

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English version

Protective clothing - Protection against liquid chemicals - Test method: Resistance of materials to penetration by liquids

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

This European Standard was prepared by the Technical Committee CEN/TC 162 "Protective clothing including hand and arm protection and lifejackets", of which the secretariat is held by DIN.

This European Standard has been prepared under a mandate given to CEN by the Commission of the European Communities and the European Free Trade Association, and supports essential requirements of the EC Directive(s).

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of an identical text or by endorsement, at the latest by May 1993, and conflicting national standards shall be withdrawn at the latest by May 1993.

The Standard was approved and in accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

0 Introduction

This European standard specifies a method of test for measurement of indices of penetration and repellancy for protective clothing materials against liquid chemicals. The data may be used as a guide for screening protective clothing materials but the results from the test method are affected by the physical properties of the test chemical e.g. volatility of the test chemical.

1 Scope

This European standard is concerned with the application of the described method of test, usually with chemicals of low volatility. Clothing made of these materials is not for use as the sole means of protection where resistance to permeation by chemicals at the molecular level (see EN 369) is essential and where a complete barrier to liquid (or gaseous chemicals) is required (e.g. risk of exposure to massive and forceful discharges of concentrated liquid chemicals).

Clothing, which has been developed from materials selected by this method of test, should be used therefore only in well-defined circumstances when an evaluation of the finished item has indicated an acceptable level of performance (e.g. in laboratory and field testing of a garment, consideration of exposure levels to specified chemicals etc.).

Two levels of the potential performance of materials are assessed by the method of test to meet with possible requirements for protection against:

a) deposition on the surface of a material, at minimal pressure, of spray droplets up to coalescence or occasional small drips;

b) contamination by a single copious splash or low pressure jet, allowing sufficient time to divest the clothing or take other action as necessary to eliminate any hazard to the wearer from chemical retained by the protective garment, or, in circumstances where pressure is applied to liquid contaminants on the surface of the clothing material as a result of natural movements of the wearer (flexing of contaminated areas of clothing at arms, knees, shoulders) and contact with contaminated surfaces (e.g. walking through sprayed foliage).

2 Normative References

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN 369 Protective clothing for use against chemicals: Resistance of materials to permeation by liquids

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1 Penetration

The process by which chemical flows through holes or essential openings in the material. The holes may be the result of mechanical damage.

3.2 Permeation

The process by which a chemical moves through a protective clothing material on a molecular level.

Permeation involves:

a) sorption of the molecules of the chemical into the contacted (outside) surface of the material;

b) diffusion of the sorbed molecules in the material, and;

c) desorption of the molecules from the opposite (inner) surface of the material.

3.3 Repellency

The ability of a material to shed liquid that is applied to its surface.

4 Principle

A measured volume of a test liquid is applied firstly, with minimal force, and secondly with higher force if appropriate (e.g. satisfactory initial test result), in the form of a fine stream or jet on to the surface of a clothing material resting in an inclined gutter. Measurement of the respective proportions of the applied liquid which penetrate a test piece and are repelled by its surface indicate the potential of the material for use in the described field of application.

5 Method

5.1 Apparatus

The apparatus, as assembled (figure 1), shall comprise the following:

5.1.1 Rigid transparent gutter, of semi-cylindrical shape, with internal diameter (125 ± 5) mm, length (300 ± 2) mm, and inclination 45°.

5.1.2 Rigid cover, semi-cylindrical in shape, length 270 mm, external diameter (105 ± 5) mm, weight (140 ± 7) g (evenly distributed). This cover is not shown in figure 1.

5.1.3 Hypodermic needle, bore (0,8 ± 0,02) mm, length is not critical but the pointed tip should be removed and the end ground flat.

5.1.4 Syringe or other leak-free attachment to the needle capable of delivering (10 ± 0,5) ml volumes of test liquid.

5.1.5 Motorized syringe drive unit or, hydraulic pump or other pressurized system to deliver the correct volume of test liquid (10 ± 0,5) ml in an unbroken stream or jet via the needle within (10 ± 1) s and within (4 ± 0,2) s.

NOTE: Appropriate precautions should be observed in the use of pressurized systems.

5.1.6 Mounting device for maintaining the hypodermic needle and attachments in their required positions (figure 1).

5.1.7 Small beaker.

5.1.8 Balance, accurate to 0,01 g.

5.1.9 Transparent film, resistant to the test liquid.

5.1.10 Absorbent paper (e.g. filter paper), 0,15 mm to 0,2 mm thick.

5.1.11 Stopwatch, accurate to 0,1 s

5.1.12 Temperature controlled room or cabinet to enable tests to be carried out at temperatures other than ambient.

5.1.13 Appropriate precautions applicable to the use of equipment under pressure and the forceful discharge of liquid chemicals should be taken.

NOTE 1: The transparent film is to protect the gutter and obviate the need to rinse it between tests.

NOTE 2: The filter paper will show any passage of the test liquid through the test piece. The semicylindrical cover is used to maintain intimate contact between the contaminated area of the test piece and the filter paper after release of the test liquid.

5.2 Test Liquid

5.2.1 Selection

Use that or those liquid(s) against which protection is required.

NOTE: If necessary, in particular for safety reasons, substitutes may be used, provided that the test laboratory can demonstrate that their effects on the results are similar to those of the chemicals against which protection is required.

Water adjusted to a surface tension of ($30 \times 10^{-3} \pm 3 \times 10^{-3}$) N/m is a convenient and safe test liquid for general screening purposes.

The results of tests with volatile liquids may not be reproducible unless validated procedures are followed to control losses by evaporation to a constant definable level. The measurements of penetration and repellency may be facilitated conveniently however by the solution of an analysable substance (e.g. fluorescent or visible dye tracers) in the volatile liquid provided it does not influence the performance of the test piece (i.e. its resistance to penetration and repellancy).

5.2.2 Temperature of application

Test liquids shall be adjusted to the required test temperature.

5.3 Preparation of test pieces

5.3.1 Test pieces are taken from flat samples of materials used or to be considered for use in construction of protective clothing resistant to penetration (see clause 2).

5.3.2 Where the influence of environmental factors, washing, chemical degradation, etc. on resistance to penetration is to be assessed representative control test pieces should be retained.

5.4 Procedure

5.4.1 For each test liquid, take six test pieces of (360 ± 2) mm by (235 ± 5) mm from the clothing or sample of material. In the case of woven fabrics, three test pieces are taken in the direction of the warp and three in the direction of the weft. For nonwoven fabric, if the direction of manufacture is recognizable, take three test pieces in that direction and three at right angles to it.

5.4.2 Fold under 30 mm of the length of the test piece and hold the fold in position on both sides by any appropriate means. Avoid any creases in the fabric.

5.4.3 Cut out a rectangle (300 ± 2) mm by (235 ± 5) mm of the filter paper and the transparent film and weigh them together to the nearest 0,01 g.

5.4.4 Check that the apparatus, test liquid and test pieces have been conditioned to the required test temperature.

5.4.5 Check that the volume of test liquid delivered via the needle is within the designated limit (see 5.1.5).

5.4.6 Place the weighed transparent film and absorbent paper, and test piece (in that order) in the gutter. Ensure that their top edges align with the top edge of the gutter and that the folded edge of the test piece is face down and protruding 30 mm from the lower edge (figure 1). Eliminate all creases in each layer and ensure that all surfaces are in close contact. Secure with clips.

5.4.7 Weigh the beaker to the nearest 0,01 g. Place it under the folded edge of the test piece for collection of test liquid running off the surface.

5.4.8 Mount the hypodermic needle vertically through the centre of an imaginary line, which joins the apices of the two uppermost corners of the gutter, so that the ground tip of the needle is (100 ± 2)mm from the inclined surface of the gutter (see figure 1).

5.4.9 Simultaneously start the stopwatch and discharge the test liquid (10 ml) within (10 ± 1) s, via the needle, on to the surface of the test piece. Without delay, rest the semi-cylindrical cover centrally on top of the test piece and ensure that the lower edges of the cover and the gutter are in line.

5.4.10 After 60 s (from the start of the discharge of the test liquid), tap the gutter to dislodge any drops hanging from the folded edge of the test piece. Remove the cover and the test piece carefully to avoid additional run-off either into the beaker or on to the underlying absorbent paper and reweigh to the nearest 0,01 g:

- the absorbent paper and underlying film
- and the beaker.

5.4.11 Complete these steps (5.4.1 to 5.4.10) for the remainder of the test pieces. Repeat the tests with a similar batch of test pieces at the designated higher rate of flow of test liquid (10 ml in (4 ± 0,2) s) only when penetration appears to be minimal (e.g. less than 0,5 ml) at the low flow rate (10 ml in (10 ± 0,5) s).

5.5 Expression of results

5.5.1 For each test piece calculate the indices of penetration and repellency, for each test liquid and flow rate, as follows.

5.5.2 Index of penetration (P) = $\frac{M_p \cdot 100}{M_t}$

where

M_p = mass (in grams) of test liquid deposited on the absorbent paper/film combination;

M_t = mass (in grams) of test liquid discharged on to the test piece.

5.5.3 Index of repellency (R) = $\frac{M_r \cdot 100}{M_t}$

where

M_r = mass (in grams) of test liquid collected in the beaker.

(M_t see 5.5.2)

5.5.4 Express the indices (P) and (R) to one significant decimal place.

NOTE: Where reliable correction factors for evaporative losses can be applied then the mass lost under the experimental conditions should be added to M_p or M_r before calculation of the respective indices (P) and (R).

6 Test report

The test report shall include the following information:

a) that the test was carried out in accordance with this standard;
b) the manufacturer's identity for the material tested and, where appropriate, the particular part of a named item from which the test pieces have been taken;
c) the weight per unit area in g/m² of the material tested;
d) description of any pre-treatments and/or preconditioning of the material tested;
e) the test liquid(s) used, including composition, trade names etc;
f) temperature (in degrees Celsius) and range used in the tests;
g) all individual test results (indices of penetration and repellency for a given liquid and flow rate of application) and any other influencing factors;
h) any comments considered appropriate by the person who has carried out the tests.