SLOVENSKI STANDARD
SIST EN 369:1996

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Varovalna obleka - Zaščita pred učinki tekočih kemikalij - Preskusna metoda: Odpornost materialov na prepustnost tekočin

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

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

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

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English version

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

Vêtements de protection - Protection contre les produits chimiques liquides - Méthode d'essai: Résistance des matériaux à la perméation par des liquides

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

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CEN

European Committee for Standardization
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Foreword

This European Standard was prepared by 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 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of an identical text or by endorsement, at the latest by September 1993, and conflicting national standards shall be withdrawn at the latest by September 1993.

In accordance with the CEN/CENELEC Internal Regulations, 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 and United Kingdom.

Annex A is informative.

Introduction

A simple flow-through, two-compartment permeation cell, of standard dimensions, is used to measure the permeation of liquid chemicals through clothing materials. It has been assumed in the drafting of this European Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people for whose guidance it has been prepared and that appropriate precautions will be taken to avoid injury to health and contamination of the environment.

1 Scope

This standard describes a laboratory test method that enables an assessment to be made of the resistance to permeation by liquids afforded by clothing materials.

The test method assesses the breakthrough time under laboratory conditions. It also enables observations to be made of the effects of the test liquid on the material under test.

It is emphasized that the test does not necessarily simulate conditions that clothing materials are likely to be exposed to in practice. The use of test data should therefore be restricted to the broad comparative assessment of such materials according to their permeation characteristics.

This test measures the permeation that arises from the combination of a process of diffusion of a test liquid from one side of a material to another together with a secondary process of desorption into a collecting medium.

The rate of the secondary process is influenced by the diffusion rate of the liquid through the material, by the degree of distortion and gradual extension of the test specimen as increasing amounts of liquid are absorbed and by the experimental procedures used to collect and analyse the diffused liquid.

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 reference the latest edition of the publication referred to applies.

ISO 2286 Rubber- or plastics-coated fabrics - Determination of roll characteristics

3 Definitions

For the purposes of this standard the following definitions apply.

3.1 Breakthrough time

The elapsed time between the initial application of a test liquid to the appropriate surface of the material and its subsequent presence on the other side of the material. Measured as described in this standard.

3.2 Permeation

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

- sorption of the molecules of the chemical into the contacted (outside) surface of the material;
- diffusion of the sorbed molecules in the material;
- desorption of the molecules from the opposite (inner) surface of permeation.

3.3 Steady state permeation

A state that is reached when the rate of permeation becomes virtually constant.

3.4 Test liquid

An individual liquid chemical or a liquid formulation of chemicals that is submitted for test by the method of this European Standard.

4 Principle

The test specimen acts as a barrier between one compartment of a permeation cell, which contains the test liquid, and another compartment through which a stream of gas or liquid is passed (flow-through compartment) for the collection of diffused molecules of the test liquid or its component chemicals for analysis. The mass of the test liquid or its component chemicals in the collecting medium is determined as a function of time after application to the test specimen.

5 Reagents

5.1 Gaseous collecting medium

Either dry air or a dry non-flammable inert gas (e.g. nitrogen, helium).

NOTE: This gas is used, under continuous flow conditions, for the collection of diffused molecules from the test liquid capable of vapourizing under the conditions of the test in sufficient quantities for analysis.

5.2 Liquid collecting medium

Either water or other liquid which does not influence the resistance of a material to permeation.

NOTE: This liquid is used, under continuous flow conditions, for the collection of diffused molecules of low volatility that are soluble in the collecting medium under the conditions of the test in sufficient quantities for analysis.

6 Apparatus

6.1 Permeation cell, comprising two flanged compartments with dimensions as shown in figure 1 forming a hollow cylinder when bolted together through the flanges. The upper compartment (or liquid compartment, see figure 1) for containment of the test liquid is fitted with a loose cover to avoid build-up of pressure and prevent excessive contamination of the immediate environment when volatile chemicals are under test.

The lower compartment (or flow compartment) is of similar overall dimensions (see figure 1) but pipework is introduced to allow gas or liquid to circulate freely at the designated rates (clause 6.3 and clause 6.4) without build-up of pressure.

NOTE 1 : The internal dimensions of the flow-through compartment (figure 1) and its pipework (internal diameter 4,5 mm) are critical to the performance of the test.

NOTE 2: The permeation cell and pipework should be constructed from inert materials. Brass apparatus is generally suitable for permeation tests by the gas-flow technique and polytetrafluoroethylene or glass by the liquid-flow technique.

6.2 Temperature controlled room, cabinet or water bath, to maintain temperature constant to a tolerance of ±1°C over the period of test.

6.3 Equipment for supply of gaseous collecting medium, comprising compressed gas supply (e.g. dry air, helium or nitrogen) complete with regulator, flowmeter and pipework for connection to the inlet of the flow compartment of the permeation cell.

The rate of flow shall be (520 ± 52) ml/min in the direction indicated on figure 1.

The gas shall not be recirculated through the cell.

NOTE: The required rate of flow may be obtained either by suitable control of the gas pressure at the inlet to the permeation cell or by providing a pump at the outlet from the analyzer. These alternative configurations are shown in figure 2. The choice of configuration is generally determined by the method of collection and/or detection of the test liquid or its component chemicals.

6.4 Equipment for supply of the liquid collecting medium, comprising liquid flow pump complete with regulator, flowmeter and pipework for connection to the inlet of the flow compartment of the permeation cell.

The rate of flow shall be (206 ± 21) ml/min in the direction indicated in figure 1.

The materials of construction of the equipment are such that no parts of the pump, associated pipework and flowmeter contaminate the liquid to be passed through the flow compartment of the permeation cell.

NOTE: If it is impossible to obtain the minimum sensitivity defined in clause 6.5 with an open loop system, it is permitted to use a closed loop system. When the closed loop system is used with discrete sampling see Annex A for the calculation.

6.5 Equipment for measurement of the mass of test liquid or its component chemicals in the gas or liquid collecting medium may include instruments responding directly to changes in concentration in the stream of gas or liquid, or may include absorbers and sampling equipment associated with specific analytical procedures.

NOTE: The analytical system shall have a minimum sensitivity for the selected component chemical of 1 µg/(min·cm²) of exposed specimen. The maximum response time should be 60s. If the delay time is in excess of 60s, the reported breakthrough time shall be corrected with the total delay time. Whatever apparatus is coupled to the permeation cell to measure concentrations in the collecting medium, the pressure and flow of the collecting medium within the permeation cell should remain constant.

6.6 Stopclock, capable of measuring to the nearest second.

7 Test Specimens

7.1 Selection

From a flat sample of the material submitted for test, cut from the same location a minimum of three test specimens of the same diameter as the flange of the permeation cell, avoiding as far as possible any obvious perforations, surface defects or pinholes.

NOTE 1 : The testing of three similar specimens is intended to establish that the test method has been carried out correctly in accordance with clause 8.5. If permeation testing is to be used to establish the uniformity of quality in a larger area of test material e.g. a roll or sheet, then an appropriate statistical sampling technique should be used. In this case three samples should be tested from each sampling site to demonstrate consistency of the permeation test.

NOTE 2: When defects in the test specimens may be such as to allow gross quantities of the test liquid to pass into the flow compartment, due account should be taken of the potential consequences of overloading the analytical detection equipment.

7.2 Preparation of the test specimens

Use a template to mark on the test specimen the positions of the bolts used to clamp the two halves of the cell together. Cut circular holes to allow the bolts to pass freely through the test specimen when placed between the two halves of the permeation cell.

The thickness of each test specimen shall be determined using techniques described in ISO 2286.

8 Procedure

8.1 Calibration

Calibrate the response of the analytical system to the test liquid or its component chemicals and, where appropriate, ensure that concentrations up to saturation of the collecting medium may be determined.

8.2 Preparation of the apparatus

Mount the test specimen between the two halves of the permeation cell. Ensure that the surface of the test specimen corresponding to the outer surface when in use is uppermost in the cell, facing the compartment used to contain the test liquid. Check that the test specimen is not under tension when laid in position over the bolts. Tighten the bolts to obtain a leak-tight assembly.

Where appropriate, take precautions to avoid transference of liquid from the top to the undersurface of the test specimen.

NOTE: These precautions apply in particular if, for example, the top surface acts as a wick and the undersurface is rough, when liquid may be drawn by capillary action across the top surface and reach the undersurface via the bolt holes.

Place the assembled permeation cell, complete with leaktight pipework and connection to the appropriate equipment (clause 6.3 or 6.4), in the temperature controlled room, cabinet or water bath (clause 6.2) at the required temperature.

NOTE: The test should be conducted at the temperature most relevant to the use of the material or, in the absence of other preference, at 20°C.

Connect the appropriate gaseous or liquid collecting medium and adjust the flow through the permeation cell to the required rate (clause 6.3, 6.4) and allow the system to stabilize. Connect the system to suitable analytical equipment (clause 6.5) and recheck the flow characteristics.

8.3 Assessment

8.3.1 Assessment of breakthrough time

Bring the test liquid to the required test temperature and maintain this temperature to within 1°C for the duration of the test.

Discharge 10 ml of the test liquid rapidly into the uppermost compartment of the permeation cell and start the clock (clause 6.6). Ensure that the appropriate surface of the test specimen is completely covered with the test liquid throughout the period of the test.

NOTE: If the density of the test liquid is high and the strength of the sample under test is low e.g. latex films, the weight of liquid may distort the test sample leading to an increase in sample area. In this case the liquid volume may be reduced but care should be taken to ensure that the test sample is completely covered with the test liquid throughout the period of the test.

Analyse, either continuously or at appropriate intervals of time according to the equipment used (see clause 6.5), the collecting medium that forms the effluent stream from the lower compartment of the permeation cell. If this entails the analysis of discrete samples, record the mid-point in the time elapsing between the drawing of successive samples and calculate the difference in time between one such mid-point and the next.

The breakthrough time is deemed to have occured when the analytical equipment detects a permeation rate of 1 µg/(min·cm^2) of exposed specimen.

Repeat the test with the other two test specimens.

8.3.2 Assessment of physical condition of test specimen

Remove the test specimen from the permeation cell. Visually inspect each test specimen in a well-lit area and observe whether the test specimen has been changed in any way by its contact with the test liquid. If any change is observed, note whether the test specimen has become flaked, swollen, disintegrated and/or embrittled. Note the nature of any other changes.