SLOVENSKI STANDARD
SIST EN 374-3:1996

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Varovalne rokavice za zaščito pred kemikalijami in mikroorganizmi - 3. del: Določanje odpornosti na pronicanje kemikalij

Protective gloves against chemicals and micro-organisms - Part 3: Determination of resistance to permeation by chemicals

Schutzhandschuhe gegen Chemikalien und Mikroorganismen - Teil 3: Bestimmung des Widerstandes gegen Permeation von Chemikalien

Gants de protection contre les produits chimiques et les micro-organismes - Partie 3: Détermination de la résistance a la perméation des produits chimiques

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English version

Protective gloves against chemicals and micro-organisms - Part 3: Determination of resistance to permeation by chemicals

Gants de protection contre les produits chimiques et les micro-organismes - Partie 3: Détermination de la résistance à la perméation des produits chimiques

Schutzhandschuhe gegen Chemikalien und Mikroorganismen - Teil 3: Bestimmung des Widerstandes gegen Permeation von Chemikalien

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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 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of an identical text or by endorsement, at the latest by July 1994, and conflicting national standards shall be withdrawn at the latest by July 1994.

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.

0 Introduction

A simple flow-through, two-compartment permeation cell, of standard dimensions, is used to measure quantitatively the permeation of chemicals through protective glove materials. Breakthrough time is measured and used as a measure of protection.

It has been assumed in the drafting of this 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 covers the determination of the resistance of protective glove materials to permeation by potentially hazardous non-gaseous chemicals under the condition of continuous contact.

It is emphasized that the test does not represent conditions likely to be found in service, and the use of test data should be restricted to comparing materials chiefly on a relative basis in broad categories of breakthrough times .

2 Normative references

This European Standard incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate place 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 .

EN 374-1 Protective gloves against chemicals and micro-organisms - Part 1: Terminology and performance requirements

ISO 4648 Rubber, vulcanized or thermoplastic - Determination of dimensions of test pieces and products for test purposes

3 Definitons

For the purposes of this standard, the definitions in EN 374-1 apply with the following definiton:

delay time: Time between actual arrival of the test chemical on the collecting side of the specimen and the time when the analytical instrumentation can detect it.

4 Principle

The resistance of a protective glove material to permeation by a solid or liquid chemical is determined by measuring the breakthrough time of the chemical through the glove material.

In the permeation test apparatus the glove material partitions the test chemical from the collecting medium.

The collecting medium, which can be a gas or a liquid, is analysed quantitatively for its concentration of the chemical and thereby the amount of that chemical that has permeated the barrier as a function of time after its initial contact with the glove material.

5 Collecting media

5.1 Gaseous collecting medium

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

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

5.2 Liquid collecting medium

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

Note: This liquid is circulated or stirred, and it is used 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 Test cell

The test apparatus consists of a two-compartment cell for contacting the specimen with the test chemical on the specimen's normal outside surface and with a collecting medium on the specimen's normal inside surface.

6.1.1 The test cell, as shown in figure 1 and figure 2, is constructed of two sections of glass pipe, each nominally sized to an internal 51 mm diameter. Materials other than glass may be used. Such materials would be required for tests involving chemicals (for example, hydrofluoric acid) which are incompatible with glass. The section that is designated to contain the test chemical is 22 mm in length. The second section, which is designated to contain the collecting medium, is 35 mm.

6.1.1.1 One end of each glass section is sealed closed (for example, with a glass disk equivalent in quality to that of the glass of the original sections).

6.1.1.2 The opposite end of each glass section is fitted with connecting joints (see figure 1).

6.1.1.3 Inlet and outlet ports with appropriate stopcock valves are added to each glass section as shown (see figure 1 and figure 2).

6.1.1.4 When assembled, the two glass sections are joined by aluminium or stainless steel flanges.

6.1.2 A specimen is positioned between the two flanges as shown in figure 1. When the specimen is in place, the test cell is divided into two compartments.

6.1.3 Polytetrafluoroethylene (PTFE) gaskets are used in all joints.

6.2 Alternative test cell

Alternative test cells for conducting permeation determinations can also be used, provided they have been found equivalent with the cell described in 6.1 (that is the reference cell). The equivalency shall be demonstrated by comparing the alternate cell with the reference cell. The evaluation shall consider the precision and bias of breakthrough time.

6.3 Temperature controlled room, cabinet or water bath

To maintain temperature constant to a tolerance of ± 1 °C over the period of test.

6.4 Compressed gas supply (e. g. dry air, nitrogen or helium)

The gas supply is connected by pipework, including a regulator and flowmeter to the inlet of the permeation cell. The rate of flow through the reference cell shall be equivalent to 5 compartment volume change per minute ± 10 %.

Note: The volume of the collecting compartment shall be measured accurately. This can be done by weighing the cell before and after filling this compartment with water. For the reference cell the volume is 71 ml.

The gas shall not be recirculated through the cell.

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 analyser. The choice of configuration is generally determined by the method of collection and/or detection of the test chemical.

6.5 Liquid pump or stirrer

The rate of flow or stirring shall be sufficient to assure that an adequate degree of mixing is produced. The chosen flow rate shall be maintained constant to a tolerance of ± 10 %.

For closed loop systems with liquid collecting media, an adequate mixing level shall be assured, if necessary by experimentation.

No parts of the pump, stirrer, or any associated apparatus shall contaminate the liquid to be passed through the flow compartment of the permeation cell.

6.6 Equipment for measurement of the mass of test chemical or its component in the gas or liquid collecting medium

The equipment may include instruments responding directly to changes in concentration in the stream of gas or liquid, absorbers and sampling equipment associated with specific analytical procedures.

The analytical system shall have a minimum sensitivity for the test chemical of 1 $\mu g\ min^{-1}cm^{-2}$ of exposed specimen. The maximum delay time should be 60 s. If the delay time is in excess of 60 s, the reported breakthrough time shall be corrected with the total delay time. In case of mixtures the analytical equipment should be capable of detecting all relevant components. 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 be maintained constant.

Suitable analytical techniques to detect the test chemical can include UV (ultraviolet) and IR (infrared) spectrophotometry, gas and liquid chromatography, colourimetry, and radionuclide tagging detection counting.

6.7 Stop clock

Capable of measuring to the nearest second.

7 Test specimens

7.1 Each material specimen to be tested shall have a minimum cross dimension of the same diameter as the flange of the permeation cell (68 mm in the case of the reference cell).

7.2 A minimum of three random specimens shall be tested for each type of glove. In the case of an irregular design at least one specimen should be tested from the weakest point of the glove.

Note: Irregular design elements can include partial overdips, seams, and differences in liner fabric.

8 Procedure

8.1 Calibration

The response of the complete collecting/analytical test system to the test chemical is calibrated in order to determine the analytical sensitivity and the delay time.

8.2 Preparation of test specimens and apparatus

The thickness is measured at the centre of each specimen according to the method given in ISO 4648.

The test specimen is mounted between the two halves of the permeation cell. It should not be under tension when so positioned. The outer surface of the glove material should be in contact with the test chemical. The bolts of the assembly should be tightened to ensure the system is leaktight.

The assembled permeation cell is placed in a temperature controlled room, cabinet or water bath (see 6.3) at the specified temperature.

8.3 The standard test temperature shall be (23 ± 1) °C. Additional test may be run at other temperatures if they are relevant to the use of the gloves.

The gas or liquid stream is connected to the cell and the flow adjusted to the required rate (see 6.4 and 6.5). After the system has stabilized and connected to the detection equipment (see 6.6) the flow is rechecked.

8.4 Assessment of breakthrough time

The breakthrough time is deemed to have occured when the analytical equipment detect a permeation rate of 1 µg $min^{-1}cm^{-2}$. See 8.5.2 and the formulas in 8.5.3.

8.5 Procedure

8.5.1 The test chemical, at the required test temperature (± 1 °C), is introduced into the challenge compartment of the permeation cell (see figure 1) and stopclock is started (see 6.7). The compartment containing the test chemical shall be completely filled during the period of the test.

8.5.2 According to the equipment used (see 6.6) either the analysis measurements are taken continuously or discrete samples are withdrawn at suitable intervals of time. In the latter case the mid-point in the time elapsing between the drawing of successive samples and the difference in time between one such mid-point and the next is recorded. It is assumed that the entry of the test chemical into the collecting medium is constant.

The permeation rate is the concentration of the test chemical in collecting medium times the flow rate of collecting medium through the cell divided by the area of the specimen in contact (µg $min^{-1}cm^{-2}$).

8.5.3 Using a closed loop system breakthrough is deemed to have occured when the calculated permeation rate reaches 1 µg $min^{-1}cm^{-2}$.

The average permeation rate between two subsequent samplings, when samples are withdrawn, analysed, and replaced prior to further sampling or when the volume of discrete samples is insignificant relative to the total volume (for example microlitre aliquots) or when the test chemical is measured in situ, is calculated as follows:

$$P = \frac{(C_i - C_{i-1})\ V_t}{(t_i - t_{i-1})\ A}$$

The average permeation rate between two subsequent samplings, when discrete samples of significant volume are removed from the collecting medium, is calculated as follows:

$$P = \frac{(C_i - C_{i-1})\ (V_t - [i-1]\ V_s)}{(t_i - t_{i-1})\ A}$$

In case of replenishment of the collecting medium after each discrete sample the calculation becomes:

$$P = \frac{\left[C_i - C_{i-1}\left[\frac{V_t - V_s}{V_t}\right]\right]Vt}{(t_i - t_{i-1})A}$$