BS EN 374-4:2013

BSI Standards Publication

Protective gloves against chemicals and micro-organisms

Part 4: Determination of resistance to degradation by chemicals

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee PH/3/8, Protective gloves.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Protective gloves against chemicals and micro-organisms - Part 4: Determination of resistance to degradation by chemicals

Gants de protection contre les produits chimiques et les micro-organismes - Partie 4: Détermination de la résistance à la dégradation par des produits chimiques

Schutzhandschuhe gegen Chemikalien und Mikroorganismen - Teil 4: Bestimmung des Widerstandes gegen Degradation durch Chemikalien

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Foreword

This document (EN 374-4:2013) has been prepared by Technical Committee CEN/TC 162 “Protective clothing including hand and arm protection and lifejackets”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by May 2014 and conflicting national standards shall be withdrawn at the latest by May 2014.

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

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

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

EN 374 consists of the following parts under the general title, *Protective gloves against chemicals and micro-organisms:*

— *Part 1: Terminology and performance requirements;*

— *Part 2: Determination of resistance to penetration;*

— *Part 3: Determination of resistance to permeation by chemicals;*

— *Part 4: Determination of resistance to degradation by chemicals.*

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies the test method for the determination of the resistance of protective glove materials to degradation by dangerous chemicals with continuous contact.

NOTE Annex A gives information on interlaboratory test results on this method.

Other tests used to evaluate chemical resistance such as permeation resistance and penetration resistance may not provide sufficient information on the physical property changes affecting a glove during exposure to a chemical. It is necessary that the outside surface of the glove be exposed to the chemical.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 374-1:2003, *Protective gloves against chemicals and micro-organisms - Part 1: Terminology and performance requirements*

EN 388:2003, *Protective gloves against mechanical risks*

EN 420:2003+A1:2009, *Protective gloves - General requirements and test methods*

3 Terms and definitions

For the purposes of this document, the terms and definition given in EN 374-1:2003 and EN 420:2003+A1:2009 apply.

4 Test principles

The resistance of a protective glove material to degradation by a liquid chemical is determined by measuring the puncture resistance change of the glove material after a continuous contact with the external surface with the challenge test chemical. The test is applicable to gloves made of natural or synthetic polymer. Lined gloves may produce unusable measurement results.

5 Test methods, Puncture resistance test

5.1 Sampling

Select three gloves for testing. Condition the gloves at (23 ± 2) °C, (50 ± 5) % relative humidity for at least 24 hours.

In the case of irregular and/or multiple construction, one sample shall be tested from each area. Using the appropriate circular die of 20 mm, cut 6 specimens of each glove for a total of 18 test specimens. For each glove, 3 specimens will be exposed to the challenge chemical and 3 specimens will be unexposed.

Select specimens so that they are homogeneous and representative of the glove’s primary construction. Avoid embossed patterned areas or other areas of varying thickness or composition when cutting these specimens.

If a glove is constituted of several unbounded layers, only the layer giving the chemical protection shall be tested.

The sample shall be tested according to the method described in 5.3. An additional non-mandatory informative test method is given as an example in Annex B.

For lined gloves, if it is not possible to separate the liner from the glove (and if the liner is too thick), the test may not be feasible, because it is not possible to seal the vial and the sample is moving. For certain samples, if there is a thick liner, it may not be necessary to use the septa to have a correct vial sealing. In this case, the liner will ensure the leakproofness.

5.2 Apparatus

The following equipment shall be used:

a) (20 ± 1) mm diameter cutting die;

b) (12 ± 1) mm diameter cutting die (for cutting a hole to the centre of each septum);

c) 20 ml crimp top vials (opening (12,5 ± 0,5) mm of diameter);

d) 20 mm diameter septa (e.g. made from chlorobutyl rubber without polytetrafluoroethylene (PTFE) layer);

e) 20 mm open centre aluminium crimp seals;

f) hand crimper;

g) hand decapper;

h) samples holder with 18 holes of 20 mm diameter;

i) 150 ml beaker;

j) transfer pipette, 2 ml;

k) dynamometer with a puncture stylus according to EN 388:2003, 6.4 and a cell to measure compression forces with a precision of ± 1 %;

l) sample vial support.

5.3 Procedure

5.3.1 Test conditions

The test shall be conducted at (23 ± 2) °C (preparation, chemical, time exposure to chemical, puncture test).

5.3.2 Pre-testing measurements

Place the challenge chemical into the 150 ml beaker. Using the transfer pipette, place about 2 ml of challenge chemical into one of the crimp top vials.

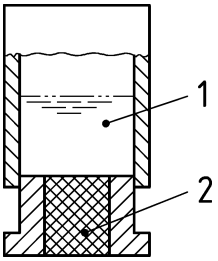
Seat a septum in an open centre aluminium crimp seal cap. Using the (12 ± 1) mm cutting die, make a centred hole in the septum.

Place a glove specimen on top of the septum with its normal external surface facing towards the interior of the vial. Place the aluminium cap with the sample on top of the vial. Seal the vial using the hand crimper and invert it so that the challenge chemical is in contact with the specimen (see Figure 1). Record the time. Place the vial in the punched-out sample holder.

NOTE The punched-out sample holder has a twofold purpose. 1) It allows air to circulate under the sample film, and 2) if the pressure from the challenge chemical forces the sample into a convex shape, the flask will still stand.

Repeat the procedure in the above paragraph for each of the remaining eight specimens that are to be exposed. Time these actions so that the exposures on succeeding specimens begin at three-minute intervals. At the end of the one-hour exposure period (±5 min), examine each test vial to confirm coverage of the specimen with the challenge chemical. If the chemical is not covering the specimen, discard the specimen and repeat the test using a larger quantity of challenge chemical.

Mount the nine unexposed specimens in the remaining vials in the same manner, except that no chemical is placed in the vial.

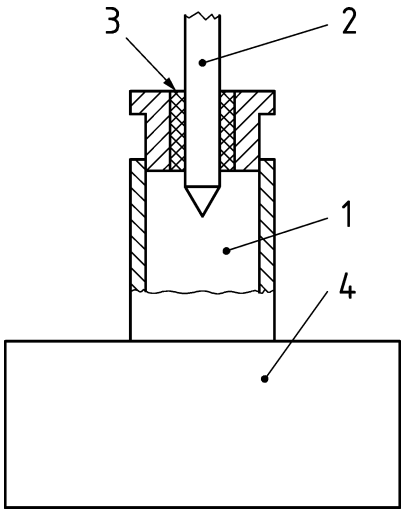


Key

1 challenge chemical

2 outer surface of the glove sample which is in contact with the challenge chemical, it is a circular area of (12,5 ± 0,5) mm diameter

Figure 1 — Position of the vial during contact time between the sample and the dangerous chemical



Key

1 20 ml crimp vial

2 puncture stylus

3 sample

4 vial carrier (to be maintain by the dynamometre jaw)

Figure 2 — Position of the vial during puncture test

5.3.3 Puncture testing

Install the puncture stylus on the dynamometer load cell. Set the carriage speed to 100 mm/min and screw the vial support onto the table.

Place a vial into the support. Puncture the specimen and record the peak force required (see Figure 2).

Repeat for each of the specimens; test each of the exposed specimens one hour after the exposure on that specimen was started.

Test specimens shall be examined for any changes to their physical properties during and after the test (after drying). Any changes such as swelling, shrinking, brittleness, hardening, softening, flaking, disintegration, colour change/bleeding, delaminating shall be noted and described on the test report for information.

5.3.4 Expression of results

Determine the degradation for each of the three glove specimens against each specific chemical or chemical mixture using the formula:

$$DRx = \frac{(OPx - RPx)}{OPx} X\ 100 \quad (1)$$

where

DRx is the degradation of the x glove specimen against challenge chemical tested, in %;

OPx is the average puncture force on the three unexposed test specimens from the x glove specimen; units shall be same as RPx;

RPx is the average puncture force on the three exposed test specimens from the x glove specimen; units shall be same as OPx .

Determine the degradation of the sample against the challenge chemical using the following Formula (2):

$$DR = \frac{(DR1 + DR2 + DR3)}{3} \quad (2)$$

where

DR is the degradation of the test sample against challenge chemical tested, in %;

$DR1$ is the degradation of the first glove specimen against challenge chemical tested, in %;

$DR2$ is the degradation of the second glove specimen against challenge chemical tested, in %;

$DR3$ is the degradation of the third glove specimen against challenge chemical tested, in %.

Determine the standard deviation (SD) of the degradation for the three gloves.

6 Test report

For each protective glove material tested, a report shall include the following information:

a) Report the manufacturer’s reference for the glove tested including the material, style, and lot number.

b) Report the name of the test chemical, its purity, and if it is in a mixture, its concentration and other components.

c) Make reference to this European Standard.

d) Report the date of the test.

e) Report DR1, DR2, DR3, DR (see 5.3.4), the percent change in the puncture for the glove material. The SD shall also be reported.

f) Report whether the liner, if present, has been separated from the test specimen.

g) Report any observations of changes in the physical appearance of the material specimens following chemical exposure. Examples of reported observations are swelling, shrinking, brittleness, hardening, softening, flaking, disintegration, colour change/bleeding and delaminating.

h) Any deviation to this European Standard shall be reported.

Annex A
(informative)

Inter laboratory test on the present test method

The following degradation data have been obtained in a collaborative correlation trial on by several laboratories, using the test method described in Clause 5.

Table A.1 — Results in % of correlation trial with natural rubber gloves (thickness 0,6 mm)

Laboratory	Ethyl acetate		Heptane	
	Mean value	Standard deviation	Mean value	Standard deviation
1	43	6,8	66	4,0
2	37	10	61	7,0
3	36	5,9	47	1,6
4	39	4,5	49	2,8
5	40	5,3	56	6,1
6	32	2,8	51	8,1
7	-	-	56	2,4
Mean value	37,8	5,9	55,1	4,6

Table A.2 — Results in % of correlation trial with other gloves materials

Laboratory	Acetone			Sulfuric acid		
	Mean value glove in Nitrile	Mean value glove in PVC	Mean value glove in Polychloroprene	Mean value glove in Nitrile	Mean value glove in PVC	Mean value glove in Polychloroprene
1	85	90	65	49	−36	3
2	89	86	63	57	−55	6
3	88	98	60	46	−50	−6
4	86	89	60	57	−41	5
5	92	87	-	40	−31	-
6	-	-	-	62	-	13

Annex B
(informative)

Weight change test

B.1 General

This method is only dedicated to material assessment and does not take into account the actual use of a personal protective equipment (PPE).This annex describes another test method for the determination of the resistance of materials to degradation by dangerous chemicals with continuous contact by a weight change test.

B.2 Sampling

The glove shall be conditioned at (23 ± 2) °C for at least 24 h. The specimens shall be taken from three gloves. Put the glove flat on a surface and measure (60 ± 2) mm from fingertip. The specimens shall consist of a cut off of the same finger of each glove.

B.3 Apparatus

B.3.1 Analytical balance, accurate to 0,001 g, used to determine weight.

B.3.2 Beakers, e.g. a 50 ml glass beaker or other container (depth of at least 5,1 cm).

B.3.3 Time measuring device, a stopwatch or other timing devices.

B.3.4 Test tube with a weight, or other device to hold specimen upright in beaker.

B.3.5 Covered weighing dish, for holding specimens during weighing.

B.4 Procedure

B.4.1 Measurements

Measure the original weight of each finger specimen to the nearest 0,001 g.

B.4.2 Test conditions

The test shall be conducted at (23 ± 2) °C (preparation, chemical, time exposure to chemical).

B.4.3 Procedure

Start the timer and immerse the finger specimen in a beaker containing the test chemical. The weighed test tube will hold the specimen upright in the beaker. The beaker should be filled to a depth of (42 ± 2) mm with the test chemical (Figure B.1). The quantity of the test chemical shall be adapted during the test to keep the beaker filled to the marking. Multiple finger specimens may be started at approximately one minute timed intervals to allow for weighing of the specimens.

Dimensions in millimetres

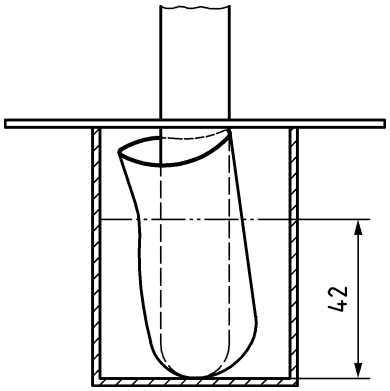


Figure B.1 — Typical arrangement of weight gain test apparatus

After 60 min (±5 min) of exposure, remove the finger specimen from the chemical, lightly blot dry to remove surface liquid with a clean towel, place in a covered weighing dish, and record the specimen weight to an accuracy to the nearest 0,001 g. The weighing of the finger cut shall be carried out as quickly as possible after 60 min exposure.

Finger specimens shall be examined for any changes to their physical properties during and after the test (after drying). Any changes such as swelling, shrinking, brittleness, hardening, softening, flaking, disintegration, colour change/bleeding, delaminating shall be noted and described on the test report.

B.4.4 Calculation

Calculate the percent weight change based on the initial weight. The weight change may be positive (increase) or negative (decrease). Calculate the change in weight between the original specimen and the specimen weight after 60 min of exposure. Divide this difference by the original weight and multiply by 100 to obtain the percent weight change.

Determine an average of the percent weight change for the three test specimens. Also determine the standard deviation (SD) of the percent weight change for the three test specimens.

B.4.5 Expression of results

The weight change results and SD are expressed in percent.

B.5 Test report

For each protective glove material tested, a report shall include the following information:

a) Report the manufacturer’s reference for the glove tested including the material, style, and lot number.

b) Report the name of the test chemical, and if it is in a mixture, its concentration and other components.

c) Make reference to this European Standard.

d) Report the percent change in weight for each specimen and the average value and SD.

e) Report the date of the test.

f) Report any observations of changes in the physical appearance of the material specimens following chemical exposure. Examples of reported observations are swelling, shrinking, brittleness, hardening, softening, flaking, disintegration, colour change/bleeding and delaminating.

g) Any deviation to the standard shall be reported.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 89/686/EEC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 89/686/EEC on the approximation of the laws of the Member States relating to personal protective equipment.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard, together with the relevant requirements given in the product standards, confers within the limits of the scope of those standards, a presumption of conformity with the Essential Requirement 1.3.2 of Annex II of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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