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Varovalne obleke pred kemikalijami - Preskusne metode in zahteve za razvrščanje materialov za izdelavo varovalnih oblek, šivanje, spajanje in sestavljanje

Protective clothing against chemicals - Test methods and performance classification of chemical protective clothing materials, seams, joins and assemblages

Schutzkleidung gegen Chemikalien - Prüfverfahren und Leistungseinstufung für Materialien, Nähte, Verbindungen und Verbünde

Habillement de protection contre les produits chimiques - Méthodes d'essai et classification de performance des matériaux, coutures, jonctions et assemblages des vêtements de protection chimique

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This European Standard was approved by CEN on 16 October 2017.

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European foreword

This document (EN 14325:2018) 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of an identical text or by endorsement, at the latest by December 2018, and conflicting national standards shall be withdrawn at the latest by December 2018.

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

This document supersedes EN 14325:2004.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

A list of significant technical changes between this document and the previous edition can be found in Annex A.

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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies the performance classification and test methods for materials used in chemical protective clothing, including gloves and footwear. The gloves and boots should have the same chemical protective barrier requirements as the fabric when an integral part of the clothing. This is a reference standard to which chemical protective clothing performance standards may refer in whole or in part, but this standard is not exhaustive in the sense that product standards may well require testing according to test method standards which are not included in this standard.

While these performance levels are intended to relate to the usage to which the chemical protective clothing is to be put, it is essential that the chemical protective clothing manufacturer or supplier indicate the intended use of the protective clothing and that the user (specifier) carries out a risk assessment in order to establish the correct performance level for the intended task.

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 863:1995, *Protective clothing — Mechanical properties — Test method: Puncture resistance*

EN 13274-4:2001, *Respiratory protective devices — Methods of test — Part 4: Flame tests*

EN 20811:1992, *Textiles — Determination of resistance to water penetration — Hydrostatic pressure test*

EN ISO 139:2005, *Textiles — Standard atmospheres for conditioning and testing (ISO 139:2005)*

EN ISO 6530:2005, *Protective clothing — Protection against liquid chemicals — Test method for resistance of materials to penetration by liquids (ISO 6530:2005)*

EN ISO 7854:1997, *Rubber- or plastics-coated fabrics — Determination of resistance to damage by flexing (ISO 7854:1995)*

EN ISO 9073-4:1997, *Textiles — Test methods for nonwovens — Part 4: Determination of tear resistance (ISO 9073-4:1997)*

CEN ISO/TR 11610:2004, *Protective clothing — Vocabulary (ISO/TR 11610:2004)*

EN ISO 12947-2:2016, *Textiles — Determination of the abrasion resistance of fabrics by the Martindale method — Part 2: Determination of specimen breakdown (ISO 12947-2:2016)*

EN ISO 13934-1:2013, *Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method (ISO 13934-1:2013)*

EN ISO 13935-2:2014, *Textiles — Seam tensile properties of fabrics and made-up textile articles — Part 2: Determination of maximum force to seam rupture using the grab method (ISO 13935-2:2014)*

ISO 6529:2013, *Protective clothing — Protection against chemicals — Determination of resistance of protective clothing materials to permeation by liquids and gases*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CEN ISO/TR 11610 and the following apply.

3.1
abrasion rub
one revolution of the outer drives of the Martindale abrasion tester

[SOURCE: EN ISO 12947-1:1998]

3.2
abrasion cycle
completion of all the translational abrasion movements tracing a Lissajous figure comprising 16 rubs, i.e. 16 revolutions of the two outer drives and 15 revolutions of the inner drive of the Martindale abrasion tester

[SOURCE: EN ISO 12947-1:1998]

3.3
material
one or several substances, in form of flexible planar structure, of which an item of clothing is made, excluding hardware and labels

3.3.1
single layer material
material consisting of only one layer

3.3.2
multilayer material
material consisting of several layers, which may be either permanently bonded together or intimately combined prior to the garment manufacturing stage, or which can be separated without any damage to each individual layer

Note 1 to entry: By “permanently bonded together” is meant for example by coating, laminating, gluing. By “intimately combined” is meant for example by weaving, quilting.

3.3.3
multilayer material consisting of separate layers
multilayer material, where individual layers that are neither permanently bonded together nor intimately combined, can be separated without any damage to the individual layers

3.4
specimen breakdown
in abrasion resistance or flex cracking resistance testing, the visually observed deterioration in a specimen after exposure to a specified number of abrasion rubs or cycles of flexing

EXAMPLE

— In woven fabrics, when two separate threads are completely broken;

— in knitted fabrics, when one thread is broken down;

— in pile fabrics, when the pile is fully worn off;

— in nonwovens, when the first hole resulting from the wear is of a diameter at least equal to 0,5 mm;

— in coated material, when coating surface has the first hole resulting from the wear of a diameter at least equal to 0,5 mm.

Note 1 to entry: The hole does not have to be through all materials for it to be a specimen breakdown.

[SOURCE: EN ISO 12947-2:2016]

4 Performance classification of materials

4.1 Determination of property value for performance classification

A number of performance classification levels are identified for the various properties of materials to be found in this standard.

The value of each property defined in 4.4 to 4.15 and which shall be used for performance classification, shall be determined in accordance with Annex C including the calculation of uncertainty of measurement for all the results.

If not specified otherwise within 4.4, 4.5, 4.6, 4.7, 4.9 or within the specific test method itself, a material with different behaviour in the length and cross directions, shall be tested for its performance in both directions. The performance classification shall be based on the results obtained for the direction resulting in the lower performance classification when evaluated according to Annex C.

For a material with different surface characteristics, the fabric side that will appear on the outside of the apparel shall be tested for all test methods that are linked to surface performance (i.e. 4.4, 4.5, 4.6, 4.8, 4.11, 4.12, 4.13, 4.14, 4.15,) and the performance classification shall be based on the results for this side.

If the chemical protective clothing consists of multiple layers of materials, with or without separable layers, all layers shall be tested together with the chemical protective clothing outer surface being tested for those properties which are linked to surface performance.

For materials, which require pre-treatment, the performance classification shall be based on the lowest performance classification obtained on either testing new (not pre-treated) and/or pre-treated materials based on evidence. The performance classification tests shall be performed on the worst case. If insufficient evidence is available to determine whether the test shall be performed as new or pre-treated, the test shall be performed in both conditions.

4.2 Pre-treatment

4.2.1 Pre-treatment by cleaning and disinfection

Before each test, all chemical protective clothing material samples, with the exception of limited-use chemical protective clothing, shall undergo pre-treatment by cleaning and disinfection as applicable.

If the manufacturer's instructions indicate that cleaning or disinfection is not allowed, i.e. limited use garments, then testing shall be carried out on new material.

Where applicable according to manufacturer's instruction, the cleaning and disinfection shall be in line with the manufacturer's instructions, on the basis of standardized procedures. If the number of cleaning and disinfection cycles is not specified, the tests shall be carried out after 5 cycles of pre-treatment, each consisting of one wash cycle, one dry cycle and one disinfection cycle carried out in the sequence as indicated by the manufacturer's instructions. This shall be reflected in the information supplied by the manufacturer. If the garment can be washed or alternatively dry-cleaned it shall only be washed, dried and disinfected. If only dry-cleaning is allowed, the garment shall only be dry-cleaned and disinfected in accordance with the manufacturer's instructions.

4.2.2 Pre-treatment by abrasion

Specimens, which have been pre-treated according to 4.2.1, may also be pre-treated by one of the numbers of abrasion rubs given in Table 1 in accordance with the method described in 4.4.1 and as specified in the product standard or as defined by the manufacturer, whichever is the larger, prior to testing according to 4.11.

4.2.3 Pre-treatment by flexing

Specimens, which have been pre-treated according to 4.2.1, may also be pre-treated by one of the numbers of flexing cycles given in Table 2 in accordance with the method described in 4.5.1 and as specified in the product standard or as defined by the manufacturer, whichever is the larger, prior to testing according to 4.11.

4.3 Conditioning

Unless otherwise indicated in the product standard, all specimens shall be conditioned by storage at (20 ± 2) °C and (65 ± 5) % relative humidity in accordance with EN ISO 139 for at least 24 h. If applicable, the tests shall be started within 5 min of removing the specimen from the conditioning atmosphere, unless otherwise indicated in the test method standard.

Conditioning may be omitted or aligned with the conditions of 4.3 if it can be shown that test results are not affected by the foreseeable changes of temperature and relative humidity.

4.4 Abrasion resistance

4.4.1 General

A set of four test specimens of a material sample, where each specimen shall consist of all layers, shall be tested in accordance with EN ISO 12947-2 in the inverted mode, i.e. a test specimen of at least 140 mm diameter placed on the abradant table and an abradant of at least 30 mm diameter mounted in the test piece holder, using abrasive paper specified in Annex B and with an applied downward pressure of 9 kPa. The abrasion resistance of the chemical protective clothing material shall be classified according to the levels of performance given in Table 1, using the highest number of abrasion rubs, determined according to 4.4.2, which do not cause damage to the material.

4.4.2 Determination of the highest number of abrasion rubs which does not cause damage to the material and which shall be used for the performance classification

4.4.2.1 General

To determine the level of performance, the leak tightness of each of the four test specimens of a material sample shall be determined after a number of abrasion rubs. An additional sample will be used to determine the leak tightness prior abrasion.

There are three methods of leak tightness assessment, the pressure pot, the hydrostatic head and visual inspection. The pressure pot shall be used if possible, but if not possible, the hydrostatic head test is preferred. Alternatively, visual inspection shall be performed, if neither pressure pot nor hydrostatic head test is performed. In this latter case, this shall be reported in the test report and also in the Instructions for Use indicating that the visual inspection is qualitative and does not provide evidence of liquid tightness after abrasion. If the assessment is performed through visual inspection, the maximum classification that can be claimed is a Class 3.

Wherever possible the pressure pot method shall be used.

Table 1 — Classification of abrasion resistance

Class	Number of rubs
6	> 2 000
5	> 1000
4	> 400
3	> 100
2	> 40
1	> 10

4.4.2.2 Pressure pot end-point determination

To verify if the use of the pressure pot method is possible, unabraded reference specimen shall be clamped in the round test pot apparatus, designed according to the specifications given in Annex E (see Figure E.1), with a diameter appropriate to hold the test specimen, and the pressure in the test pot shall then be reduced by 1 kPa from atmospheric pressure. Preferably the specimen's exterior face of the fabric shall not be exposed to the pressure, if this is not possible then reverse the face of the fabric prior to reverting to testing using the hydrostatic head. The increase of pressure after 1 min shall be measured and recorded. If the pressure increase for the unabraded specimens is less than 100 Pa, then the pressure pot method is applicable and the leak tightness shall be determined as follows:

For each test specimen, the tested area of the abraded specimen is clamped in the round test pot apparatus shown in Figure E.1 and the pressure in the test pot shall then be reduced by 1 kPa. The increase of pressure after 1 min shall be measured and recorded. The difference in the change of pressure in 1 min between a specimen prior to abrasion and the same specimen after abrasion shall be calculated. The maximum resultant value of the difference in the change of pressure in 1 min between abraded and non-abraded shall be determined for the set of specimens. If the maximum resultant value does not exceed 100 Pa in 1 min, a new set of test specimens shall be abraded to a higher level of number of rubs according to the levels of numbers of rubs in Table 1, until the level is reached at which the maximum resultant value exceeds 100 Pa in 1 min. The highest level of number of rubs, at which the sample still passes, shall be used for the performance classification.

NOTE The pressure pot method can typically not be applied in case of a too high level of air-permeability and/or breathability of the specimen prior to pre-treatment, e.g. such as flexing or abrasion.

4.4.2.3 Hydrostatic head end-point determination

The end point, i.e. the highest number of abrasion rubs which does not cause damage to the material, shall be determined by the measurement of hydrostatic head method according to EN 20811 using a rate of increase in pressure of (0,98 ± 0,05) kPa/min (or 10 cm/min). The hydrostatic head of the specimens of the set of four test specimens prior to any abrasion shall be measured and the average hydrostatic head for this set calculated. If the average hydrostatic head exceeds 200 mm, then the hydrostatic head method is applicable and the leak tightness shall be determined as follows:

For each test specimen, the tested area of the abraded specimen is clamped into the hydrostatic test apparatus and the hydrostatic head measured. If the average hydrostatic head of the specimens of a set of test specimens exceeds 200 mm, a new set of specimens shall be abraded to a higher level of number of rubs according to the levels of numbers of rubs in Table 1, until the level is reached at which the average hydrostatic head is less than 200 mm. The highest level of number of rubs, at which the average hydrostatic head is still above 200 mm, shall be used for the performance classification.

4.4.2.4 Visual inspection end-point determination

Materials, not assessed by the pressure pot or with a hydrostatic head prior to abrasion, shall be assessed by visual inspection. If one of the four test specimens shows a specimen breakdown (according to definition 3.4) after having been pre-treated by a number of abrasion rubs, the material is considered to have failed the abrasion resistance requirement for this number of rubs. The highest number of rubs, at which any of the specimens does not show a specimen breakdown (according to definition 3.4), shall be used for the performance classification. Please see limitation to the performance classification and the requirements in the Instruction for Use in 4.4.2.1.

4.5 Compression-folding (Schildknecht) flex cracking resistance

4.5.1 General

A set of six test specimens of a material sample (three in machine and three in cross direction), where each specimen shall consist of all layers shall be tested. The specimens shall be tested in accordance with EN ISO 7854, method B. The compression folding flex cracking resistance of the chemical protective clothing material shall be classified according to the levels of performance given in Table 2 of 4.5.2, using the highest number of flexing cycles which do not cause damage the material's leak tightness according to 4.5.2.

4.5.2 Determination of the highest number of flexing cycles which does not cause damage to the material and which shall be used for the performance classification

4.5.2.1 General

To determine the level of performance, the leak tightness of each of the six test specimens of a material sample shall be determined after a number of flexing cycles. An additional sample will be used to determine the leak tightness prior flexing.

There are three methods of leak tightness assessment, the pressure pot, the hydrostatic head and visual inspection. The pressure pot shall be used if possible, but if not possible, the hydrostatic head test is preferred. Alternatively, visual inspection shall be performed, if neither pressure pot nor hydrostatic head test is performed. In this latter case, this shall be reported in the test report and also in the Instructions for Use indicating that the visual inspection is qualitative and does not provide evidence of liquid tightness after flex cracking. Visual inspection shall not be used for the performance classification of Type 1 through Type 3 (EN 943-1, EN 943-2, EN 14605). Wherever possible the pressure pot method shall be used, the specimen shall be clamped in a rectangular test pot apparatus, designed according to the specifications given in Annex E (see Figure E.2), with the rectangular dimensions appropriate to hold the test specimen.

Table 2 — Classification of leak tightness after compression-folding (Schildknecht) flex cracking resistance

Class	Number of cycles
6	> 50 000
5	> 20 000
4	> 8 000
3	>3 000
2	> 1250
1	> 500