BS EN 388:2016

BSI Standards Publication

Protective gloves against mechanical risks

bsi.

National foreword

This British Standard is the UK implementation of EN 388:2016. It supersedes BS EN 388:2003 which is withdrawn.

BSI, as a member of CEN, is obliged to publish EN 388:2016 as a British Standard. However, attention is drawn to the fact that during the development of this European Standard, the UK committee voted against its approval as a European Standard.

National Annex NA (informative) details the UK committee concerns and gives guidance on cut resistance product markings in relation to mechanical risk gloves.

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

A list of organizations represented on this subcommittee 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 mechanical risks

Gants de protection contre les risques mécaniques

Schutzhandschuhe gegen mechanische Risiken

This European Standard was approved by CEN on 29 July 2016.

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European foreword

This document (EN 388:2016) 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of an identical text or by endorsement, at the latest by May 2017, and conflicting national standards shall be withdrawn at the latest by May 2017.

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 supersedes EN 388:2003.

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, see informative Annex ZA which is an integral part of this document.

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 requirements, test methods, marking and information to be supplied for protective gloves against the mechanical risks of abrasion, blade cut, tear, puncture and, if applicable, impact.

This standard is intended to be used in conjunction with EN 420.

The test methods developed in this standard may also be applicable to arm protectors.

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 420, *Protective gloves — General requirements and test methods*

EN 13594:2015, *Protective gloves for motorcycle riders — Requirements and test methods*

EN ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system (ISO 7500-1)*

EN ISO 11644, *Leather — Test for adhesion of finish (ISO 11644)*

EN ISO 12947-1, *Textiles — Determination of the abrasion resistance of fabrics by the Martindale method — Part 1: Martindale abrasion testing apparatus (ISO 12947-1)*

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

EN ISO 13997:1999, *Protective clothing — Mechanical properties — Determination of resistance to cutting by sharp objects (ISO 13997:1999)*

ISO 4649:2010, *Rubber, vulcanized or thermoplastic — Determination of abrasion resistance using a rotating cylindrical drum device*

ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 98-4, *Uncertainty of measurement — Part 4: Role of measurement uncertainty in conformity assessment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
protective glove against mechanical risks
glove that provides protection against at least one of the following mechanical risks: abrasion, blade cut, tear and puncture

3.2
glove providing a specific protection
glove that is designed to provide an area of improved protection for the whole hand or part of it

Note 1 to entry: For example, palm protection style or protection against impact.

3.3
glove series
single glove style or glove type with the same palm material up to the wrist line where the only variants are size, length, left/right hand and colour

3.4
arm
part of the body between the wrist and the shoulder

3.5
gloves made from several layers
— unbonded layers: a glove that is made from 2 or more layers of materials which are not connected together, after preparing the sample for the test;

— bonded layers: a glove that is made from 2 or more layers of materials which are connected together (e.g. glued, stitched, dipped, impregnated) after preparing the sample for the test

3.6
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]

Note 1 to entry: An abrasion rub is one revolution of the outer drives of the Martindale abrasion tester (see EN ISO 12947-1).

3.7
arm protector
protective sleeve separate from the glove or the clothing that provides protection against at least one of the following mechanical risks: abrasion, blade cut, tear and puncture

4 Requirements

4.1 General

The protective gloves according to this standard shall first meet all the applicable requirements of EN 420.

All specimens shall be taken from the palm of different gloves for classification purposes. For arm protectors, specimens shall be taken from the area for which protection is claimed.

A protective glove against mechanical risks shall have performance level of 1 or above for at least one of the properties (abrasion, blade cut, tear and puncture) or at least level A of the EN ISO 13997:1999 TDM cut resistance test; classified according to the minimum requirements for each level shown in Tables 1 and 2.

NOTE 1 Gloves meeting the requirements for resistance to puncture may not be suitable for protection against sharply pointed objects such as hypodermic needles.

Table 1 — Levels of performance

Test	Level 1	Level 2	Level 3	Level 4	Level 5
6.1 Abrasion resistance (number of rubs)	100	500	2 000	8 000	-
6.2 Coupe test: Blade cut resistance (index)	1,2	2,5	5,0	10,0	20,0
6.4 Tear resistance (N)	10	25	50	75	-
6.5 Puncture resistance (N)	20	60	100	150	-

Table 2 — Levels of performance for materials tested with EN ISO 13997

	Level A	Level B	Level C	Level D	Level E	Level F
6.3 TDM: cut resistance (N)	2	5	10	15	22	30

NOTE 2 There is no correlation between the levels of performance obtained with the 6.2 and 6.3 test methods.

NOTE 3 Uncertainty of measurement, see Annex B.

If relevant, additional areas of the protective glove shall be tested (e.g. for specific protection or for areas which provide lower protection) and the results shall be reported in the user instructions.

4.2 Additional Protection

4.2.1 General

Additional protection can be claimed when the gloves conform to the requirements defined in the following clause(s).

4.2.2 Impact protection

Each area where impact protection is claimed shall be tested. Due to the test method (test specimens dimensions), protection against impacts on fingers cannot be tested.

A protective glove against mechanical risks may be designed and constructed to provide specific impact attenuation (for example, impact protection of knuckles, back of the hand, palm,). These gloves shall comply with the following requirement.

When the tests were carried out according to 6.6, performance shall conform to Level 1 of EN 13594:2015, Table 7.

5 Sampling and conditioning

5.1 Conditioning of samples and all other test consumables (e.g. abrasive paper, EPDM, cotton canvas) is as follows:

— temperature (23 ± 2) °C;

— relative humidity (50 ± 5) %.

The period of conditioning is at least 24 h. Tests shall preferably be performed in the above mentioned environment.

5.2 If the test is performed in a different environment and if the testing duration does not exceed 15 min, it shall be started within 5 min after removal from the conditioning.

5.3 If special applications require testing in a different environment, it is the responsibility of the manufacturer or his authorized representative to arrange for additional tests and to present the results including a full description of the testing environment in the information supplied by the manufacturer (Clause 8).

6 Test methods

6.1 Abrasion resistance

6.1.1 Principle

Circular specimens of material are abraded under known pressure with a cyclic planar motion in the form of a Lissajous figure which is the result of the simple harmonic motions at right angles to each other. The resistance to abrasion is measured by the number of rubs required for breakthrough to occur.

6.1.2 Consumables

6.1.2.1 Abradant

An abradant shall meet the requirements as laid down in Annex A.

NOTE 1 A suitable abradant has been tested by the standardization group, the Klingspor PL31B, Grit 180 [1)] (see Annex A).

NOTE 2 At the present time, only one calibration procedure is available using textile reference material. A more robust calibration method for other reference material is still under construction.

6.1.2.2 Double-sided adhesive tape

The double sided adhesive tape shall be used to provide adhesion of the sample during the test to achieve reproducible results. The mean adhesion value shall be of minimum 0,20 N/mm.

Tests are carried out according to the method given in Annex C.

NOTE 1 If the adhesion is not sufficient, the sample will move during the test and in this case a tear phenomenon can be observed rather than abrasion.

NOTE 2 Examples of suitable double sided adhesive tapes are provided in C.5. Alternative tapes can be verified for suitability using the test method defined in Annex C.

6.1.3 Apparatus

An abrasion machine of the type described in EN ISO 12947-1 as a Martindale Wear and Abrasion is required. It shall fulfil the following requirement:

Pressure on specimen: (9,0 ± 0,2) kPa.

1) Klingspor PL31B, Grit 180 is the trade name of a product supplied by KLINGSPOR Schleifsysteme GmbH & Co. KG, Hüttenstraße 36, D-35708 Haiger. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of the product named. Equivalent products may be used if they can be shown to lead to the same results.

6.1.4 Test specimens

Four test specimens shall be taken from four individual gloves of the same glove series. In case of an irregular design of the palm, the test specimen shall be taken in the area where the least protection is expected (remove the reinforcements that do not cover the whole palm).

Where the test specimen is made of several unbounded layers, the test is performed on each layer. When the specimen is made of bonded layers if the layers can be separated without damaging the material, the test must be performed on each layer independently. Otherwise, the test must be performed on all layers, taking care not to have a seam in the test area.

6.1.5 Test procedure

6.1.5.1 Setting up the machine

6.1.5.1.1 Mounting test specimens

Cut four test specimens to the correct dimensions, diameter (38,0 ± 0,5) mm. Secure the test specimen without tension carefully and centrally on the metal insert by means of double-sided adhesive tape under a weight of approximately 10 kg applied for at least 5 min. Good adhesion can be achieved through the use of double-sided tape which prevents loosening of the test specimen and the inclusion of air bubbles. Place the ring of the specimen holder in position on the mounting plate provided on the base of the machine.

In order to test the materials that are thicker than the standard ring (for example leather with a thickness greater than 1,2 mm), the diameter of the opening of the clamping ring should be increased (see Figure 1).

Dimensions in millimetres

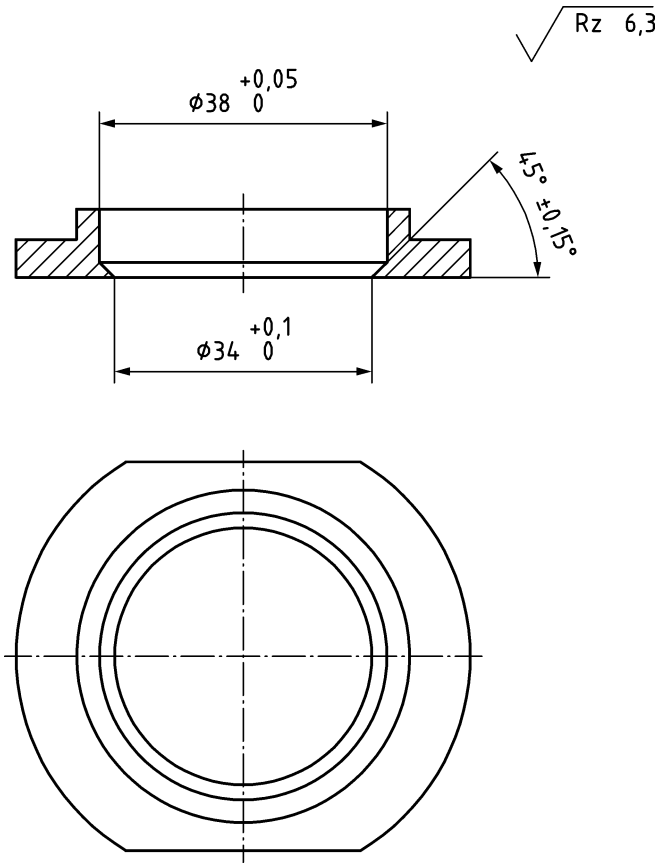


Figure 1 — Alternative clamping ring for thick material

Some materials might need a longer contact time to ensure maximum adhesion between the test specimen and the adhesive tape. Surface treatment (e.g. removal of fluff) may be used in order to improve adhesion between the test specimen and the adhesive tape, provided this treatment will not affect the performance of the material during the test. If a different contact time (> 5 min) and/or if a surface treatment is used, this should be reported.

While ensuring that the ring containing the specimen and metal insert is held firmly in the mounting plate, start to screw the top of the specimen holder on to the ring, taking care that the screw threads are not crossed. Having started the screwing down operation, use both hands to maintain a continuous downwards pressure on the assembly against the mounting plate.

This procedure will normally ensure that the specimen is securely retained in the holder in a wrinkle-free condition and that it is ready for testing.

NOTE It is important to use a sufficiently effective double-sided adhesive tape which prevents the movement of the test specimen during the duration of the test (appropriate double-side adhesive tapes can for example be found in the building and construction industry). This information is given for the convenience of users in Annex C.

6.1.5.1.2 Mounting abradant

Secure carefully the abradant (6.1.2.1) by means of double-sided adhesive tape covering the whole surface of the mounting plate. Ensure the abradant is flat by placing the weight supplied with the testing machine for this purpose on its surface, and if a retaining frame is used, then position and tighten it up

evenly using diagonally opposite screws in sequence. Make sure that the abradant is held in place firmly and that there are no tucks or ridges.

6.1.5.1.3 Mounting specimen holders

Mount the test specimen holders on the top plate under a pressure of (9,0 ± 0,2) kPa and switch on the machine. Four test specimens are preferably to be tested at the same time on the same machine. If tested differently, it shall be reported in the test report and the reason why.

Every time a specimen holder is taken from the machine to check the end point of the specimen for breakthrough, retighten the specimen holder before it is replaced on the machine.

If it is necessary to interrupt the test for an appreciable length of time (e. g. overnight or at the weekend) remove the specimens from their holders and store them face upwards. Protect the specimens by covering them with a clean card or piece of fabric.

6.1.5.2 Method of assessment

The performance of the sample is determined by the specimen breakthrough, which is the visually observed deterioration in a specimen after exposure to a specified number of abrasion rubs, i.e.:

— in woven fabrics, when two separate threads are completely broken, resulting in a hole to appear;

— in knitted fabrics, when one thread is completely broken, resulting in a hole to appear;

— in bonded layers, when the first hole through all layers together resulting from the wear is of a diameter at least equal to 1 mm;

— in other materials then those mentioned above, when the first hole resulting from the wear is of a diameter at least equal to 1 mm.

6.1.5.3 Test method

Each test will be performed with a new abradant. Begin the test and check the test specimens after 100 rubs. If there is no breakthrough, continue the test until reaching 500 rubs (performance level 2). If there is no breakthrough, continue the test until the next performance level in Table 1 is reached. Examine the test specimens at the required rub number for each performance level.

At each examination of a specimen at a specified performance level, both the test specimens and the abradant shall be cleaned (e. g. by clean compressed air) and the specimen holder tightened before it is replaced on the machine.

If a breakthrough is found when examining the test specimens at a given performance level, the classification will be at the preceding inferior performance level.

When breakthrough occurs at less than 2 mm of the edge of one test specimen or when tearing occurs, this test specimen has to be discarded and the entire test has to be repeated. If in the second test, at least one test specimen fails, the lowest value of the test specimens that have not been discarded in both tests shall be recorded.

When the specimen is constituted of several layers (see 6.1.4, 2nd paragraph), the final result of the test will be the sum of the results of all the layers.

The report shall show the 4 individual results. The performance level is defined as the lowest of the 4 values.

6.1.6 Test report

The test report shall contain the following information:

— reference to the clause of this European Standard;

— the reference of the sample;

— all individual results as per the test given in 6.1.5;

— any deviation from the test method (in particular different contact time with the adhesive tape and surface treatment of test specimen);

— reference of the used consumables (abrasive paper and adhesive tape);

— any physical change observed on the test specimen;

— the performance level in accordance with Table 1.

6.2 Blade cut resistance

6.2.1 Principle

Specimens are cut by a counter-rotating circular blade which moves with an alternating motion under a specified load.

6.2.2 Equipment

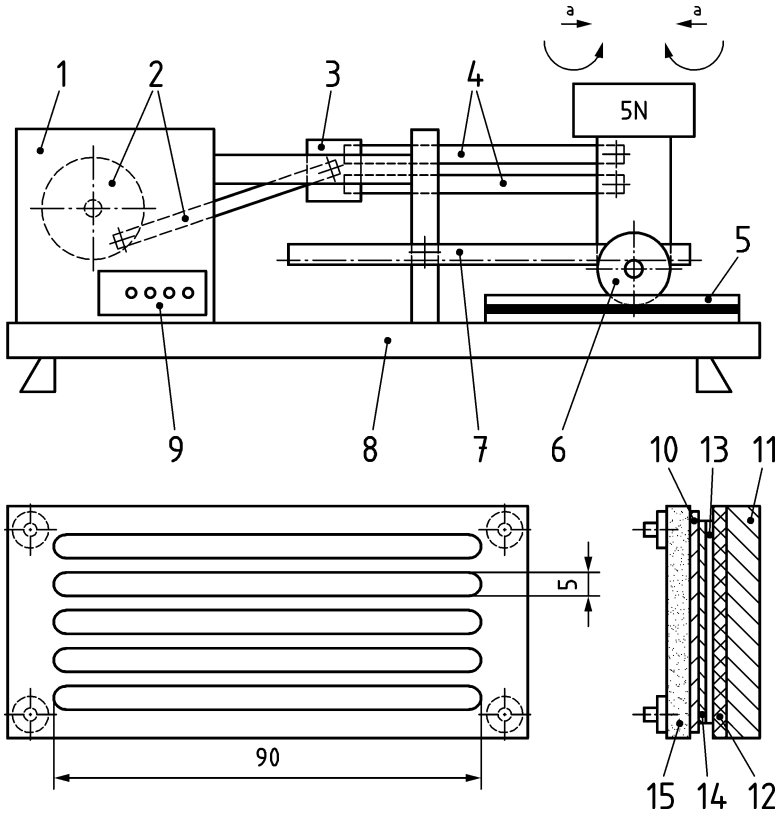
The coupe test equipment (see Figure 2, Figure 3 and Figure 4) consists of:

a) a test bench providing an alternating horizontal movement to a circular, rotating blade. The horizontal movement is 50 mm long and the blade rotates completely 360°; in the opposite direction to its movement. The resulting sinusoidal cutting speed of the blade is at (8 ± 2) cm/s;

b) a mass applied to the blade resulting in a force of (5 ± 0,5) N;

c) a circular blade with a diameter of (45 ± 0,5) mm, a thickness of (0,3 ± 0,03) mm and a total cutting angle of 30° to 35° (see Figure 3). The blade shall be in stainless steel with a Vickers Hardness of 700 to 720;

Dimensions in millimetres

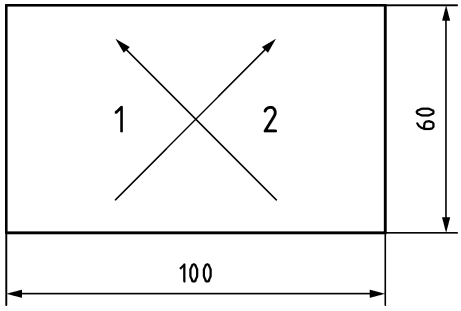


Key

1	compartment of motor and electronic detection	9	counter
2	wheel and driving rod	10	specimen
3	sliding system	11	insulated support
4	rods	12	conductive rubber
5	test piece device	13	aluminium foil
6	circular blade	14	filter paper
7	toothed rack	15	upper part
8	support plate	a	alternating motion of the blade

Figure 2 — Apparatus for testing blade cut resistance of protective gloves

Dimensions in millimetres



Key

1 warp or longitudinal direction

2 weft or transversal direction

Figure 3 — Control specimen dimensions

Dimensions in millimetres

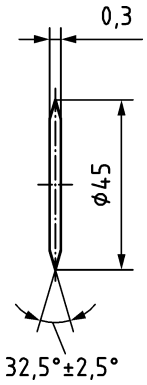


Figure 4 — Circular blade specifications

NOTE A blade ref OLFA® RB of 45 mm diameter is suitable for this test.[2)]

d) a support of conductive rubber (hardness (80 ± 3) IRHD), e.g. EPDM, on which the test specimen is placed;

e) a clamping frame for the test specimen as described in Figure 2;

f) an automatic system to detect the moment of cut-through;

g) a cycle counter calibrated to one tenth of a cycle.

6.2.3 Test specimen

Each consists of a strip (60 ± 6) mm wide and (100 ± 10) mm long cut on the bias (45° angle). In the case of a specimen made of several unbonded layers, the complete specimen shall be tested with all

2) The OLFA® RB 45 mm is the trademark of a product manufactured by the OLFA corporation, Osaka, 537 Japan. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of the product named. Equivalent products may be used if they can be shown to lead to the same results.

layers together. In case of an irregular design of the palm, the test specimen shall be taken from the palm area where the least protection is expected.

Two test specimens shall be taken from 2 separate gloves.

6.2.4 Control specimen

The dimensions of the control specimen are identical with those of the test specimen, cut from a cotton canvas[3)] with the technical specifications given in 6.2.5.

6.2.5 Canvas

Fabric warp and weft: cotton spun from open end fibres.

CANVAS: The canvas shall be fabric warp and weft: cotton spun from open end fibres with the following properties:

— linear mass warp = 2 plies of 83 Tex +/- 1 Tex;

— linear mass weft = 250 Tex +/- 1 Tex;

— twist warp = S445 t/m;

— twist weft = Z162 t/m;

— warp = 14 double threads per cm;

— weft = 9 threads per cm;

— tensile strength in warp = 1400 N (minimum) (EN ISO 13934-1);

— tensile strength in weft = 1100 N (minimum) (EN ISO 13934-1);

— mass per unit area = 530 g/m^2 +/- 5%;

— thickness = 1,0 +/- 0,1 mm.

6.2.6 Test method

On the rubber support, place an aluminium foil of about 0,01 mm thick covered with a paper sheet of (65 ± 5) g/m^2 and less than 0,1 mm thick. The purpose of this sheet is to limit displacements of the specimens during the trial and to avoid unexpected cut-through detections due to steel yarns in certain fabrics or due to gaps in the structure of thin knitted fabrics. The control specimen is placed without stretching on top of the foil within the clamping frame.

The clamping frame is positioned on the table. The arm holding the blade is lowered gently onto the control specimen.

Before any test, the sharpness of the blade is checked as follows: at cut-through with the control specimen, the number of cycles (C) is recorded. The number of cycles shall be between 0,8 and 1,4 at the first test sequence and between 0,8 and 2,0 at every 4 other consecutive test sequences.

3) Such a canvas is made by TENTHOREY DE LA PLAINE - 88510 ELOYES – FRANCE, Fabric Quality identification: n°14861. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of the product named. Equivalent products may be used if they can be shown to lead to the same results.

If the number of cycles is < 0,8, the sharpness of the blade shall be reduced by performing cutting motions on three layers of the control fabric. If the number of cycles is superior to 2,0 after each test sequence, the blade shall be changed for the next sequence. After every test (i.e. after every 5 test sequences), a new blade shall be used to start a new test.

The test specimen is subjected to the same test and the number of cycles (T) is recorded. The test is manually stopped when T reaches maximum 60 cycles.

Five tests shall be made on each test specimen according to the following sequence for each test (starting point, immediately after contact with the test specimen, should be at one of the extremes of the test specimen):

a) test on control specimen;

b) test on test specimen;

c) test on control specimen.

For materials dulling the blades; if after the first sequence the number of cycles C_{n+1} is greater than 3 times C_n in one of the tested specimen, the EN ISO 13997:1999 cut resistance method as per 6.3 shall be performed and this method becomes the reference test method for the assessment of the protection against cut risks.

However, the test method corresponding to 6.2 could be done on request.

6.2.7 Calculation of test results

The results shall be presented in accordance with Table 3.

Table 3 — Blade cut test - Calculation of index

Sequence	C_n Control specimen	T Test specimen	C_{n+1} Control specimen	I Index
1	C_1	T_1	C_2	i_1
2	C_2	T_2	C_3	i_2
3	C_3	T_3	C_4	i_3
4	C_4	T_4	C_5	i_4
5	C_5	T_5	C_6	i_5

$\overline{C_n}$ represents the average value of cycles on control specimen before and after the cut of the test specimen T_n and is calculated as follows:

$$\overline{C_n} = \frac{(C_n + C_{n+1})}{2}$$

For each test specimen the final index value (I) is calculated as follows:

$$I = \frac{1}{5}\sum_{n=1}^{5} i_n \text{ with}$$

$$i_n = \frac{\left(\overline{C_n} + T_n\right)}{\overline{C_n}}$$

The minimum value of *I* is 1 if *T* = 0. *I* is a number without unit.

The report shall include the tables (Table 3) obtained on the 2 samples and show the 10 results i_n, as well as the two calculated mean values C_n. The performance level is defined as the lowest of the two calculated index values.

6.2.8 Test report

The test report shall contain the following information:

— reference to the clause of this European Standard;

— the reference of the sample;

— the results as per 6.2.7;

— any deviation from the test method;

— reference of the used consumables (blade, cotton canvas).

— the performance level in accordance to Table 1.

6.3 Cut Resistance method (EN ISO 13997)

6.3.1 General

This test method is described in EN ISO 13997:1999. Table 2 shows the correspondence between the performance level (A to F) and the equivalent cutting load of EN ISO 13997:1999.

6.3.2 Test specimen

Test specimens shall be taken from the gloves palm.

The specifications concerning gloves given in Clause 5 and Annex A of EN ISO 13997:1999 shall be applied.

The 5 final values (EN ISO 13997:1999, 6.3.5 e) shall be measured on the same sample of the palm.

6.3.3 Test report

The test report shall contain the following information:

— see EN ISO 13997:1999, Clause 7;

— reference of the used consumables (blade, neoprene);

— the performance level in accordance with Table 2.

6.4 Tear resistance

6.4.1 Principle

The resistance to tear is defined as the force necessary to propagate a tear in a rectangular specimen slit half way along its length.

6.4.2 Equipment

Only tensile testers of at least Class 2 according to EN ISO 7500-1, equipped with low inertia force measurement systems shall be used.

6.4.3 Test specimen

The test specimen dimensions are defined in Figure 5. Dimensions of the specimen to be tested: (100 ± 10) mm × (50 ± 5) mm. A (50 ± 5) mm incision is made in the longitudinal direction of the sample, (25,0 ± 2,5) mm from the edge. The incision shall be made with a sharp blade straight and perpendicular to the specimen surface. In case the glove contains reinforcements (e.g. pads) in the palm, the test specimen shall be taken from the layers without these reinforcements. Where the test specimen is made of several unbonded layers, the test is performed on each layer. The classification is based on the layer with the highest performance level.

Dimensions in millimetres

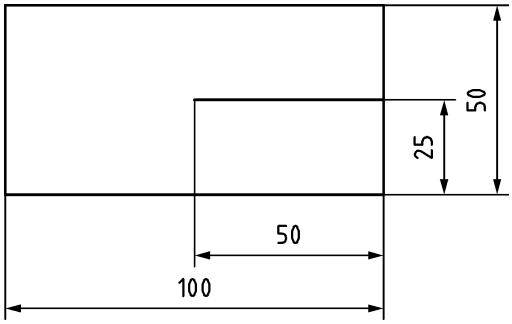
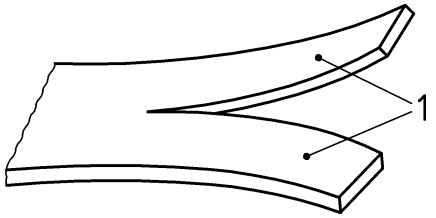


Figure 5 —Test piece

6.4.4 Setting up the test specimen

At least 20 mm of each pre-cut defined strip (see Figure 6) is clamped in a tensile tester with the jaws at least 10 mm apart such as to guarantee a pulling direction parallel to the longitudinal direction of the specimen.



Key

1 strips

Figure 6 — Test strips

6.4.5 Test method

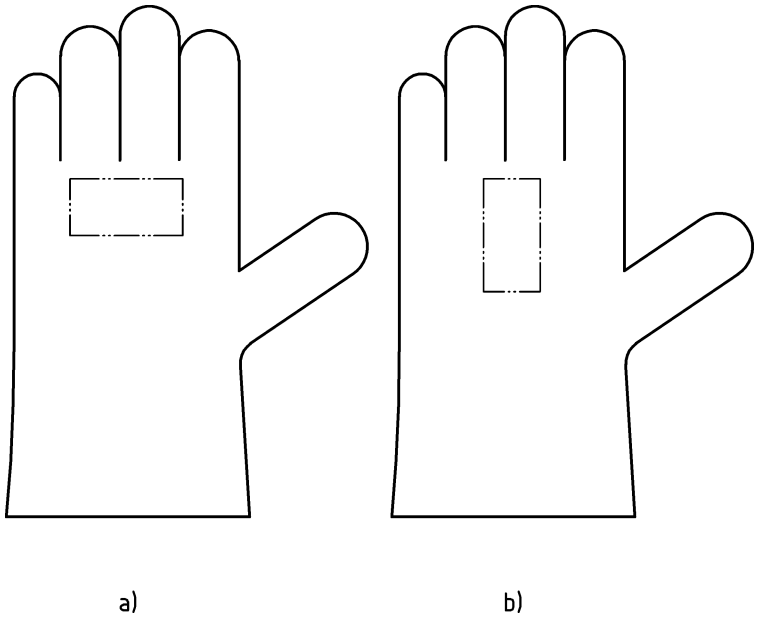
6.4.5.1 The tearing force is recorded on a X-Y recorder at a tensile test speed of (100 ± 10) mm/min. The specimen shall be torn totally apart. Note that in some cases the tearing may not be in the longitudinal direction of the specimen.

6.4.5.2 If the specimen is not fully torn apart under a force in excess of 75 N, then the test may be stopped and the maximum force reached is recorded.

6.4.5.3 The test shall be performed on one specimen cut from each of four different gloves of the same glove series.

6.4.5.4 Two specimens shall be tested in the direction of the glove from cuff to finger tips, and two specimens shall be tested across the palm width (see Figure 7).

6.4.5.5 The tear resistance for each specimen is taken as the highest peak recorded, and the classification is determined by taking the lowest of the individual values.



Key

a) across the palm width of the glove

b) in the direction of the glove

Figure 7 — Tear test - Test area

6.4.6 Test report

The test report shall contain the following information:

— reference to the clause of this European Standard;

— the reference of the sample;

— the results as per the test given in 6.4.5;

— any deviation from the test method;

— the performance level in accordance with Table 1.

6.5 Puncture resistance

6.5.1 Principle

Puncture resistance is defined by the force exerted by a steel stylus of defined dimensions to puncture a test specimen held on a retaining device. It should not be confused with piercing exerted by thin tips or needles.

6.5.2 Equipment

The equipment consists of:

— a low inertia compression tool, Class 2 according to EN ISO 7500-1, equipped to measure forces from 0 N to 500 N;

— a steel stylus centred in the axis of the tool, shaped to the precise requirements and dimensions of Figure 8;

— a retaining device for the test specimen centred in the axis of the tool, as given in Figure 9.

Dimensions in millimetres

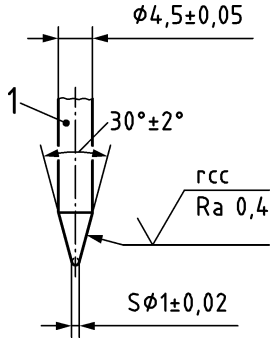
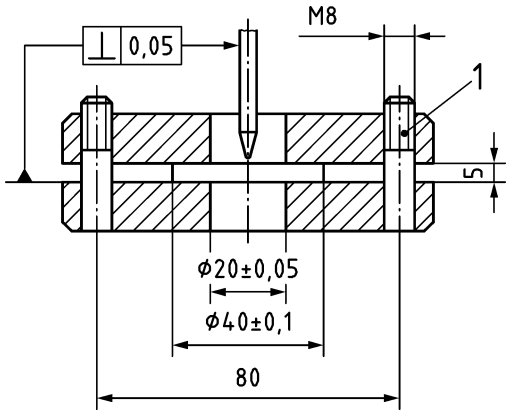


Figure 8 — Stylus - Steel 60 HRC Rockwell

Dimensions in millimetres



Key

1 tightening stud

Figure 9 — Retaining device

6.5.3 Test specimen

A circular specimen with a minimum diameter of 40 mm is taken in such a way that seams, reinforcements or extra thicknesses are located outside the clamping area and the point of perforation. In the case of several unbonded layers, these layers are tested together. In case of an irregular design of the palm, all areas shall be tested; the final result is the lowest obtained value.

6.5.4 Test method

a) Clamp the test specimen centrally in the retaining device with the exterior surface towards the stylus.

b) Move the stylus downwards onto the test specimen at 100 mm/min. Continue until a displacement of 50 mm, measured from the sample level is reached. Record the highest value of the force, even if the test specimen is not punctured.

c) The test shall be performed on four specimens cut from four different gloves of the same glove series.

d) The profile and measurements of the stylus shall conform to Figure 8 for every test. For most materials, checking the stylus at least every 500 uses is recommended but for hard and abrasive materials that can damage the stylus, checking more frequently is necessary.

e) The classification is determined by the lowest value recorded.

6.5.5 Test report

The test report shall contain the following information:

— reference to the clause of this European Standard;

— the reference of the sample;

— the 4 measured values as defined in 6.5.4;

— any deviation from the test method;

— the performance level in accordance with Table 1.

6.6 Impact Test

For knuckles, the tests are carried out according to EN 13594:2015, 6.9 with impact energy of 5 J.

For other parts (back of the hand, palm, etc.), the centre of the claimed protection area shall be tested according to EN 13594:2015, 6.9 with impact energy of 5 J. Four impacts in the centre of the protective area from four different gloves shall be tested. The results are given as requested in EN 13594:2015, 6.9 h).

7 Marking

7.1 General

Marking of the protective glove or arm protector shall be in accordance with the applicable clauses of EN 420.

7.2 Pictograms

For gloves satisfying the requirements of Clause 4, the mechanical properties of the glove shall be shown by the pictogram, see Figure 10, for the mechanical risks followed by the respective performance levels of each mechanical test (see Figure 11).

The first number corresponds to the abrasion resistance, the second one to the blade cut resistance, the third one to the tear resistance, the fourth one to the puncture resistance and the fifth character (a letter) to the EN ISO 13997:1999 cut resistance (as shown in Tables 1 and 2).

If the blade cut resistance test as per 6.2 proves to show dulling of the blades as defined under 6.3, and cut resistance is being claimed, at least the EN ISO 13997:1999 alphabetical cut resistance level shall be marked. The numerical cut level as per 6.2 may be optionally reported in the marking alongside the alphabetical level given by the results of the test according to EN ISO 13997:1999 method's alphabetical level.

The positioning of the pictogram and performance levels in relation to each other shall be in accordance to EN 420.

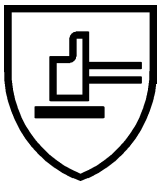


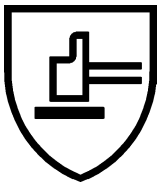
Figure 10 — Pictogram for mechanical risks

7.3 Marking of additional requirements

Impact protection

When the requirements given in 4.2.1 are fulfilled by the gloves, the marking code "P" is added after the five performance levels number (see example in Figure 11).

7.4 Examples of marking



EN 388

Example1: 3 4 4 3 E P

Example 2: 3 X 0 3 E

Example 3 : 3 2 0 3 X

Figure 11 — Example of marking for the mechanical risks

Table 4 — Explanation of the examples given in Figure 11

Example	N° 1	N°2	N°3
Abrasion (6.1)	level 3	level 3	level 3
Cut (6.2)	level 4	test not performed or not applicable	level 2
Tear (6.4)	level 4	level 1 not achieved	level 1 not achieved
Puncture (6.5)	level 3	level 3	level 3
Cut (6.3)	level E	Level E	test not performed
Impact protection	achieved	test not performed	test not performed

8 Information supplied by the manufacturer in the user notice

The information shall be in accordance with the applicable clause of EN 420.

Details of any special tests carried out in a different environment shall be given (see 5.3).

If relevant, a warning shall be included that for gloves with two or more layers the overall classification does not necessarily reflect the performance of the outermost layer.

If impact protection is claimed, it shall state:

— the area(s) where protection is claimed;

— a warning that the protection does not apply to the finger.

For any mechanical resistant gloves which achieve and show a tear performance (6.4), equal or greater than level 1, a warning shall be included that gloves shall not be worn when there is a risk of entanglement by moving parts of machines.

For dulling during the cut resistance test (6.2), the coupe test results are only indicative while the TDM cut resistance test (6.3) is the reference performance result. This sentence shall be indicated in the user notice.

Annex A
(normative)

Abradant

A.1 Definition of the abradant

The abradant shall meet the following specifications:

— Grit: 180;

— Grain type: aluminium oxide;

— Coating density: semi-open;

— Backing: The backing shall consist of suitable-quality paper having a minimum basis weight of 110 g/m^2 ± 5 %;

— Adhesive: The adhesive must be suitable for its purpose;

— Abrasive: The abrasive grain employed must be suitable for its purpose. Only grain per FEPA P Standard shall be used.

The abrasive paper shall have the following characteristics:

a) The breaking strength shall not be less than:

   1) in the longitudinal direction: 500 N/50 mm;

   2) in the transverse direction: 250 N/50 mm.

b) The weight of abrasive paper shall be 300 g/m^2 ± 15 %.

A.2 Acceptation criteria of the abradant

When testing the cotton canvas (6.2.5) with the method described in 6.1.5 after 100 cycles, the weight lost shall be between 0,009 g and 0,027 g.

Annex B
(normative)

Test results - Uncertainty of measurement

For each of the required measurements performed in accordance with this standard, a corresponding estimate of the uncertainty of measurement shall be evaluated.

One of the three following approaches shall be used:

— a statistical method, e.g. that given in ISO 5725-2;

— a mathematical method, e.g. that given in ISO/IEC Guide 98-3;

— uncertainty and conformity assessment as given in ISO/IEC Guide 98-4.

Annex C
(normative)

Validation test for the adhesive used in EN 388, 6.1.2.2

C.1 Objective

It is very important that the sample is well stuck during the abrasion test (EN 388, 6.1).

The bonding performance of the adhesive tape is essential.

This test method is based on EN ISO 11644.

C.2 Apparatus and materials

C.2.1 Tensile-testing machine, incorporating the following features:

a) force range appropriate to the specimen under test;

b) a uniform speed of separation of the jaws of 100 mm/min;

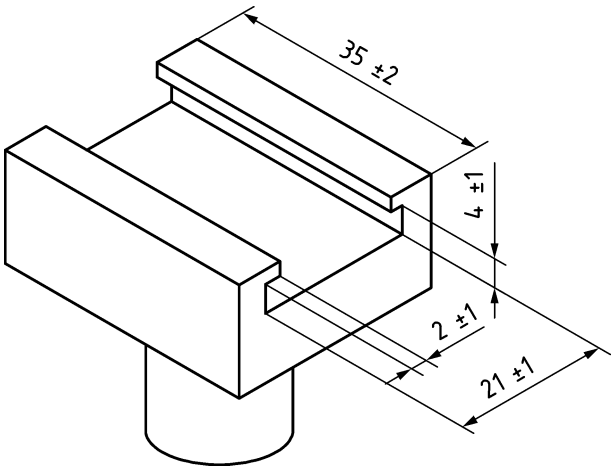
c) suitable means for fixing the adherent-plate holder (C.2.3) and the hook link (C.2.4);

d) provision for recording a force-distance diagram during the test.

C.2.2 PVC-plate, comprising a piece of hard poly(vinyl chloride) (PVC), measuring approximately 70 mm × 20 mm × 3 mm, to which the leather specimen is bonded. PVC with a high infrared (IR) absorption is preferred.

C.2.3 Adherent-plate holder (see Figure C.1), made of any suitable material, for holding the adherent-plate, to which the leather specimen has been bonded, in the lower clamp of the tensile-testing machine. Optionally, the plates can be held firmly by screws through the sides of the plate holder (see Figure C.3).

Dimensions in millimetres



(± 2 mm for 35 mm, otherwise ± 1 mm)

Figure C.1 — Adherent-plate holder

C.2.4 Hook link, made of steel wire 1 mm to 2 mm in diameter, at least 200 mm long, for attaching the free end of the leather specimen to the upper clamp of the tensile-testing machine (see Figure C.3). The length of the hook link ensures that the angle of peel always remains close to 90°.

C.2.5 Punch, suitable for making a hole 2 mm to 3 mm in diameter in the leather reference rubber specimen, if using the hook link (C.2.4).

C.2.6 Reference rubber (see ISO 4649:2010, Annex B), dimension of the piece of rubber to be tested, 100 mm ± 2 mm × 10 mm ± 1 mm.

The rubber shall be splitted with a 1,5 mm thickness. The tested surface is the outer one (the more smooth). This surface is degreased with petroleun eher (d=0,65 g/cm^3). After degreasing, let the reference rubber dryed 2 min and stick the adhesive tape.

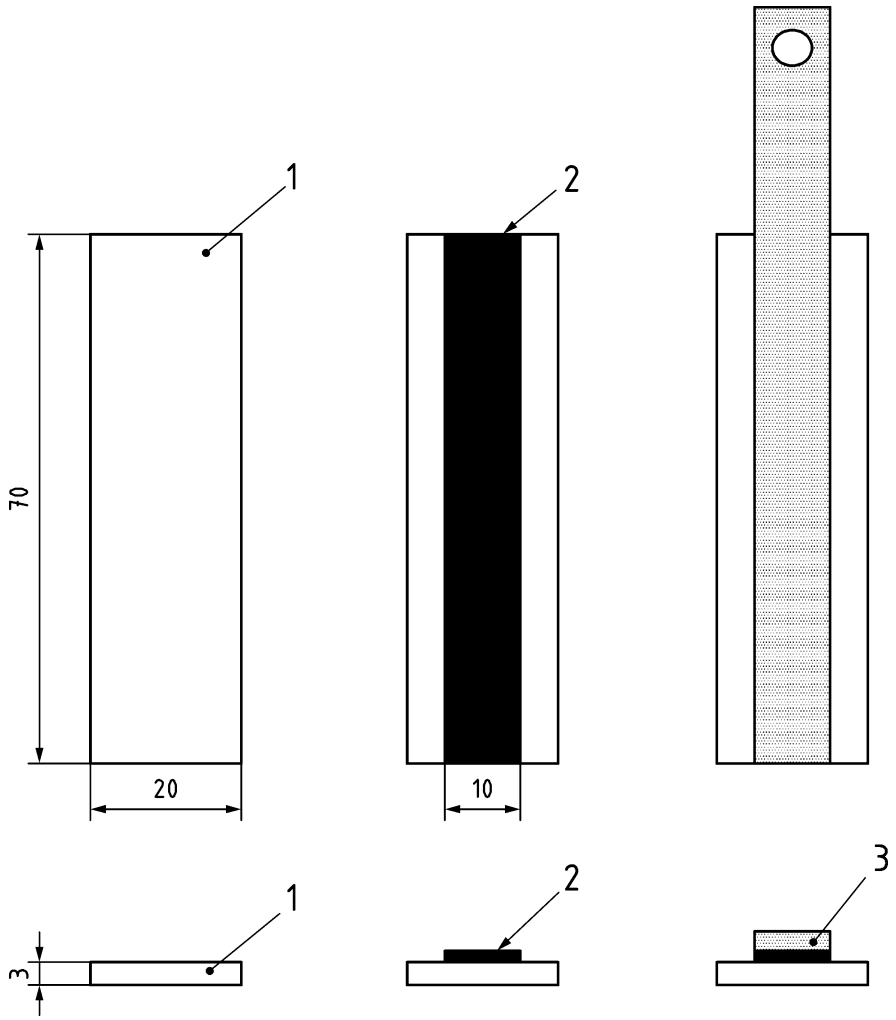
C.3 Preparation of test specimens

The adhesive tape is the test specimen.

The test specimens and the reference rubber shall be conditioned for at least 16 h in the standard atmosphere specified in EN 388 before testing.

Stick the test specimen strip of 70 mm ± 2 mm × 10 mm ± 1 mm on the PVC plate (C.2.2) and then stick the reference rubber on to the strip (see Figure C.2).

Dimensions in millimetres



Key

1 PVC plate

2 test specimen strip

3 reference rubber

Figure C.2 — Preparation of the test specimen

Then place a PVC plate on top of the assembly under a weight of 10 kg.

Keep the weight on the assembly for a duration of 5 min ± 30 s, then remove the 10 kg weight and perform the test immediately.

Two test assemblies shall be prepared.

C.4 Test procedure

C.4.1 Fix the holder (C.2.3) in the lower clamp of the tensile-testing machine (C.2.1).

C.4.2 Slide the conditioned test specimen (PVC-plate / test specimen / reference rubber) into the holder until one end of the plate is flush with one end of the holder.

C.4.3 Attach one end of the hook link (C.2.4) in the upper clamp of the tensile-testing machine and attach the other end to the leather specimen by hooking it into the hole at the end of it (see Figure C.3).

Dimensions in millimetres

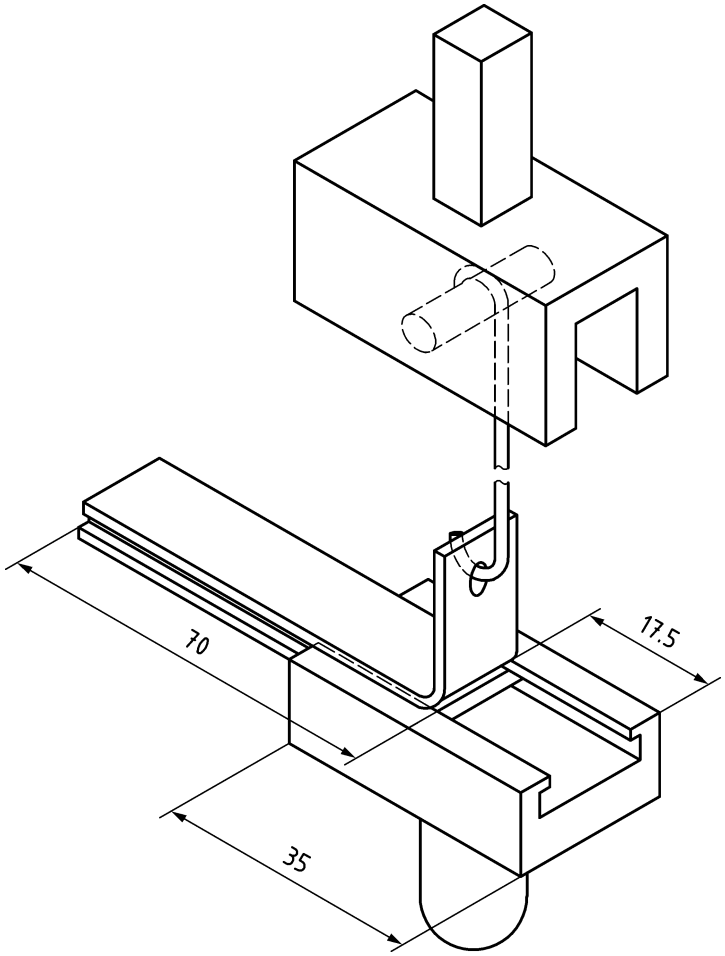


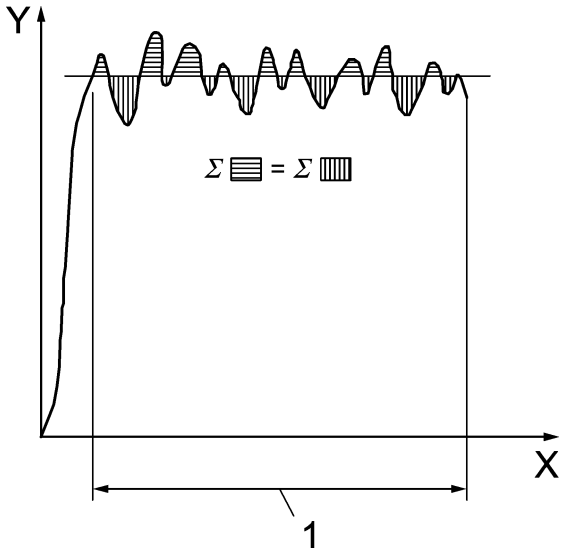
Figure C.3 — Arrangement of the test specimen and clamps for the test with the hook link system

C.4.4 Set the tensile-testing machine to a uniform speed of separation of the jaws of 100 mm/min and record the force-distance diagram for the separation of the reference rubber from the test specimen of 30 mm to 35 mm.

C.4.5 The force shall be applied such that the reference rubber peels off at an angle of about 90° to the PVC-plate.

The test is done on the second test specimen.

C.4.6 For each force-distance diagram, shown schematically in Figure C.4, determine the mean force during the peel propagation of the test specimen, i.e. the adhesion value. Record this adhesion value, expressed in newtons per mm, rounded to the nearest 0,01 N/mm.



Key

1 distance approximatively 30mm

X adhesion value

Y adhesion

Figure C.4 — Evaluation of force-distance diagram

The registration of the force is started after the first force maximum (initial surge peak). All peaks are registered, (see Figure C.4) but the first and last 10 % of the displacement are not to be used for the evaluation. The force of adhesion is calculated from the mean value of the force peaks and valleys.

NOTE If no force peaks are present, the total displaced distance (excluding the first and last 10 %) is divided into 9 sections of equal distance. The adhesion force is calculated from the mean value of the force values at the start of each section.

For the 2 test-specimens, calculate and record the mean of all adhesion values obtained. The result is the average of the 2 values.

C.5 Examples of acceptable adhesive tape

— TESA® 56170-0004[4)];

— Polyken® tape[4)];

— 3M™ ref 465[4)].

4) These are examples of suitable product(s) available commercially. This information is given for the convenience of users of this European Standard and does not constitute an endorsement by CEN of these products. Equivalent products may be used if they can be shown to lead to the same results.

Annex ZA
(informative)

Relationship between this European Standard and the essential requirements of Directive 89/686/EEC aimed to be covered

This European Standard has been prepared under a Commission's standardization request M/031 to provide one voluntary means of conforming to essential requirements of 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, compliance with the normative clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Annex II of the Directive 89/686/EEC Personal Protective Equipment.

Essential Requirements of Directive 89/686/EEC	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
1.4 Information supplied by the manufacturer	Clause 7, Clause 8	
2.12 PPE bearing one or more identification or recognition marks directly or indirectly relating to health and safety	Clause 7	
3.1.1. Impact caused by falling or projecting objects and collision of parts of the body with an obstacle	4.2.1	
3.3 Protection against physical injury (abrasion, perforation, cuts, bites)	4.1	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

National Annex NA
(normative)

Cut Resistance

NA.1 Introduction

This informative annex provides the reader with information on cut resistance in relation to gloves protecting against mechanical risks. When specifying and selecting protective gloves, cut resistance should be given high priority, when relevant to the end use.

In this context the term 'cut resistance' refers to the resistance of a glove or arm protector to cutting actions from a very sharp blade. Specifically, it refers to either the cut resistance index as determined during the Coupe test (see EN 388:2016, clause 6.2) and/or the Newton rating as determined in ISO 13997:1999 (see EN 388:2016, clause 6.3).

The two cut tests defined in EN 388:2016 provide a benchmark to give end users a better idea of which products will work well in service. The information given here is intended to interpret and complement the test data generated by EN 388:2016 and to ultimately reduce the number of accidents and their associated costs.

Gloves should not be assumed to protect against mechanical hazards unless this has been demonstrated by accredited laboratory testing. Further valuable information may be gained from additional testing. Work-place trialling of gloves is recommended to ensure suitability.

The committee is of the opinion that terms such as 'cut-proof' and 'anti-cut' are misleading and should not be used.

It is important that cut resistant gloves/arm protectors be used wherever there is a potential risk to cutting by sharp objects. However, in cases where there is also a risk of entanglement with moving parts, a suitable alternate form of protection should be used e.g. use of guards. High dexterity of gloves will also decrease the risk of accidents occurring.

NA.2 Explanation of EN 388:2016 cut resistance tests and markings

The two tests that can be performed when assessing cut resistance are independent of one another. The Coupe test result is displayed as a number in the second position on a glove conforming to EN 388:2016 and the ISO 13997:1999 result is displayed as a letter in the fifth position. Gloves can achieve higher levels of protection than just meeting the maximum protection levels associated with the tests i.e. ISO 13997:1999 Level F.

When testing materials against the Coupe method control cuts are performed on a standard material to assess blade sharpness. Control cuts are performed before and after a sample cut so that the sample's effect on the blade can be measured. If the sample has proven to blunt the blade by a factor of three or more the reference test method for cut resistance becomes the ISO 13997:1999 test.

It is important to note that the opinion of the UK committee is that, should the Coupe test be performed and the sample proven to blunt the blade as defined within the standard, the result from this test should not be visible to end users. This is because doing so could lead to misinformation as it has been proven that the test is not applicable to this type of material. Instead the second position should be replaced with an 'X' to show this.

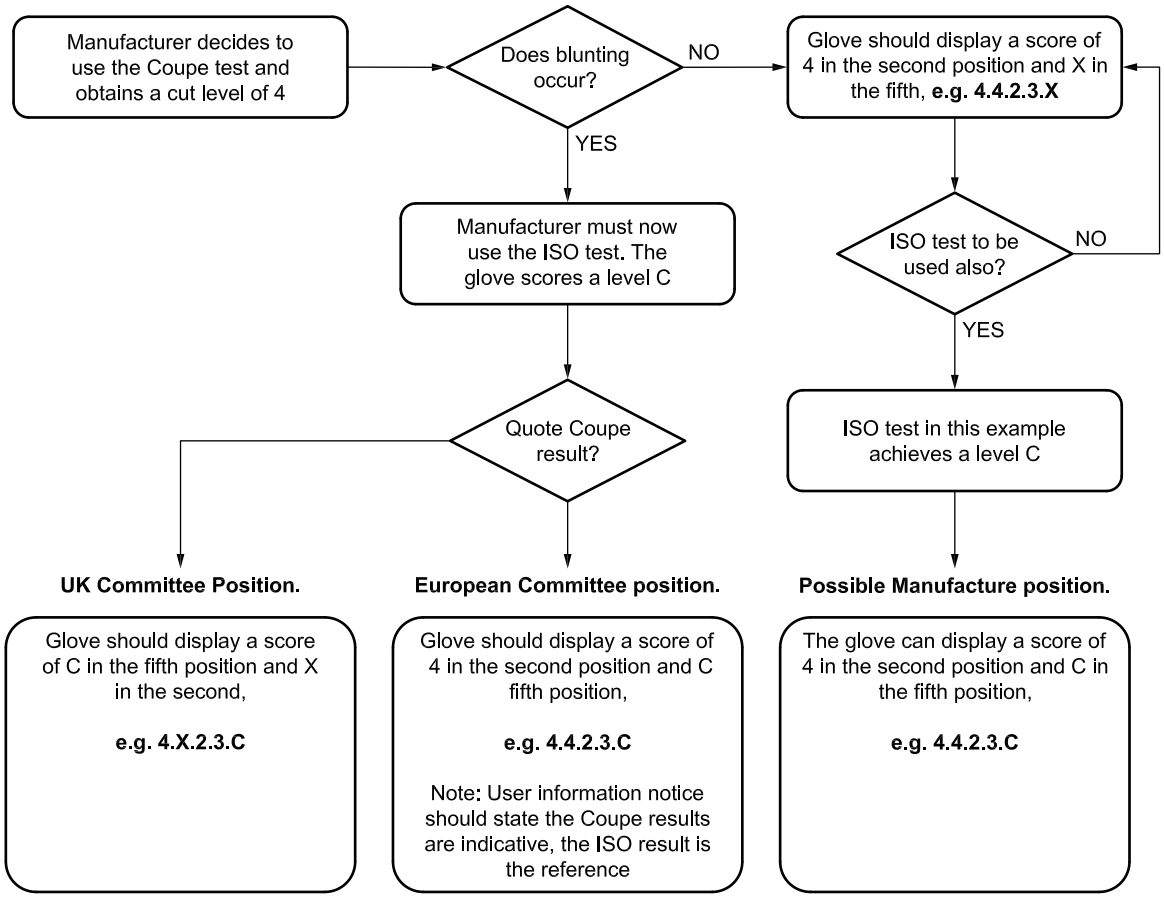


Figure 1 — Options: Coupe with mandatory or optional ISO cut method

NA.3 Additional Testing

The standard determines that the area of testing for cut protection is taken from the palms of gloves and assumes homogeneity of the glove as a whole. However, in practical use all parts of the glove may be subjected to cuts from sharp objects, including the back of the hand. It would therefore be prudent, where there is an enhanced risk of cuts to the whole hand, and as far as is practicable, to test alternate areas of gloves other than the palm for cut. Further to this, care should be taken when choosing gloves that exhibit extra reinforcements in the palm area as this could mean that the displayed cut score is not representative of the glove as a whole; again, further testing would serve to alleviate these concerns.

NA.4 Factors affecting glove performance

NA.4.1 General

Mechanical hazard properties, including cut, are generally tested on new gloves. Cut resistance may change with wear, it is therefore desirable to monitor performance throughout its service life. This may include regular inspection of gloves, field-trials and proper recording of cut-related incidents.

NA.4.2 Other factors

Glove performance may be impaired by the following factors:

- Soiling;
- Wear;

- Damage;
- Exceeding service life;
- Degradation due to certain environmental conditions/contaminants.

The UK committee recommends gloves be properly and regularly inspected, stored, maintained and replaced as necessary to ensure optimal performance.

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