BRITISH STANDARD

BS EN
13567:2002

Protective clothing — Hand, arm, chest, abdomen, leg, genital and face protectors for fencers — Requirements and test methods

The European Standard EN 13567:2002 has the status of a British Standard

ICS 13.340.01

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 13567:2002.

The UK participation in its preparation was entrusted by Technical Committee PH/3, Protective clothing, to Subcommittee PH/3/11, Protective equipment for sports players, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

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EUROPEAN STANDARD

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English version

Protective clothing - Hand, arm, chest, abdomen, leg, genital and face protectors for fencers - Requirements and test methods

Vêtements de protection - Protections des mains, des bras, de la poitrine, de l'abdomen, des jambes, génitales et de la face pour les escrimeurs - Exigences et méthodes d'essai

Schutzkleidung - Hand-, Arm-, Brust-, Unterleibs-, Bein-, Genital- und Gesichtsschützer für Fechter - Anforderungen und Prüfverfahren

This European Standard was approved by CEN on 25 March 2002.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 13567:2002 E

Contents

Foreword

This document EN 13567:2002 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of an identical text or by endorsement, at the latest by January 2003, and conflicting national standards shall be withdrawn at the latest by January 2003.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(s), see informative annex ZA, which is an integral part of this document.

Annexes A, B and C are informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Fencing by virtue of being a combat sport in which body contact by the weapon occasionally (but usually inadvertently) occurs outside the zones of protection, is by its nature dangerous. Protective clothing and equipment for fencers is intended as far as possible to prevent injuries, or in the worst cases to reduce the severity of injuries, particularly by the point of the weapon.

Broken blades pose a particular threat. The circumstances of the breakage of blades may result in high tip velocities and consequent high energy impacts by the broken blade. Broken blades have been known to penetrate protective equipment with fatal consequences. No practical clothing is capable of withstanding all broken blade impacts.

In this standard the concept of the 'optimum level of protection' has been taken into account. This concept is that the level of protection specified should be as high as it can be, without causing such unacceptable discomfort or impediment to fencing movements that fencers would not use the protective clothing.

The clothing specified in this standard provides two levels of protection perceived by the organisers and participants in the sport to be appropriate. Its use is expected to reduce risks of injuries to fencers to a tolerable level.

1 Scope

This European Standard specifies the general requirements for ergonomics, sizing, coverage and performance of protective clothing and equipment for use in the sport of fencing. Requirements for the marking of clothing and equipment and the information to be supplied by the manufacturer are given. Test methods are described and performance levels are defined.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 166:2001, *Personal eye-protection — Specifications.*

EN 388, *Protective gloves against mechanical risks.*

EN 420, *General requirements for gloves.*

EN 1082-1:1996, *Protective clothing — Gloves and arm guards protecting against cuts and stabs by hand knives — Part 1: Chain mail gloves and arm guards.*

EN ISO 5084:1996, *Textiles - Determination of thickness of textiles and textile products (ISO 5084:1996).*

EN 13546:2002, *Protective clothing — Hand, arm, chest, abdomen, leg, foot and genital protectors for field hockey goal keepers, and shin protectors for field players — Requirements and test methods.*

EN 13595-3:2002, *Protective clothing for professional motorcycle riders — Jackets, trousers and one-piece or divided suits — Part 3: Test method for determination of burst strength.*

EN ISO 13938-1:1999, *Textiles – Bursting properties of fabrics – Part 1: Hydraulic method for determination of bursting strength and bursting distension (ISO 13938-1:1999).*

EN ISO 13938-2:1999, *Textiles – Bursting properties of fabrics – Part 2: Pneumatic method for determination of bursting strength and bursting distension (ISO 13938-2:1999).*

prEN ISO 14876-2:1999, *Protective clothing — Body armour — Part 2: Bullet resistance — Requirements and test methods (ISO/DIS 14876-2:1999).*

ISO 3758, *Care labelling code using symbols.*

ISO 6330:2000, *Textiles — Domestic washing and drying procedures for textile testing.*

ISO 7500-1:1999*, Metallic materials — Verification of static uniaxial testing machines — Part 1: Torsion/compression testing machines – Verification and calibration of the force-measuring system.*

ISO 8559:1989, *Garment construction and anthropometric surveys — Body dimensions.*

3 Terms and definitions

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

3.1
protective clothing and equipment
clothing and specific devices worn on the body, arms, hands and legs and over the face and neck, that are intended to reduce the severity of injuries from fencing weapons

3.2
zone of protection
area of protective equipment that is intended to provide protection, and is subject to specific testing

3.3
coverage
area of the fencer's body covered by the whole item of protective clothing or equipment and its attachments

3.4
garment
unit of clothing which itself has an integral zone of protection replacing or in addition to an article of non-protective clothing

3.5
handedness
designs and the markings on equipment that relate to its intended use by fencers holding their weapons in the right hands or left hands or whether the equipment is for ambidextrous use by right or left handed fencers

3.6
performance level
number designating the level of the protection that it is intended the product should provide. This number is used in designating the test severity to which the product is to be subjected. For non-normative guidance on performance levels and the choice of equipment see annex B

3.7
fencing
International and Olympic sport based on European duelling with swords and embracing disciplines characterised by the relevant weapons

3.8
weapon
collective term covering the following specific swords used in fencing

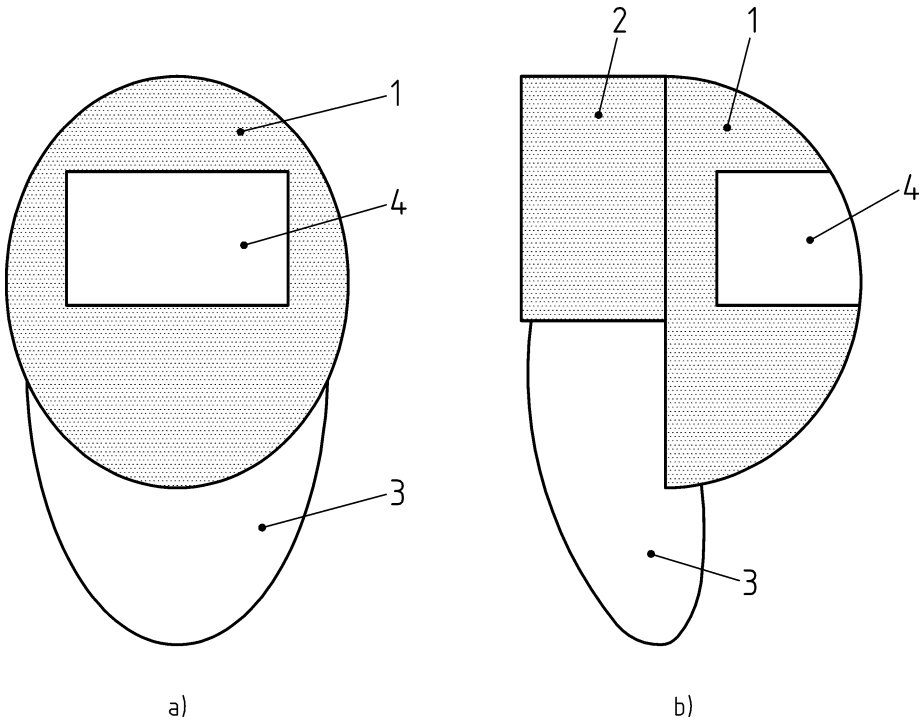
3.8.1
foil
rectangular section blade conventional duelling weapon with which hits are scored with the point only. The target is the anterior of the torso including the abdomen and the posterior torso down to the waist. The head, arms and legs are excluded, but are often hit

3.8.2
epee
traditional duelling weapon of V section blade with which hits are scored only with the point, and for which the target is the whole body, including the head and feet

3.8.3
sabre
weapon derived from the Cavalry sabre with a blunt cutting edge. Hits are scored with any part of the blade. The target is the whole body above the waist with the exception of the hands

3.9
point
expanded and/or flattened end of the blade of a weapon so designed as to reduce the possibility of the perforation of the protective clothing

3.10
fencing mask
protective device covering the face and sides of the head and the front of the neck. The parts are illustrated in



Key

a Side view
b Front view

1 Hard shell
2 Lateral protection
3 Bib
4 Visor (optional)

Figure 1 — Component parts of a fencing mask

3.10.1
hard shell
framework, part of which is see-through covering the face of the head

3.10.2
lateral protection
framework, part of which can be see-through covering the sides of the head and meeting over the top of the head

3.10.3
mask bib
protective element covering the front of the neck

3.10.4
visor
optional transparent area of the mask replacing part or all of the hard shell

3.10.5
join
any junction between the hard shell and visor, or hard shell or visor and the lateral protection

3.10.6
see-through area
region of the hard shell through which a fencer is able to see their opponent

3.11
fencing clothing
clothing designed specifically for the sport of fencing

3.11.1
fencing jacket
garment covering the full length of both arms from the wrist to the shoulder, the chest and at least the upper part of the abdomen

3.11.2
fencing breeches (trousers)
garment covering the abdomen, thighs and knees (and occasionally the lower leg)

3.11.3
fencing underpants
protective garment covering the abdomen and upper half of the thigh. If used, this garment is worn inside the trousers

3.11.4
(fencing) under plastron
one armed garment worn under a jacket covering at least part of the weapon arm, the axilla (armpit) of the weapon arm and part of the chest wall on the same side

NOTE There are two-armed under plastrons which cover both of the fencer's arms. These are generally used by sabre fencers to reduce bruising.

3.11.5
fencing gloves
clothing covering the hand, wrist and part of the forearm of the fencer

3.11.6
long fencing socks
garments covering the feet and the lower part of the leg to just above the knee

3.12
fencing breast protector
device worn over the breasts by lady fencers. The devices may be in one part or may consist of two, or may be elements for fitting into the inside of the front of the jacket or into the brassiere, or other garment

3.13
genital protector
device worn inside the trousers to protect the genitalia

3.14
body dimensions
3.14.1
stature (height)
vertical distance between the crown of the head and the ground measured with the subject standing upright without shoes and with their feet together

3.14.2
chest girth
maximum horizontal girth measured during normal breathing with the subject standing upright and the tape measure passed over the scapulae under the arm pits and across the chest

3.14.3
bust girth
maximum horizontal girth measured during normal breathing with the subject standing upright and the tape-measure passed over the scapulae under the armpits and across the breasts: normal underclothing to be worn

3.14.4
under bust girth
horizontal girth of the body immediately below the breasts measured as for the bust girth

3.14.5
waist girth
maximum horizontal girth measured during normal breathing with the subject standing upright and the tape-measure passed around the body in the plane of the waist, 50 mm above the supra-cristal plane which is at the level of the highest points of the iliac crests. The dimension 50 mm refers to a subject of 1 780 mm tall and should be scaled pro-rata with the height of the actual subject

3.14.6
outside leg length
distance from the waist to the ground, measured with the tape-measure following the contour of the hip

4 Requirements

4.1 General

Protective clothing and equipment for fencers shall meet a general requirement that the product is safe to use and fit for its purpose and shall also meet the following specific requirements.

4.2 Innocuousness

Protective clothing and equipment for fencers shall be designed and manufactured to provide protection when used according to the manufacturer's instructions, without endangering the user or other players. There shall not be hard or sharp edges, seams, buckles or other items on the surfaces of the products that could harm the user or other players during normal use. Examination shall be made according to 5.4.

Construction materials and incorporated substances shall not harm those coming into contact with them. The manufacturer shall list in the information supplied with the product, the substances used in the main components of the product, and shall label any product containing substances or preparations generally known to be hazardous.

Information about determining the chemical innocuousness of protective clothing and equipment is given in informative annex A.

4.3 Ergonomic requirements

Fencers' protective equipment shall be designed to minimise discomfort and impediment while wearing it. Fabrics in contact with the skin shall be wettable and not impermeable. The designs should permit normal fencing movements. The mask and visor shall not unduly distort the view of the user. The bib shall not cause the mask to be displaced when the user flexes their neck. The equipment shall be assessed according to 5.5.

4.4 Restraint requirements

Fencers' protective equipment shall be designed so that it should remain in place during normal use and during impacts. This restraint may be achieved using integral straps with buckles, touch and close fasteners, separate 'harness' or other items of protective equipment or clothing. The manufacturer shall give details of how adequate restraint of the equipment may be achieved in the information supplied by the manufacturer, see clause 7.

Fencers' masks shall not be pulled off a test subject's head when a force of 20 N is applied as described in 5.8, nor brought into contact with a test subject's face when tested with a force of 50 N as described in 5.8.

4.5 Sizing

Protective equipment shall be marked with its size (see clause 6). The size shall be related to the body dimensions of the fencers the equipment should fit, and this shall be explained in the information supplied by the manufacturer (see clause 7). The following body dimensions shall be used in sizing the protective equipment. Other dimensions may be used in addition. Definitions of some body dimensions are given in 3.15; others shall be determined by reference to ISO 8559:1989.

Jackets and under plastrons shall be sized against the users' chest or bust girth and stature.

Breeches and fencing underpants shall be sized against the users' waist girth and stature or outside leg measurement.

Gloves shall be sized against the users' hand length and hand breadth as described in EN 1082-1:1996, annex B, Table B1.

Socks shall be sized against the users' shoe size.

Breast protectors shall be sized according to brassiere and brassiere cup sizes as defined in ISO 8559, or against the user's bust girth or under bust girth.

Fencing masks shall be sized according to their circumference as specified in Table 1 and measured according to 5.7.

Genital protectors shall be sized as specified in EN 13546:2002 for hard genital protectors.

4.6 Minimum dimensions of zones of protection

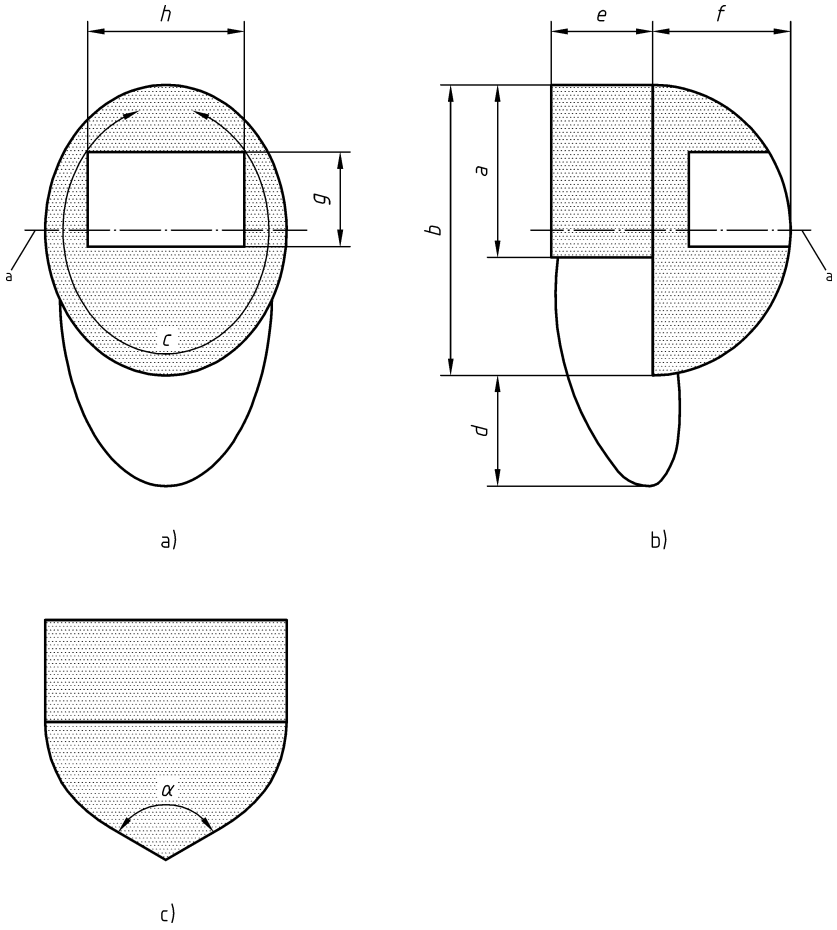
4.6.1 General

All protective equipment shall have a zone or zones, of protection, the dimensions of which shall be related to the size of the user. The dimensions and position of the zones of protection relative to the coverage provided by the whole equipment shall be given in the information supplied by the manufacturer (see clause 7). Where the dimensions of the coverage exceed those of the zone of protection by more than 15 mm in any direction, the outline of the zone of protection shall be clearly displayed. This may be by a line or a colour boundary on the inside or the outside of the equipment, or by a pictogram permanently attached to the equipment. It shall be possible to display the extent of the zone of protection where the garment is offered for sale.

The dimensions of the zones of protection of clothing and equipment shall be measured as described in 5.7.

4.6.2 Masks

Fencing masks shall have dimensions as shown in Table 1, and illustrated in Figure 2. If a transparent visor is fitted there shall be a height of at least 40 mm of transparent material above the horizontal plane through the hard shell at the level of the mid point of dimension *B*, and at least 30mm of transparent material below this plane.



Key

a) Side view
b) Rear view
c) Top view

a/*b* The ratio of the vertical height of the lateral protection to the vertical height of the hard shell
a Horizontal plane at the level of the mid point of dimension B
c The internal circumference of the hard shell measured on the inner surface of the padding
d The depth of the bib
e The width of the lateral protection
f The front to back internal depth of the hard shell
g The minimum vertical height of the transparent area of a visor if present
h The minimum horizontal width of the transparent area of a visor if present
α The front angle of mesh masks without a visor

Figure 2 — Fencing mask - Dimensions of component parts

Table 1 — Fencing mask – Dimensions of component parts

Nominal size	*a*/*b*	*c*	*d*	*e*	*f*	*g*	*h*	α^a
		mm	mm	mm	mm	mm	mm	
XS	> 2/3	< 690	> 100	> 100	> 70	>70	>130	< 130°
S	> 2/3	680-740	> 100	> 100	> 70	>70	>130	< 130°
M	> 2/3	730-760	> 100	> 100	> 70	>70	>130	< 130°
L	> 2/3	750-780	> 100	> 100	> 70	>70	>130	< 130°
XL	> 2/3	> 770	> 100	> 100	> 70	>70	>130	< 130°
[a] Applies only to metal mesh masks								

4.6.3 Fencing clothing

4.6.3.1 General

The specific zone of protection as well as the coverage provided by protective clothing for the trunk is determined by the particular discipline involved. It is also determined by whether the wearer is left or right handed. In all cases it is a requirement that each item of protective clothing shall be plainly marked with the particular fencing disciplines for which the clothing is suitable, as well as the ”handedness” for which it is intended (see clause **6**). When the correct size of garment is worn the user should have certain areas of the body covered by protective material when making all normal fencing movements (see **annex B**):

4.6.3.2 Coverage by fencing jackets, breeches and underpants

Jackets – From 30 mm above the neck line down to within 50 mm of the wrist, to the waist all round the torso, and in jackets for epee over the anterior surface of the abdomen (dimension *D*, Figure 3a).

Breeches – From at least 100 mm above the waist to at least 75 mm below the plane of the knee joint, all round the abdomen and thighs.

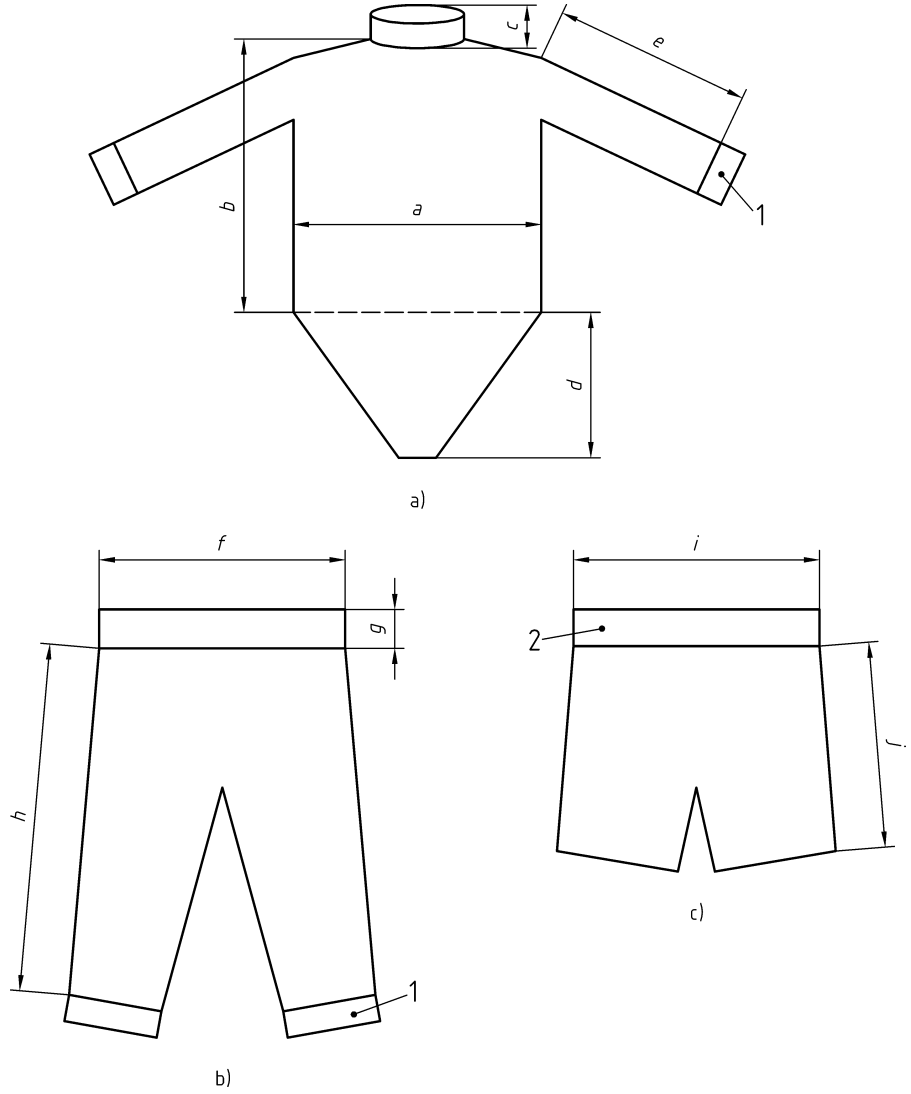
Underpants – The anterior 50 % of the circumference of the abdomen and thighs from the waist to at least halfway down the thighs.

4.6.3.3 Dimensions of the zones of protection of fencing jackets, breeches and underpants

The dimensions of the zones of protection shall be determined by the values given in the information supplied by the manufacturer for the relevant control dimensions of the largest user the garment is intended to fit. The dimensions of the zones of protection shall not be less than those defined by Table 2 and illustrated in Figure 3.

Table 2 — The minimum dimensions of the zones of protection of jackets, breeches and underpants

Dimensions of the zones of protection as percentages of the control dimensions, or as a minimum value in millimetres											
		Jacket					Breeches			Under pants	
		a %	*b* %	*c* mm	*d* %	*e* %	*f* %	*g* mm	*h* %	*i* %	*j* %
Control dimension	Height	-	29	-	9	29	-	-	36	-	20
	Chest girth	51	-	-	-	-	-	-	-	-	-
	Waist girth	-	-	-	-	-	51	-	-	51	-
minimum value		-	-	30	-	-	-	100	-	-	-
For with " - " characterized fields are not determined control dimensions or minimum values											



Key

a) Jacket
b) Breeches
c) Underpants

a Chest width of a jacket laid flat
b Shoulder to waist length
c Collar height
d Height of abdominal protection
e Sleeve length
f Waist width of breeches laid flat
g Height of the zone of protection above the waist
h Outer leg length from the lower edge of the waist band of breeches downwards
i Waist width of underpants laid flat
j Outer leg length from the lower edge of the waistband of under pants downwards

1 Cuffs. These are not included in the zones of protection
2 Waistband of underpants. This is not included in the zone of protection

Figure 3 — Diagram of the dimensions of jackets, breeches and underpants to be measured on the garments laid out flat

4.6.3.4 Coverage by under plastrons

These are designed to be a loose comfortable fit, being one armed they are generally supplied in ‘small’, ‘medium’, ‘large’ and ‘extra large’ sizes. The manufacturer’s instructions shall state how the correct garment should be chosen and the range of sizes of user each size should fit.

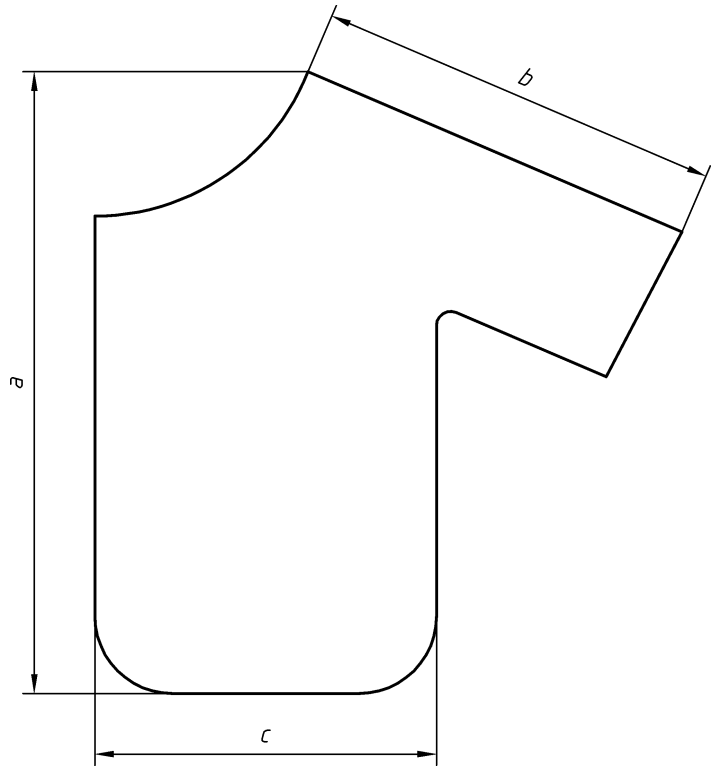
The coverage provided by under plastrons should be from the neck-line to the hips and covering one side of the torso, reaching the midline on the chest and the back. The sleeve should extend to a point not more than 100 mm above the point of the elbow.

4.6.3.5 Dimensions of the zones of protection of under plastrons

The dimensions of the zones of protection shall be determined by the values given in the information supplied by the manufacturer for the relevant control dimensions of the largest user the garment is intended to fit. The dimensions of the zones of protection shall not be less than those in Table 3 and illustrated in Figure 4.

Table 3 — The minimum dimensions of the zones of protection of under plastrons

Control dimension	Dimensions of the zones of protection as percentages of the control dimension		
	A %	B %	C %
Height	28	20	
Chest girth			26



Key

a Torso height from the lower edge to the top of the shoulder
b Length from the neckline to the end of the sleeve
c The minimum width of the anterior and posterior panels of the plastron

Figure 4 — Diagram of the dimensions of an under plastron to be measured on the garment folded at the centre of the side and laid out flat

4.6.4 Gloves

The zones of protection in gloves shall be on the back of the palm (hand) from the base of the fingers to at least 100 mm above the wrist. The dimensions of the zone of protection shall be at least those in Table 4.

Table 4 — Minimum dimensions of the zones of protection in gloves

Glove size according to EN 420	Dimension mm	
	Width of the zone of protection measured across the glove	Length of the zone of protection measured from the base of the crotch between the second and third fingers towards the wrist
6,5	75	196
7,0	80	200
7,5	80	204
8,0	85	208
8,5	95	212
9,0	100	216
9,5	100	220
10,0	100	224
10,5	110	228
11,0	110	232

4.6.5 Socks

Socks shall be continuously protective throughout their length. They shall have the minimum dimensions given in Table 5.

Table 5 — Minimum dimensions of the zones of protection of socks

Shoe size	Dimension mm	
	Height of the sock from the base of the heel to the top	Length of the foot region from the toe to heel
31/33	450	160
34/35	465	170
36/38	480	220
39/40	490	230
40/41	500	240
42/43	510	250
44/45	530	260
46/47	550	270

4.6.6 Breast protectors

The zone of protection of a breast protector shall be sized against bust girth it shall not have a diameter less than 0,1 times the stated bust girth.

4.6.7 Genital protectors

The zone of protection of a hard genital protector shall be continuous with the shell. The shell shall be without perforations greater than 6 mm in diameter in a central frontal area which shall be not less than 75 % of the shell dimension in any direction.

Genital protectors shall have the minimum dimensions specified in EN 13546:2002.

4.7 Construction materials and construction details

4.7.1 General

Protective clothing and equipment for fencers shall be constructed from the following materials or materials with equivalent properties.

4.7.2 Fencing masks

4.7.2.1 Mask hard shells, lateral protection and visors

Fencing mask hard shells, lateral protection and visors shall be constructed from stiff material meeting the specific penetration requirements in 4.8. These parts of the mask may be constructed throughout of the same material or of different materials. A transparent visor may be incorporated. Perforated material may be used. It shall not be possible at any point to pass a cylindrical probe with a diameter of (2,1 ± 0,05) mm, or a flat probe (0,2 ± 0,05) mm thick and (4,0 ± 0,1) mm wide, through the mask with light manual force.

4.7.2.2 Resistance to deformation

It shall not be possible to pass the cylindrical or flat probes through any point on the mask when it is not compressed or when it is compressed between flat plates laterally with a force of (900 ± 50) N or when it is compressed between flat plates vertically with a force of (900 ± 50) N. After compression in each direction inspection shall show no fractures or failures of joins have occurred.

4.7.2.3 Steel wire mesh

Steel wire mesh shall be made from wire not less than 1,0 mm in diameter. It shall be woven in a square mesh pattern. The mesh apertures shall be less than 2,0 mm square in plane zones and less than 2,1 mm in curved zones. The mesh should have a similar crimp in the warp and weft wires. Level 1 mesh shall be plated or coated to prevent rusting or shall be of stainless steel. Level 2 mesh shall be made from stainless steel or similar corrosion resistant material.

4.7.2.4 Plastic masks and transparent plastic or mineral (glass) visors

Plastic masks and transparent plastic or mineral (glass) visors shall be made from material that can be shown not to be subject to stress fracturing or to fatigue fracturing caused by impacts, in the design in which it is used. (See annex C for some information on problems with plastics). The fixing systems employed for transparent masks shall conform to the relevant recommendations of the manufacturer of the particular plastic. Visors shall meet the requirements for protection against high energy impacts [High energy impacts (A)] for face shields in 7.1.4.2 and 7.2.2 of EN 166:2001.

4.7.2.5 Join profile

The join regions shall have smooth outer surfaces with no steps greater than 2,5 mm in height that would be likely to arrest a blade tip. Changes in levels that are chamfered to an angle that is shallower than 45° are not regarded as steps. Where there are apparently non-perforating gaps or channels between areas of outer surface material, in addition to meeting 4.7.2.1, the gaps or channels shall be less than 2,5 mm wide if they are more than 2,5 mm deep.

4.7.2.6 Join construction

Joins between the hard mask shell and the lateral protection shall consist of connection by wire stitching, riveting, welding or other secure system that is irremovable except by intent.

4.7.2.7 The bib

Bibs shall be made of flexible material that may be layers of cloth or other material that has sufficient stiffness to remain in place during normal use. Bib stiffness shall be assessed according to 5.5. The bib shall be continuously attached to the hard shell and lateral protection by sewing, gluing and riveting, or gluing and sewing, or riveting. The bib shall overlap the lower edge of the lateral protection by at least 20 mm, and the hard shell by at least 10 mm. The bib shall not become detached from the mask so that it is possible to pass either probe specified in 4.7.2.1 between them when tested according to 5.9.

4.7.2.8 Interior padding or any other system to support the mask on the head and face

Interior padding or another system to support the mask on the head and face shall be provided that allows the mask to be placed comfortably on the user's head and face. The thickness and compressibility of padding or the properties of any other system shall be limited so that under foreseeable impacts the mask does not move significantly onto the user's head with the consequence that their nose might contact the hard shell, see 4.4 and 5.8.

4.7.3 Fencing clothing

4.7.3.1 Jackets, breeches, under pants and under plastrons

Jackets, breeches, underpants and under plastrons shall be made out of fabrics which are machine washable.

4.7.3.2 Closures

All closures shall be constructed of materials that meet the performance requirements of the zone of protection in which they are situated.

On torso garments specifically for right or left handed fencers zip fasteners and other closures shall be placed on the side of the non-armed hand. The closure shall include an overlap of protective material of at least 5 mm width, which shall cover the closure and shall only be open to the direction away from the opponent.

On torso garments designed for right or for left handed fencers with closures in the centre of the back, the protective material of the two sides shall butt together with no overlap.

On breeches with central zip flies the closure shall have an overlap of protective material of at least 5 mm width which shall cover the closure and shall be open to the direction away from the opponent.

4.7.3.3 Fencing gloves

Fencing gloves shall be constructed from tightly woven, non-woven, or knitted fabric, or from leather or artificial leather which shall be washable.

4.7.3.4 Fencing socks

Fencing socks shall be constructed from tightly woven, knitted or other fabric which shall be washable.

4.8 Penetration resistance

4.8.1 General

There are two levels of penetration resistance performance specified in these requirements. See clauses 6 and 7, and also annex B for information.

NOTE The penetration resistance requirements for fabrics correspond to the current (1999) Fédération Internationale d'Escrime (FIE) requirements for dry testing. FIE wet test requirements are 10 % below dry test requirements. Wet testing is not required under this European Standard.

4.8.2 Masks

When tested according to the test methods described in section 5.10.3 and 5.10.4 of this standard, there shall be no penetration of the hard shell, lateral protection and joins in masks at the forces or impact energies in Table 6.

When tested according to the test methods described in section 5.10.5 the mean value of the force recorded on penetration of mask bibs shall not be less than the values in Table 6. No more than one individual result shall be less than 96 % of the value in Table 6.

After the penetration tests it shall not be possible to insert a probe with the same dimensions as the end of the penetrator through the hard shell, lateral protection, visor or any join between them at any angle of presentation of the probe. After the low velocity test the permanent deformation of the mesh shall be less than 10 mm when measured according to 5.10.3.4.

Table 6 — Fencing mask - Penetration resistance requirements

Performance level	Penetration force, or impact energy		
	Mask, hard shell		Mask, bib High velocity test
	Low velocity test	Impact test energy, J	
1	No penetration at 600 N	5,5	> 350 N
2	No penetration at 1 000 N	8,5	> 1 600 N

4.8.3 Jackets

The mean value of the penetration forces of the zones of protection of fencing jackets shall be higher than the values in Table 7 when tested as described in clause 5.10.5. No more than one individual result shall be less than 96 % of the value in the table.

Table 7 — Fencing jacket - Penetration force requirements

Performance level	Penetration force
1	> 350 N
2	> 800 N

4.8.4 Breeches

The mean value of the penetration forces of the zones of protection of fencing breeches shall be higher than the values in Table 8 when tested as described in 5.10.5. No more than one individual result shall be less than 96 % of the value in the table.

Table 8 — Fencing breeches - Penetration force requirements

Performance level	Penetration force
1	> 350 N
2	> 800 N

4.8.5 Under pants

The mean value of the penetration forces of the zones of protection of fencing under pants shall be higher than the values in Table 9 when tested as described in 5.10.5. No more than one individual result shall be less than 96 % of the value in the table.

Table 9 — Under pants - Penetration force requirements

Performance level	Penetration force
1	> 350 N
2	> 800 N

4.8.6 Under plastrons

The mean value of the penetration forces of the zones of protection of fencing under plastrons shall be higher than the values in Table 10 when tested as described in 5.10.5. No more than one individual result shall be less than 96 % of the value in the table.

Table 10 — Under plastron - Penetration force requirements

Performance level	**Penetration force**
1	> 350 N
2	> 800 N

4.8.7 Gloves

All gloves shall be at least 0,5 mm thick from the fingertips to the wrist, and at least 1,0 mm thick in the zone of protection and in the cuff. Glove thickness shall be measured according to the method in EN ISO 5084:1996. The mean value of the penetration forces of the zone of protection of fencing gloves shall be higher than the values in Table 11 when tested as described in 5.10.5. No more than one individual result shall be less than 96 % of the value in the table.

Table 11 — Glove - Penetration force requirements

Performance level	Penetration force
1	No requirement
2	> 350 N

4.8.8 Socks

Socks shall be at least 1,0 mm thick. Sock thickness shall be measured according to test methods described in EN ISO 5084:1997.

4.8.9 Breast protectors

When tested by the method in clause 5.10.6 with an impact energy of (2,5 ± 0,05) J breast protectors shall not be penetrated, nor show other damage such as cracks or fractures.

4.8.10 Genital protectors

When tested by the method in clause 5.10.6 with an impact energy of (2,5 ± 0,05) J genital protectors shall not be penetrated, nor show other damage such as cracks or fractures.

4.9 Burst strength of seams

The seams between materials providing the mechanical properties of the zones of protection in jackets, breeches, under pants and under plastrons shall have a burst strength of at least 300 kPa when tested according to 5.11.

5 Test methods

5.1 Instruments

Measuring instruments unless otherwise specified shall be an error limit of ± 2 % of the pass/fail level of the characteristic being measured.

For each of the required sequences of measurements performed in accordance with this standard except those depending on a reference material, a corresponding estimate of the uncertainty of the final result shall be determined. This uncertainty (Um) shall be given in the test report in the form Um = ± X. It shall be used in determining whether a "Pass" performance has been achieved. If the final result minus Um is below the pass level when the requirement that a certain value shall be exceeded, the sample shall be deemed to have failed.

5.2 Products for testing

Test items shall be supplied by manufacturers complete with labels and the information supplied by the manufacturer (see clause 7) that will be supplied with the products. At least one specimen of each size shall be supplied except that in cases where the available size range exceeds five sizes, only five examples representing the whole size range are required. However, more may be required by the test house to complete the examinations, and this shall be agreed between the supplier and test house.

— At least one example of each available size shall be examined in 5.6 and 5.7.

— At least two sizes shall be tested according to 5.8, 5.9, 5.10.3, and 5.10.4; the sizes being selected to represent the larger and smaller products sold.

— Ten test specimens cut from each type of material, each combination of material or each construction type, within a zone of protection in jackets, breeches, under pants and under plastrons, shall be tested according to 5.10.5.

— At least three test specimens, of different sizes if they are available, shall be used in tests according to 5.10.6.

— Five test specimens cut from each type of seam, join or closure within a zone of protection in jackets, breeches, under pants and under plastrons shall be tested according to 5.11.

The manufacturer shall state the performance level to which the product shall be tested, or supply one additional example of the product for survey testing to establish the appropriate performance level at which to test the products.

Each test item shall be inspected to verify that it is as described by the manufacturer and to determine its basic construction. Some products could incorporate innovations and other features not anticipated by this standard, which raise serious concerns about the safety and performance of the product. The inspector shall record all such concerns.

5.3 Conditioning of products

Test samples of garments or lengths of fabric, but not samples of mask bibs or mask bib fabrics, shall be pre-conditioned by washing five times according to ISO 6330, or according to the manufacturer's instructions.

Masks and mask bibs shall be cleaned five times according to the manufacturer's instructions.

Test samples shall be hung in an atmosphere of (20 ± 2) °C and (65 ± 5) % relative humidity for at least 48 h before testing. Testing shall be carried out in the conditioning environment or within 60 min of removal from that environment.

5.4 Innocuousness

The product shall be examined visually and by hand to locate any hard or sharp edges, seams, buckles, or other items that might injure the fencer or any other person during normal use. Documents supplied by the manufacturer shall be examined to determine whether the claim that the materials are suitable for use in fencing protective clothing and equipment is justified. Testing to ensure that the requirement is met shall be carried out if the documents examined are not adequate. The Information supplied by the manufacturer (see clause 7) shall be examined for a list of the substances used in the main components of the product. The results of the examination shall be recorded in the test report.

5.5 Ergonomic testing

The product shall be examined with the assistance of a fencer. The results of manufacturers' user trials and development studies included in the Technical File may be taken into account.

The product shall be assessed as to whether it is adequately comfortable and permits all normal fencing movements. The restraint and adjustment systems shall be examined to determine whether the product is likely to become displaced in normal fencing. The Information supplied by the manufacturer (see clause 7) shall be examined to determine whether adequate instructions for selection and adjustment of the product are given.

The assistant shall report on whether there are any apparent hazards in using the equipment including whether their vision is unduly obstructed by any component of the mask. The bib stiffness shall be assessed by an appropriate size of subject wearing the bib attached to a mask. They shall flex their neck so that the mask shell contacts their chest then straighten their neck. The actions shall be carried out five times. The subject shall report whether the bib tends to lift the mask from the face on flexing their neck and whether the bib remains in contact with, or adequately close to, their chest on extending their neck.

The product may be used in training or competitions to complete the ergonomic examination, but only after the level of performance of the product has been determined in the mechanical tests. Only new undamaged products shall be used in training or competitions, which shall be at a level appropriate for the product.

The results of the examination shall be recorded in the test report.

5.6 Sizing

The dimensions of the product, restraint systems and adjustments, shall be measured with appropriate tape measures or other devices. The size marked on the product and details in the Information supplied by the manufacturer (see clause 7) shall be examined to determine whether the product corresponds to the marking and to the information given. The results of the examination shall be recorded in the test report.

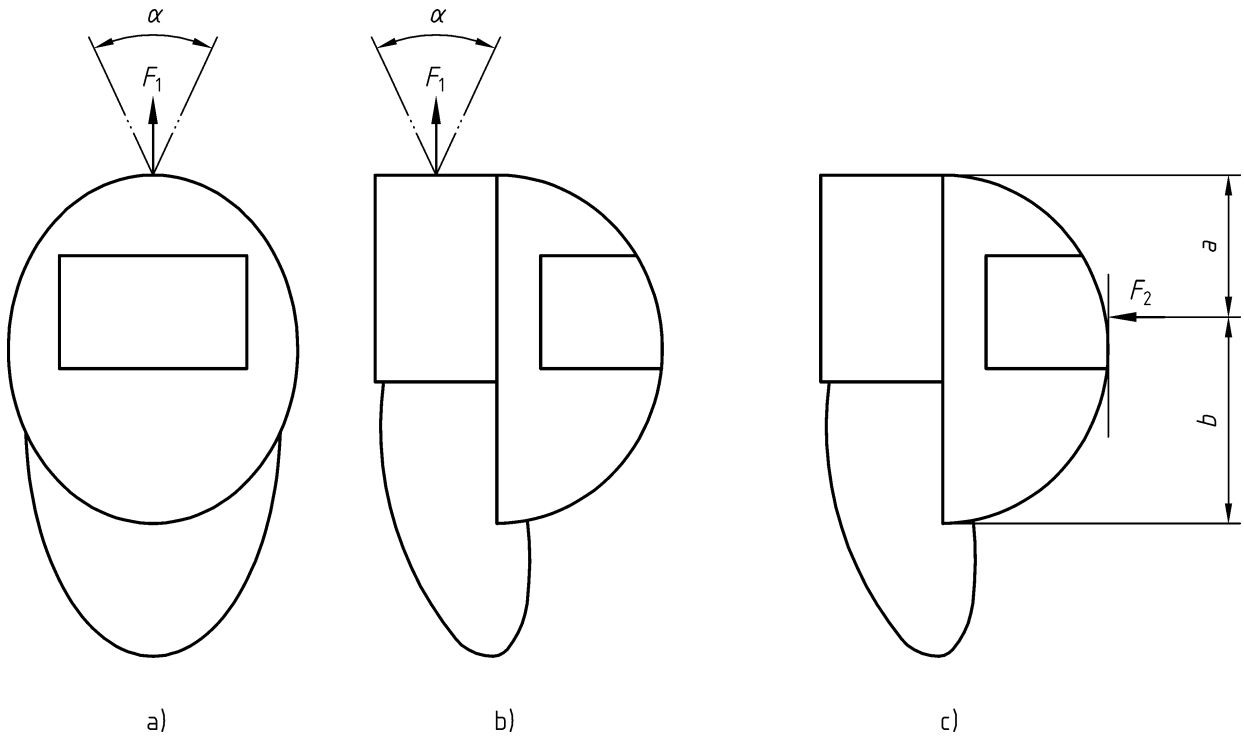
5.7 Examination of zones of protection

The clothing and equipment shall be examined to determine the limits of the protective material in them. The results shall be compared with the information provided by the manufacturer. The dimensions of the material constituting the zone of protection shall be compared with the requirements in clauses 4.6.2 to 4.6.7. Jackets, breeches, under pants, under plastrons, socks and gloves shall be measured laid out flat. Masks shall be measured as they are worn. The inside circumference of the hard shell shall be measured with the padding lightly compressed. Angle ***a*** on mesh masks shall be measured as the angle to the tangents to the external face 10 mm either side of the mid line. Genital protectors shall be examined and measured as described in EN 13546:2002.

The results of the examination shall be recorded in the test report.

5.8 Restraint testing of masks

A mask shall be chosen to fit a test subject's head. It shall be put on according to the instructions provided, and any restraint mechanism such as an elastic strap or plastic strap adjusted. A thin wire or fishing cord shall be attached to a point near to the centre of the lateral protection to the hard mask on the top of the head (see Figure 5). A force of (20 ± 2,5) N shall be applied to the wire and movement of the mask observed. The direction of the force shall be varied through a 60° cone as shown in Figure 5. The test subject's head shall be suitably supported while a force of (50 ± 2,5) N is gently applied to the centre front of the hard mask pushing it onto the test subject's face, see Figure 5. Contact of the mask with the subject's nose, cheeks or chin shall be noted.



Key

a) Side view of the vertical pull test
b) Front view of the vertical pull test
c) Side view of the horizontal push test

F_1 Vertical pull of (20 ± 2,5) N exerted on mask

α Angle of cone through which the direction of the pull is varied

F_2 The direction of the (50 ± 2,5) N push on the mask

a Distance of the point of application of F2 to the top of the hard shell

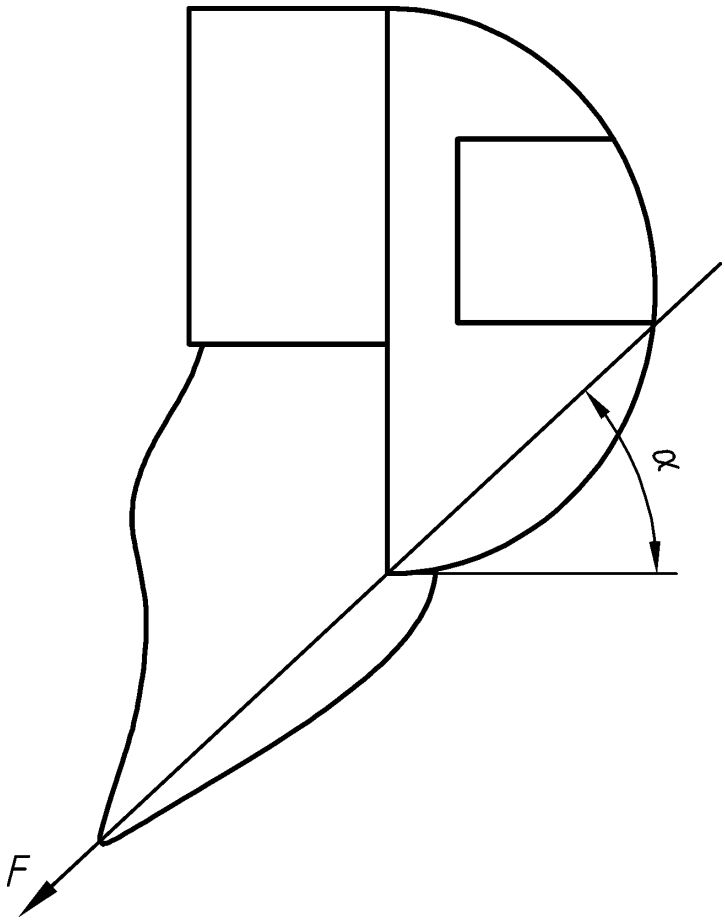
b Distance of the point of application of F2 to the bottom of the hard shell

a = (*b* ± 10) mm

Figure 5 —Restraint testing of a mask

5.9 Bib attachment testing

The mask to which the bib is attached shall be firmly fixed to a massive base or other support. A clamp with jaws at least 50 mm wide and 20 mm deep shall be attached to the bib near the centre of its lower edge. A force rising to (1 000 ± 50) N shall be progressively applied over a period of at least 30 s pulling the bib away from the mask in a direction at (45 ± 5) º to the horizontal axis of the mask as shown in Figure 6. The attachment of the bib to the mask shall be examined for separation with the probes specified in 4.7.2.1.



Key

F Direction in which the force is to be applied to the bib.
α Angle of the force to horizontal axis of the mask.

Figure 6 —Bib attachment testing

5.10 Penetration testing

5.10.1 General

Four tests are specified for products of different constructions to evaluate their different mechanisms of resisting penetration by blades and broken blades. The same square section penetrator is used in the first three tests. A cylindrical impactor is used in the fourth test.

1) Low velocity test for the hard shell, lateral protection and visors of masks;

2) Impact test for the hard shell, lateral protection and visors of masks;

3) High velocity penetration test for mask bibs, clothing fabrics, and other clothing materials

Either A compression tester with a penetrator mounted on the force transducer;

Or A drop rig with the penetrator on the falling mass;

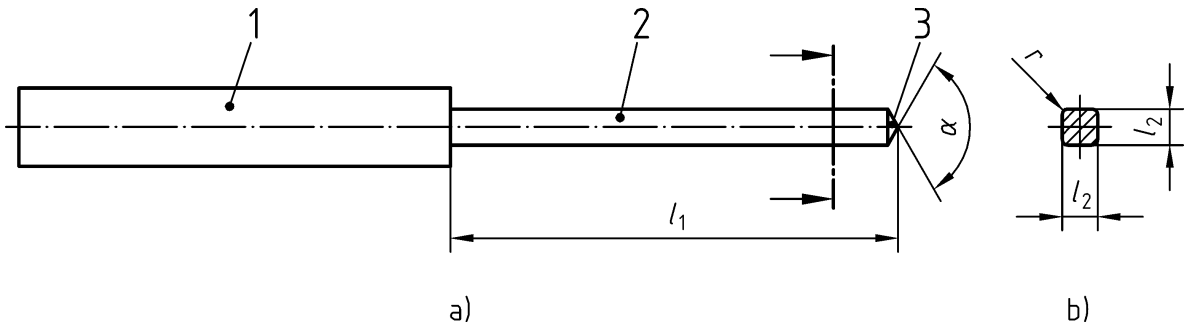
Or A drop rig with fixed penetrator;

4) Impact and fracture test for breast protectors and genital protectors.

5.10.2 Penetrator

5.10.2.1 Penetrator dimensions

A steel penetrator shall be used. It shall have a (3 ± 0,05) mm square section stem with corners with a radius of (0,5 ± 0,05) mm. The stem shall be 30 mm to 50 mm long and it shall be provided with a means of rigidly attaching it to the load cell of the compression tester. The tip shall be ground to a sharp pyramid with face angles of 60° ± 1° to the long axis of the penetrator. The penetrator shall have a hardness greater than 62 HRC. See Figure 7.



Key

a) Side view
b) Cross section of the stem

1 Mounting section
2 Square section stem
3 Pyramidal ground tip

l_1 Length of the stem, 30 mm to 50 mm
l_2 Width of the stem, (3 ± 0,05) mm
r Radius of the corners of the stem (0,5 ± 0,05) mm
a Included angle of the tip 120° ± 2°

Figure 7 — The penetrator

5.10.2.2 Verification of penetrator performance

When two layers of cotton canvas reference material as specified in EN 388:1994 are tested in the apparatus specified in 5.10.4, the mean force of penetration of ten test specimens shall be (645 ± 30) N. The fabric layers shall have their warp directions at (45 ± 10)º to each other. The angles of the pyramid of the penetrator, and between the pyramid and the stem of the penetrator shall be sharpened or dulled as necessary to achieve results within these limits.

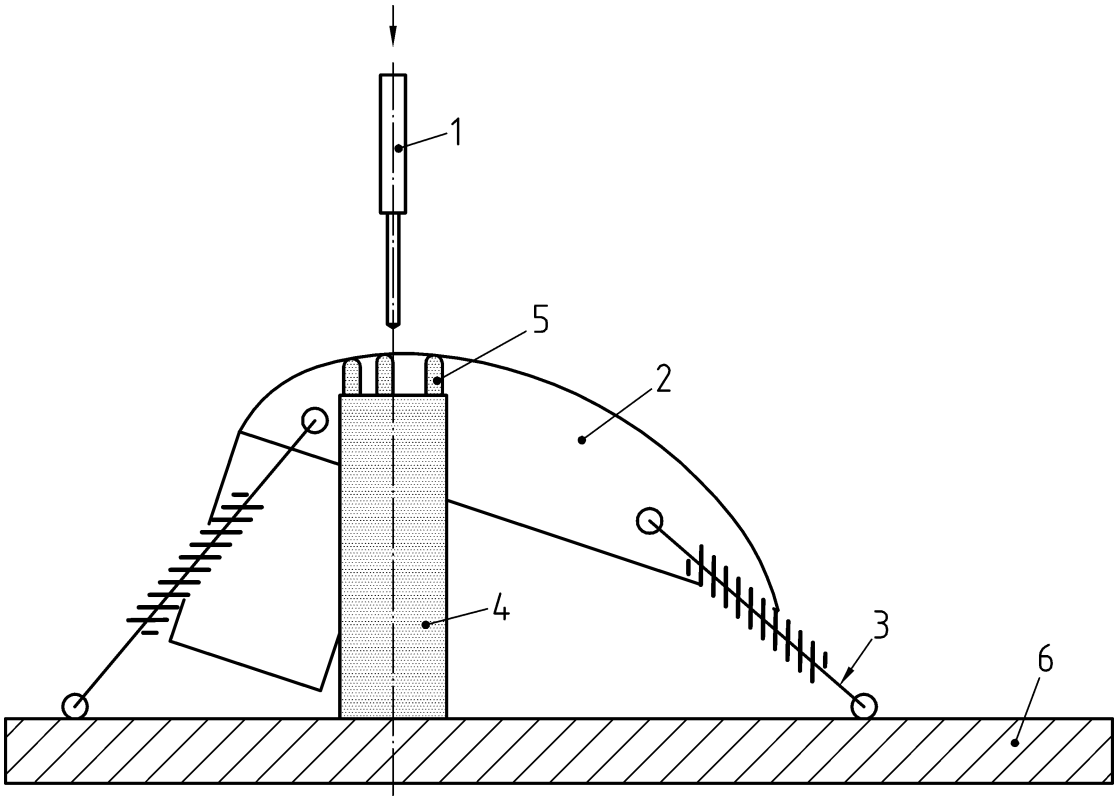
Penetrator performance shall be verified before each series of tests on a particular product under 5.10.3 and 5.10.4, and at least every 100 tests on fabrics under 5.10.5.

5.10.3 Low velocity test for the hard shell, lateral protection and visors of masks

5.10.3.1 Apparatus

A constant rate compression testing machine operating at (100 ± 10) mm/min shall be used. The machine shall have a limit deviation of Class 1 in ISO 7500-1:1986. The error in the force measurement shall not exceed ± 1 % at the prescribed force limits, and the error in the distance measurement shall not exceed ± 0,1 mm.

A test specimen support shall be provided that securely holds the mask during the test. The general design of a suitable support is illustrated in Figure 8. The tube on which the mask is supported shall be of an adequate length to hold the mask clear of any base plate. For testing smaller sizes of masks it will be necessary to mount the tube on a stiff arm so that parts of the shell can pass below the tube. The arm with the tube mounted on it shall be sufficiently stiff so that it is not be deflected by more than 0,1 mm when subjected to a vertical downwards static force of 500 N. The tube shall have an inside diameter of (60 ± 0,5) mm and a wall thickness of (10 ± 0,5) mm. It shall be made of metal. It shall be provided with three hemispherical point supports (10 ± 1,0) mm in diameter spaced equidistant around its upper surface. At least two of the supports shall be adjustable in height by over 15 mm so that the plane tangential to the surface of the mask at the test point may be adjusted to (90 ± 10) ° to the long axis of the penetrator. The support shall be positioned so that the penetrator enters the centre of the tube with an accuracy of ± 2 mm.



Key

1 The penetrator
2 Hard shell of a mask
3 A system to hold the mask in place for testing
4 The cylindrical tube
5 Hemispherical point supports
6 Solid base

Figure 8 — Face mask support

5.10.3.2 Test specimens

The test specimens shall be whole masks, however part or all of the lateral protection may be removed if necessary to position the mask on the apparatus, if this will not effect the properties of the area under test.

5.10.3.3 Test positions

Tests shall be carried out in the following positions:

2 tests on the hard shell within 25 mm of the vertical mid line and within 50 mm of the horizontal mid line.

2 tests on the hard shell within 25 mm of the vertical line midway between the anterior mid line and the lateral protection, and within 50 mm of the horizontal mid line.

2 tests on the lateral protection within 20 mm of the vertical mid line of the lateral protection and within 50 mm of the extension of the horizontal mid line of the hard shell across the lateral protection.

3 tests on the visor, if present, within the central area representing two thirds of the visor's whole area.

2 tests on the visor (10 ± 3) mm from the centre of any type or size of hole through the visor material.

6 tests on the visor (10 ± 3) mm from the edge of the visor material, two tests each to be along the upper edge, the bottom edge and one side of the visor.

2 tests on each type of join present in the hard shell except the visor frame fixation.

2 tests on the hard shell equidistant between fixation points of the visor frame to the hard shell. (Such fixation points may be welds, soldered points or other designs). 2 tests on the hard shell within 5 mm of the edges of fixation points of the visor frame to the hard shell.

Penetration tests shall not be made less than 40 mm from the position of a previous test.

5.10.3.4 Procedure

a) Fix the mask and penetrator to the test machine,

b) Adjust the mask and the relative height of the support points to present the test position correctly to the penetrator,

c) Advance the machine until a force of (1,0 ± 0,5) N between the mask and penetrator is shown,

d) Set the distance recording at '0' mm,

e) Advance the penetrator at (100 ± 10) mm/min,

f) Stop the machine at the performance requirement force limit. [Level 1 – (600 ± 10) N or Level 2 – (1 000 ± 20) N], or when penetration occurs if this occurs below these forces,

g) Determine whether penetration has occurred, by examination and use of a penerator as a probe.

h) Return the machine to the '0' mm position. Advance the penetrator until a force of (1,0 ± 0, 5) N between the deformed mask and penetrator is shown. Record the permanent deformation which is the advance of the penetrator,

i) Record each result separately and whether the mask has satisfied the performance requirements.

5.10.4 Impact test for the hard shell, lateral protection and visors of masks

5.10.4.1 Apparatus

A drop rig in which a guided mass of (1,5 ± 0,1) kg including an attached penetrator, falls from an appropriate height to give the required impact energies of 5,5 J and 8,5 J is suitable. A system shall be provided to arrest the falling mass so that only the penetrator strikes the mask, not the falling mass. The penetrator as specified in 5.10.2

shall be used. The mask shall be held on an adjustable tubular support as described in 5.10.3.1 placed on a massive base of >750 kg.

5.10.4.2 Test specimens

The test specimens shall be whole masks, however part or all of the lateral protection may be removed if necessary to position the mask on the apparatus.

5.10.4.3 Test positions

Tests shall be carried out in the following positions:

2 tests on the hard shell within 25 mm of the vertical mid line and within 50 mm of the horizontal mid line.

2 tests on the hard shell within 25 mm of the vertical line midway between the anterior mid line and the lateral protection, and within 50 mm of the horizontal mid line.

2 tests on the lateral protection within 20 mm of the vertical mid line of the lateral protection and within 50 mm of the extension of the horizontal mid line of the hard shell across the lateral protection.

3 tests on the visor, if present, within the central area representing two thirds of the visor's whole area.

2 tests on the visor (10 ± 3) mm from the centre of any type or size of hole through the visor material.

6 tests on the visor (10 ± 3) mm from the edge of the visor material, two tests each to be along the upper edge, the bottom edge and one side of the visor.

2 tests on each type of join present in the hard shell except the visor frame fixation.

2 tests on the hard shell equidistant between fixation points of the visor frame to the hard shell. (Such fixation points may be welds, soldered points or other designs).

2 tests on the hard shell within 5 mm of the edges of fixation points of the visor frame to the hard shell.

Penetration tests shall not be made less than 40 mm from the position of a previous test.

5.10.4.4 Procedure

a) Fix the penetrator to the falling mass,

b) Adjust the mask and the relative height of the support points to present the test position correctly to the penetrator,

c) Raise the mass so that the penetrator tip is the appropriate height above the test position,

d) Release the mass,

e) Determine whether penetration has occurred, by examination and use of a penetrator as a probe,

f) Record each result separately and whether the mask has satisfied the performance requirements.

5.10.5 High velocity penetration test for mask bibs, clothing fabrics, and other clothing materials

5.10.5.1 General

Three alternative types of apparatus are specified.

5.10.5.2 Compression tester

A constant rate compression testing machine operating between 6 ms^{-1} and 8 ms^{-1} is suitable. The penetrator as specified in 5.10.2.2 shall be fixed to the force transducer. The test specimen shall be placed in a stationary test specimen holder as specified in 5.10.4.5. A recording system shall be provided to record the force measured by the force transducer to a limit deviation of ± 1 % at the prescribed force limits.

5.10.5.3 Drop rig with the penetrator on the falling mass

A drop rig in which a guided mass of at least 5 kg falls from an appropriate height to give an impact velocity between 6 ms^{-1} and 8 ms^{-1} is suitable. A system shall be provided to arrest the falling mass so that only the penetrator strikes the test specimen, not the falling mass. The penetrator as specified in 5.10.2.2 shall be fixed to a force transducer mounted on the falling mass. The test specimen shall be placed in a stationary test specimen holder as specified in 5.10.4.5. A recording system shall be provided to record the force measured by the force transducer to a limit deviation of ± 1 % at the prescribed force limits.

5.10.5.4 Drop rig with fixed penetrator

A drop rig in which a guided mass of at least 5 kg falls from an appropriate height to give an impact velocity between 6 ms^{-1} and 8 ms^{-1} is suitable. The test specimen holder shall be part of the falling mass, and the penetrator shall be fixed to a stationary force transducer. A system shall be provided to arrest the falling mass so that only the test specimen strikes the penetrator. A recording system shall be provided to record the force measured by the force transducer to a limit deviation of ± 1 % at the prescribed force limits.

5.10.5.5 Test specimen holder

All three apparatus shall use the test specimen holder specified in Figure 9. It shall be made of metal. It shall be provided with removable clamping rings with interlocking grooves and ridges or such grooves shall be machined in the body and collar.

Key to Figure 9 (Figure on next page)

a Vertical section view
b Lower surface of grooved clamping ring

1 Threaded locking collar
2 Grooved clamping rings
3 Test specimen
4 Body of specimen holder
l_1 Collar height, (20 ± 3) mm
l_2 Groove height, (2 ± 0,1) mm
l_3 Opening in collar (35,7 ± 0,1) mm
l_4 Thread specification M 68 x 20
l_5 Opening in clamping ring (35,7 ± 0,1) mm
l_6 Diameter of inner ridge on clamping ring (44 ± 0,1) mm
l_7 Diameter of outer ridge on clamping ring (55 ± 0,1) mm
l_8 Overall clamping ring diameter (66,4 ± 0,5) mm

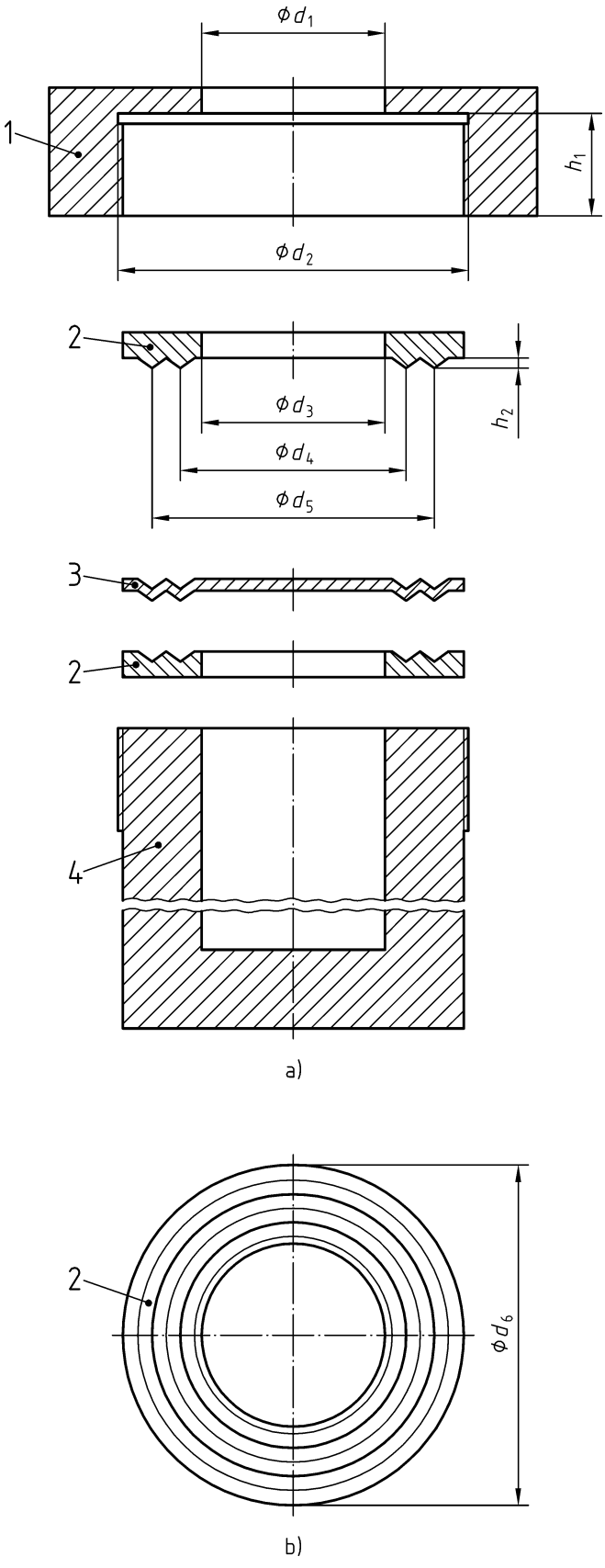


Figure 9 — Fabric test specimen holder

5.10.5.6 Test specimens

Fabric test specimens shall be cut from washed and dried samples pre-conditioned according to 5.3. Test specimens shall be taken across the width of the sample. They shall be circles (65 ± 2) mm in diameter. At least 10 test specimens shall be cut from each sample.

Testing shall be carried out in the conditioning environment specified in 5.3 or within 60 minutes of removal of the test specimens from that environment.

5.10.5.7 Test procedure

a) Fix the test specimen in the holder attached to either the moving part of a compression tester or the falling mass of a drop rig so that the outer face of the fabric faces the penetrator,

b) Tighten the locking collar with a torque of at least 100 Nm,

c) Adjust the machine so that the penetrator will contact the centre of the test specimen with a limit deviation of ± 1 mm,

d) Set the recording system to record,

e) **Either** set the compression tester to advance and stop it when penetration occurs,

   Or drop the mass with the attached penetrator,

   Or drop the mass with the attached test specimen.

f) Record the force at penetration,

g) Calculate the mean of 10 results. Give the result rounded to the nearest 1 N,

h) Report individual penetration force results, and the mean value.

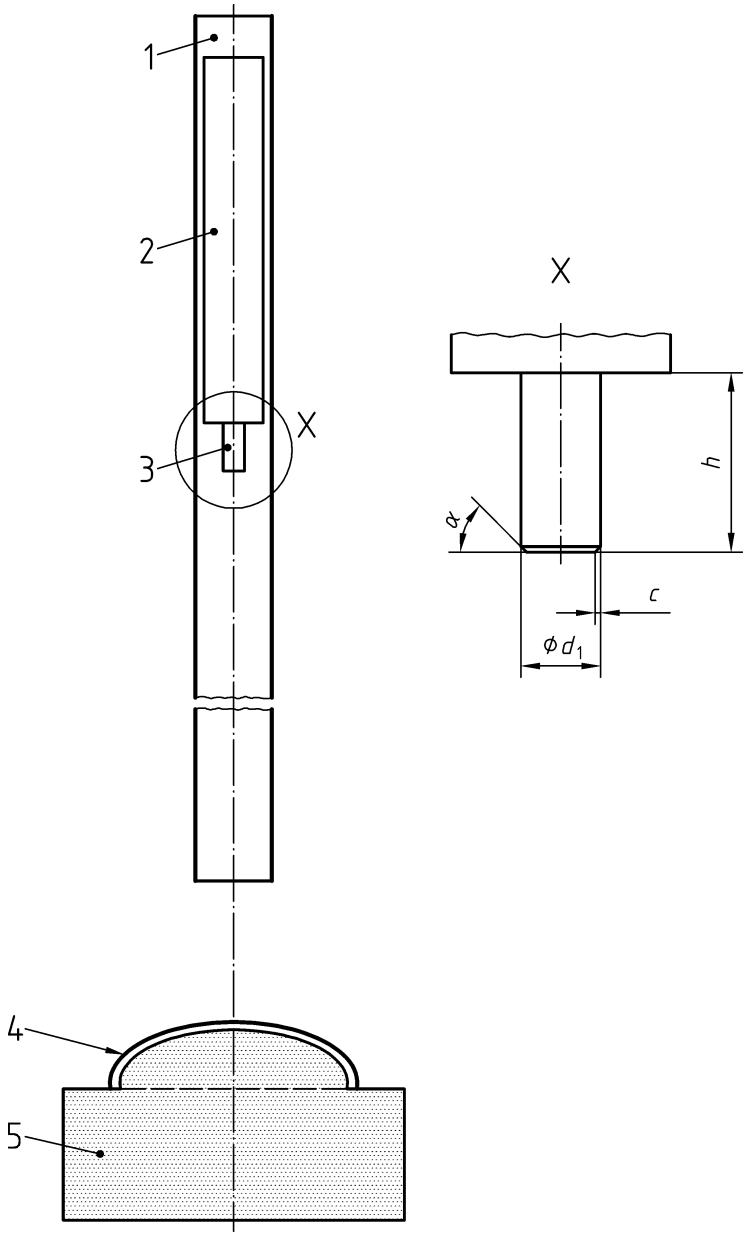
5.10.6 Impact and fracture test for breast protectors and genital protectors

5.10.6.1 Apparatus

The apparatus shall be a drop rig in which a guided falling mass with an attached impactor falls onto a test specimen. The falling mass including the impactor shall be (500 ± 15) g and the energy of impact shall be (2,5 ± 0,05) J for genital and breast protectors. The impactor shall be as specified in 5.10.6.2.

5.10.6.2 Impactor

The impactor face shall be based on the dimensions of the point of a foil. The impactor shall be cylindrical and (7 ± 0,1) mm in diameter. The edge shall be ground at (45 ± 5)° for a width of (0,5 ± 0,05) mm as illustrated in Figure 10.



Key

a Sketch of a possible apparatus
b Detail of the impactor, vertical section

1 Guidance system
2 Falling mass
3 Impactor
4 Test specimens
5 Test specimen support box filled with modelling clay backing material

l_1 Height of impactor, ≥15 mm
l_2 Diameter of impactor, (7 ± 0,1) mm
l_3 Width of ground corner of impactor, (0,5 ± 0,05) mm
a Ground angle, (45 ± 5)°

Figure 10 — The principle of the impact test for breast protectors and genital protectors, and details of the impactor

5.10.6.3 Test specimen support

Complete breast protectors or genital protectors shall be used. They shall be filled with backing material and held down by elastic straps onto boxes of backing material as described in prEN ISO 14876-2:1999.

5.10.6.4 Test impact number and positions

Test impacts shall be made in the central areas of test specimens representing 66 % of their hard shell surface area. Impacts shall be made at least 30 mm apart. Three impacts shall be made on each test specimen. Three test specimens shall be used.

5.10.6.5 Procedure

a) Fix the test specimen to the backing material box so that the plane tangential to the surface of the test specimen at the intended point of the impact is horizontal ± 10°. There should be no air spaces in the backing material filling the test specimen or below it in the box,

b) Drop the falling mass and impactor onto the test specimen,

c) Record the velocity of impact and calculate the energy of impact,

d) Examine the test specimen for damage, noting cracks, holes or penetration. Record any damage,

e) Restore the backing material in the test specimen and box to its initial condition,

f) Continue testing until nine impacts of the prescribed energy have been carried out.

5.11 Burst testing

5.11.1 Apparatus

Burst testing shall be carried out in a pneumatic or hydraulic apparatus conforming to EN ISO 13938-1:1999 or EN ISO 13938-2:1999 using a test area of 100 cm^2, (112,8 mm diameter), or to the modification of this method in EN 13595-3:2002. It is not required that the distension at bursting can be measured.

5.11.2 Test specimens

Test specimens shall be cut from washed and dried samples pre-conditioned according to 5.3. At least five test specimens of each type of seam or closure shall be prepared. The seam or closure to be tested shall lie across the centre of the test specimen ± 10 mm. Test specimens shall be circles of an appropriate diameter to fit the particular apparatus, or may be in continuous fabric if the apparatus is capable of clamping such test specimens.

Testing shall be carried out in the conditioning environment specified in 5.3 or within 60 min of removal of the test specimens from that environment.

5.11.3 Test procedure

Follow the appropriate procedure for the apparatus used:

a) The test specimens shall be clamped so that they do not slip during the test,

b) Fluid shall be pumped into the apparatus until the specimen bursts or the pressure is 50 % above the value of the requirement,

c) The bursting pressure, or the pressure resisted, shall be recorded to the nearest 25 kPa,

d) Examine the test specimen to verify it did not slip and that failure did not occur against the clamping system. If either event occurred reject the result,

e) Calculate the mean of five accepted results.

6 Marking

Each individual item of protective clothing and equipment for fencers shall be permanently and conspicuously marked with the following:

a) The name, trademark or other means of identification of the manufacturer or his authorised representative in the European Union or country where the product is placed on the market.

b) Designation of the product type, commercial name or code that uniquely identifies the item.

c) The size designation of the item.

d) The number of this standard.

e) The performance level of the item, e.g. ‘Level 1’ or ‘Level 2’.

f) A warning that contamination or solvents may dangerously reduce the performance of plastic masks and visors.

g) A line or boundary marking the edge of the zone of protection if it is more than 15 mm from the edge of the garment.

h) An indication whether the garment is left or right handed, or for left and right handed fencers.

i) The type of weapon or discipline for which the item is intended.

j) An instruction to see the information provided with the information supplied by the manufacturer (see clause 7).

The following information should also be given on the product whenever possible:

k) The hazards encountered in fencing against which (some) protection is given.

l) The hazards encountered in fencing against which protection is not given.

m) Textile and material types used in the protective clothing or equipment.

n) International care label symbols (negative labels are important).

7 Information to be supplied by the manufacturer

Protective clothing shall be supplied with instructions for fitting and use that will promote their safe and effective use. The information shall be precise and comprehensible in the official language(s) of the state or region in which they are placed on the market. The information shall contain at least the following:

a) All the information required in clause 6, Marking.

b) The full address of the manufacturer or importer.

c) An explanation of the levels of performance of equipment available under this standard.

d) How to select clothing and protective equipment of the correct level of performance.

e) How to select the correct size of clothing and protective equipment and check its fit noting FIE or other relevant regulations.

f) Details of the sizes of clothing and protective equipment and the body dimensions to which they relate.

g) Details of the location and sizes of the zones of protection.

h) How to adjust the clothing or protective equipment.

i) How to fix the clothing or protective equipment so that it remains in place during normal use.

j) A warning that no protective equipment can offer full protection against injury.

k) A warning about any contamination or alteration to the clothing or protective equipment or misuse that would dangerously reduce its performance.

l) A list of the substances used in the main components of the product.

m) Detailed instructions for caring for and cleaning the clothing and protective equipment.

n) Instructions concerning inspection, repair of the item, and how to decide that it should be thrown away because it may no longer provide protection.

Annex A
(informative)

Information about determining the chemical innocuousness of protective clothing and equipment

A.1 General

This informative annex is provided for the assistance and information of manufacturers and test houses in the application of the innocuousness requirements in Annex II of the PPE Directive (89/686/EEC) and EN 340.

The basic requirements are that protective clothing and equipment should not adversely affect the health of the user. This can be assumed to be likely if it is shown that the constituent materials are chemically suitable, and that they will not in the foreseeable conditions of normal use release or degrade to release substances generally known to be toxic, carcinogenic, mutagenic, allergenic or otherwise harmful.

NOTE Information on the classification and identification of harmful substances can be found e.g. in the Directives 67/548/EEC (classification, packaging, labelling of dangerous substances) and 76/769/EEC (restriction on use of dangerous substances) and amendments.

A.2 Evidence of innocuousness

Any of the following types of document may be presented as evidence that a product is innocuous:

a) The manufacturer's technical file,

b) Materials specifications from the material producers, and certificates of conformity,

c) Safety data sheets relating to the materials,

d) Certificates or reports relating to the suitability of the materials for use with food, in medical devices, or other relevant applications,

e) Certificates or reports relating to toxicological, allergenic, carcinogenic or mutagenic investigations on the materials,

f) Other documents submitted by the manufacturer.

The examination of the documents should determine whether the claim that the materials are suitable for use in the protective clothing or protective equipment is justified. Particular attention should be paid to the presence of plasticisers, unreacted components, heavy metals or, impurities, and the chemical identity of pigments and dyes, some of which are harmful.

A.3 Possible specific innocuousness testing

In the absence of satisfactory documentary evidence, testing may be necessary to ensure materials in fencing protective clothing and equipment meets the requirements for innocuousness in European Directives. The following may be relevant:

1) The chromium VI content of leather in clothing and gloves should comply with the requirement in EN 420.

2) All metallic materials which could come permanently into contact with the skin (e.g. studs, fittings and buckles) should have an emission of nickel of less than 0,5 µg/cm² per week. The test method to be used is that in EN 1811.

3) The pH value of protective clothing material should be greater than 3,5 and less than 9,5. The test method for leather to be used is that in ISO 4045 and for other materials that in ISO 3071.

4) The colour fastness to perspiration of protective clothing material should be determined in accordance with ISO 105-A02 and should be at least grade 4 of the Grey scale for the colour change of the specimen. The test should be conducted in accordance with ISO-105-E04.

5) Substances such as azo-dyes which release carcinogenic amines as defined by Directive 67/548/EEC and its amendments, should not be detectable by appropriate methods.

Annex B
(informative)

Levels of protection

B.1 Performance levels

Fencing by virtue of being a combat sport in which body contact by the weapon occasionally (but usually inadvertently) occurs outside the zones of protection, is by its nature dangerous. Protective clothing and equipment for fencers is intended as far as possible to prevent injuries, or in the worst cases to reduce the severity of injuries, particularly by the point of the weapon.

Broken blades pose a particular threat. The circumstances of the breakage of blades may result in high tip velocities and consequent high energy impacts by the broken blade. Broken blades have been known to penetrate protective equipment with fatal consequences. No practical clothing is capable of withstanding all broken blade impacts.

As a guide the following levels of protection are suggested as appropriate. However, the actual level of protection suitable for each fencer will depend on many factors such as their weight, height and level of experience and also that of their opponent, which cannot be determined by the manufacturer. The suitability of different levels of protection could also be determined from advice or regulation by a local, National or International fencing organisation. In practice individual fencing federations do indicate the level of performance which they judge to be necessary for the type of fencing, and the age and individual circumstances of the fencers under their jurisdiction. In some cases or for some items this could be a requirement to wear a mix of level 1 and 2 items, or two level 2 items.

— Level 1

  This is the lowest level of protection for fencing equipment.

— Level 2

  This is the highest level of protection for fencing equipment and is the Standard set for top international competition by the fencing International Governing Body the Fédération Internationale d'Escrime (FIE).

B.2 Performance of combinations

A fencer can wear one or more protective garments giving a combined protection which is greater than any of the individual garments. Higher performance levels can be reached by some combinations of garments. The manufacturer's instructions should clearly state what the performance value of each item is and also give an indication of the performance levels of combinations.

B.3 Fencing jackets, breeches and underpants

As the coverage by jackets and breeches is dependant on the size of the wearer the purchasers should examine the instructions provided and ensure the garment fits their body correctly.

The specific zone of protection as well as the coverage provided by protective clothing for the trunk is determined by the particular discipline involved. It is also determined by whether the wearer is left or right handed. In all cases it is a requirement that each item of protective clothing shall be plainly marked with the particular fencing disciplines for which the clothing is suitable, as well as the "handedness" for which it is intended.

When the correct size of garment is worn the user should have the following areas of the body covered by the zones of protection when making all normal fencing movements:

— **Jackets** – From 30 mm above the neck-line to the waist all round the torso, and down the arms to within 50 mm of the wrist.

— **Breeches** – From at least 100 mm above the waist to 75 mm below the plane of the knee joint all round the abdomen and thighs.

— **Under pants** – The anterior 50 % of the circumference of the abdomen and thighs from the hips to below the knees at least half way down the thighs.

— **Under plastron** – From the neck-line to the hips and covering one side of the torso, reaching the midline on the chest and the back. The sleeve should extend to a point not more than 100 mm above the point of the elbow.

B.4 Masks - bibs

The FIE Regulations in 1999 required a bib with a depth of 100 mm to 120 mm. Experience has shown that bibs larger than 120 mm or with excessive stiffness can cause the mask to be lifted from the face of some fencers during use. Individual fencers should be warned to check for this hazard.

Annex C
(informative)

Visors and masks made of material other than steel wire mesh

Masks with transparent visors have only recently been made and used by fencers, and there is therefore limited experience regarding their performance in use. Some early examples of masks with visors do exist that are not entirely satisfactory. The visors were made from 2,0 mm thick flat polycarbonate bent into a curved shape and held in place by a retaining strip along the bottom edge and by fixing bolts along the top edge. These have shown the following failures:

— Stress fractures due to the excessive stress on the outside of the visor caused by the bending it into shape.

— Stress fractures which have developed from the fixing holes.

— The surface of the polycarbonate has been scratched due to the points of swords hitting the surface. There is a chance of fracture or fatigue cracks developing from such scratches.

— The gap in the mesh shell in which the visor fits has shown signs of opening up after prolonged use.

Any design must therefore be shown in the Manufacturer's Technical File to avoid these design failings. In particular any visor using a see through plastic like polycarbonate should:

a) Be readily replaceable or be part of a mask that will be discarded when the visor is scratched.

b) Not be stressed when fixed in the mask. It must be formed to the shape of the aperture in which it is fixed.

c) Have no fixing holes in the visor unless it can be shown that stress cracks will not be generated from these holes.

d) Have some means of preventing minor surface scratching such as a thin sacrificial outer visor to prolong the life of the inner visor.

e) Be fitted in a mask which is strong enough to prevent the aperture in which the visor is fixed from opening out during use.

f) Should not so restrict ventilation in the face area that a fencer becomes hypoxic during heavy exercise with an arterial oxygen partial pressure below 80 mm Hg.

g) Should not tend to mist up during heavy exercise. The design should address the problems of moisture from sweat and from exhaled air.

Annex ZA
(informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Trade Association and Supports essential requirements of EU Directive 89/686/EEC.

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

The following clauses of this European Standard are likely to support requirements of Directive 89/686/EEC, Annex II.

EU Directive 89/686/EEC, Annex II		Clauses of this European Standard
1	All risks encountered	1 and 4, Annex B
1.1.1	Ergonomics	4.1, 4.2, 4.3, 4.4, 4.5, and Annex C
1.1.2.1	Highest level of protection possible	4.8 and 4.9
1.1.2.2	Classes of protection appropriate to different levels of risk	Annex B
1.2.1	Absence of risks and other 'inherent' nuisance factors	4.2
1.2.1.1	Suitable constituent materials	4.2 and 7
1.2.1.2	Satisfactory surface condition of all parts of PPE in contact with user	4.2
1.2.1.3	Maximum permissible user impediment	4.3
1.3.2	Lightness and design strength	4.7 and Annex C
1.3.3	Compatibility of different classes or types of PPE designed for simultaneous use	6 and 7
1.4	Information supplied by the manufacturer	7
2.1	PPE incorporating adjustment systems	4.3
2.2	PPE 'enclosing' the parts of the body to be protected	4.7
2.3	PPE for the face, eyes and respiratory tract	3.8 and 4
2.4	PPE subject to ageing	7
3.1.1	Impact caused by falling or projecting objects and collision of parts of the body with an obstacle	4.6, 4.7 and 4.8
3.3	Protection against physical injury (abrasion, perforation, cuts, bites)	4.6, 4.7 and 4.8

Compliance with the clauses of this European Standard provides one means of conforming to the specific essential requirements of the Directive concerned and associated EFTA regulations.

Bibliography

EN 340, *Protective clothing — General Requirements.*

EN 420, *General Requirements for gloves.*

EN 1811, *Reference test method for release of nickel from products intended to come into direct and prolonged contact with the skin.*

ISO 105-A02, *Textiles — Tests for colour fastness – Part A02: Grey scale for assessing change in colour.*

ISO 105-E04, *Textiles — Tests for colour fastness – Part E04: Colour fastness to perspiration.*

ISO 3071, *Textiles — Determination of pH of the aqueous extract*.

ISO 4045, *Leather — Determination of pH.*

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