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**Koruyucu giyecekler- At binicileri için koruyucu
ceketler, vücut ve omuz koruyucuları- Kurallar ve deney
metotları**

(-)

Protective clothing - Protective jackets, body and shoulder protectors for equestrian use, for horse riders and those working with horses, and for horse drivers - Requirements and test methods

Vêtements de protection - Vestes, gilets de protection et protège-épaules pour sports équestres, pour cavaliers, pour personnes travaillant avec des chevaux

et pour meneurs d'attelage - Exigences et méthodes d'essai

Schutzkleidung - Schutzjacken, Körper- und
Schulterschützer für den Reitsport, für Reiter, Personen, die mit Pferden
arbeiten, und für Gespannfahrer - Anforderungen und Prüfverfahren



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Bu standard, CEN/TC 162 Teknik Komitesi tarafından hazırlanmış, CEN tarafından 27.11.2017 tarihinde onaylanmış ve Türk Standardları Enstitüsü Teknik Kurulu'nun 19.03.2018 tarihli toplantısında Türk Standardı olarak kabul edilerek yayımına karar verilmiştir.

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EUROPEAN STANDARD

EN 13158

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EUROPÄISCHE NORM

February 2018

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Supersedes EN 13158:2009

English Version

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This European Standard was approved by CEN on 27 November 2017.

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Contents	Page
European foreword	4
Introduction	5
1 Scope	6
2 Normative references	6
3 Terms and definitions	6
3.1 Horse rider's protective clothing	6
3.2 Body dimensions	7
3.3 Horse drivers	7
3.4 Levels of performance	8
4 Requirements	8
4.1 Requirements for protectors for horse riders, those working with horses, and for horse drivers and passengers	8
4.2 Coverage to be provided by protective jackets, body protectors, and shoulder protectors, and the dimensions of protective material in the protectors	8
4.3 Movement of protective material blocks, and gaps between them	19
4.4 Restraint	19
4.5 Ergonomic requirements	20
4.6 Impact performance requirements	20
4.7 Innocuousness	21
5 Test methods	22
5.1 General	22
5.2 Garments for testing	22
5.3 Conditioning of garments	22
5.4 Examination and measurement of sizes, and of protective material extent	23
5.5 Separation of protective material blocks	27
5.6 Testing the restraint of protective jackets, body protectors and shoulder protectors	29
5.7 Ergonomic assessment of protective jackets, body and shoulder protectors	30
5.8 Impact energy transmission measurement	31
6 Marking	34
7 Information supplied by the manufacturer	35
Annex A (informative) Guidance on cone construction and use	37
A.1 Design of cones	37
A.2 Cone construction	37
A.3 Use of cones in measurements	39
Annex B (normative) Coverage to be provided by protective jackets, body protectors, and shoulder protectors, and the dimensions of protective material in the protectors	40
B.1 Protectors for horse riders and those working with horses	40
B.2 Protectors for horse drivers and passengers	41

Annex C (informative) Significant technical changes between this European Standard and EN 13158:2009	43
Annex ZA (informative) Relationship between this European Standard and the essential requirements of Regulation EU 2016/425 aimed to be covered.....	44
Bibliography	46

European foreword

This document (EN 13158:2018) has been prepared by Technical Committee CEN/TC 162 “Protective clothing including hand and arm protection and lifejackets”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by August 2018 and conflicting national standards shall be withdrawn at the latest by August 2018.

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

This document supersedes EN 13158:2009.

The significant technical changes between this document and the previous edition are given in Annex C.

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Regulation EU 2016/425.

For relationship with EU Regulation, see informative Annex ZA, which is an integral part of this document.

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Introduction

Protective jackets, body protectors and shoulder protectors are worn by horse riders, those working with horses, horse drivers and passengers in horse driven vehicles, so that they will have some protection from impacts consequent on falling from horses or vehicles. Such impacts may be against soft or hard ground, or objects such as trees, vehicles, posts or rails. Fallen riders, drivers and passengers, and those working with horses will also have some protection from injury from being kicked, trodden on, or crushed by a horse or vehicle.

Falls from horses and vehicles involve high levels of energy dissipation. Injuries cannot be entirely prevented by material in protective clothing but should be reduced in severity. Injuries will not be prevented by the protective clothing in accidents involving severe torsion, flexion, extension or crushing of the body.

It has been assumed in the drafting of this European Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people, for whose guidance it has been prepared. The apparatus described should only be used by competent persons and requires safeguards to prevent, as far as is reasonably practicable, injury to the operator and other persons.

1 Scope

This document specifies the requirements and test methods for the coverage, sizing, adaptability and adjustability, restraint, ergonomics, construction, innocuousness, and performance under impact to be provided by protective jackets, body and shoulder protectors to be worn by children, youths and adults of either sex while riding horses, working with horses, driving horses or being a passenger in a horse driven vehicle.

These protectors are intended to provide some protection against impacts due to falls from horses and vehicles, and impacts while on the ground due to a fall, or while working with a horse. Impacts may be against the ground or objects such as trees or vehicles, or impacts may be due to kicks or being trodden on.

The protectors covered by this standard are not intended to provide complete protection against injuries in accidents involving severe torsion, flexion or extension. Requirements for marking and the provision of information are given.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1 Horse rider's protective clothing

3.1.1

protective jacket

short sleeved or long sleeved item of clothing incorporating materials meeting the requirements for body protectors and shoulder protectors covering the defined areas of the torso, lower back and shoulders and designed to reduce injury from blunt impacts, falls and kicks

3.1.2

body protector

sleeveless item of clothing covering defined areas of the torso and lower back and consisting of one or more layers of material and designed to reduce injury from blunt impacts, falls and kicks

3.1.3

shoulder protector

device considered to be an item of clothing that covers the lateral aspect of the shoulder and defined areas of the front, back and top of the shoulder and is designed to reduce injury from blunt impacts and falls on the shoulder

3.2 Body dimensions

3.2.1

chest 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 chest

3.2.2

bust girth

maximum horizontal girth measured during normal breathing with the subject, wearing normal underclothing, and standing upright and the tape-measure passed over the scapulae under the armpits and across the breasts

3.2.3

under bust girth

maximum horizontal girth measured during normal breathing with the subject, wearing normal underclothing, and standing upright and the tape-measure passing immediately below the breasts

3.2.4

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

Note 1 to entry: The dimension of 50 mm refers to a subject of 1 780 mm tall and should be scaled *pro rata* with the height of the actual subject.

3.2.5

waist to waist over-the-shoulder length

maximum length measured from the plane of the waist on the anterior of the body, as defined in 3.2.4, over the shoulder to the plane of the waist on the posterior of the body

Note 1 to entry: The tape-measure crosses the shoulder at the mid-point between the point of the shoulder and the junction of the shoulder to the neck. Anteriorly the tape measure passes over the chest (or bust) to a point 90 mm lateral to the midline of the body on the plane of the waist. Posteriorly the tape measure follows the shortest distance to a point 90 mm lateral to the midline of the body. The distances of 90 mm refer to a subject with a waist girth of 850 mm and should be scaled *pro rata* with the waist girth of the actual subject. Normal underclothing is worn when measurements are being taken.

3.3 Horse drivers

3.3.1

horse driver

person on a wheeled or skid-mounted vehicle controlling a horse or horses pulling the vehicle

3.3.2

passenger

person on or in a wheeled or skid mounted vehicle pulled by a horse or horses but not controlling the horse or horses

3.3.3

licensed jockey

jockey that earns a living and is registered with a relevant racing authority

3.4 Levels of performance

3.4.1

performance level

<equestrian activities> number that designates a particular category or range of performance by which the results of testing can be graded

Note 1 to entry: The performance levels of the protective clothing are defined by the test performance criteria given in 4.6.

Note 2 to entry: The performance levels are identical for protective jackets, body protectors and shoulder protectors.

3.4.2

performance level 1

<equestrian activities> lowest level of performance for garments worn by licensed jockeys only

3.4.3

performance level 2

<equestrian activities> category of garments for low risk

3.4.4

performance level 3

<equestrian activities> category of garments for high risk

4 Requirements

4.1 Requirements for protectors for horse riders, those working with horses, and for horse drivers and passengers

The requirements in 4.2, 4.3, 4.4, 4.5, 4.6 and 4.7 apply to protectors for horse riders, for those working with horses, and for horse drivers and passengers.

4.2 Coverage to be provided by protective jackets, body protectors, and shoulder protectors, and the dimensions of protective material in the protectors

4.2.1 General

Protective jackets, body protectors and shoulder protectors for horse riders, those working with horses and for horse drivers and passengers shall provide the coverage, and shall have the minimum and maximum dimensions of protective material given below, measured on the garments as described in 5.4 and 5.7.2. Protective jackets shall contain protective materials meeting the minimum and maximum dimension requirements for both body and shoulder protectors. Certain exceptions to these dimensions which are permitted for ergonomic reasons are given in 4.2.3.

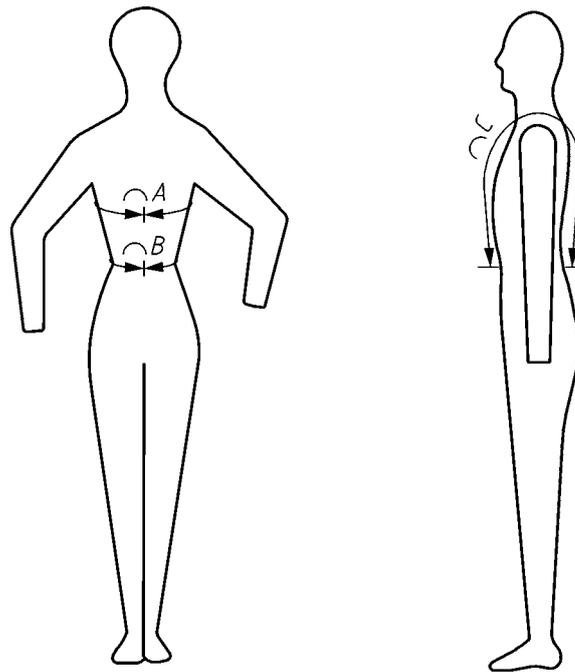
Annex B gives the requirements on body coverage, fitting and sizing of protectors.

4.2.2 Protective material dimensions in protective jackets and body protectors

Protective material in protective jackets and body protectors shall have an area greater than that defined by the dimensions listed below, illustrated in Figure 1b and specified in Table 1. Where garments are made with two or more layers of foam or other impact attenuating material, the defined area is required to contain all the layers at their full thickness. Examination and measurement shall be carried out according to 5.4.

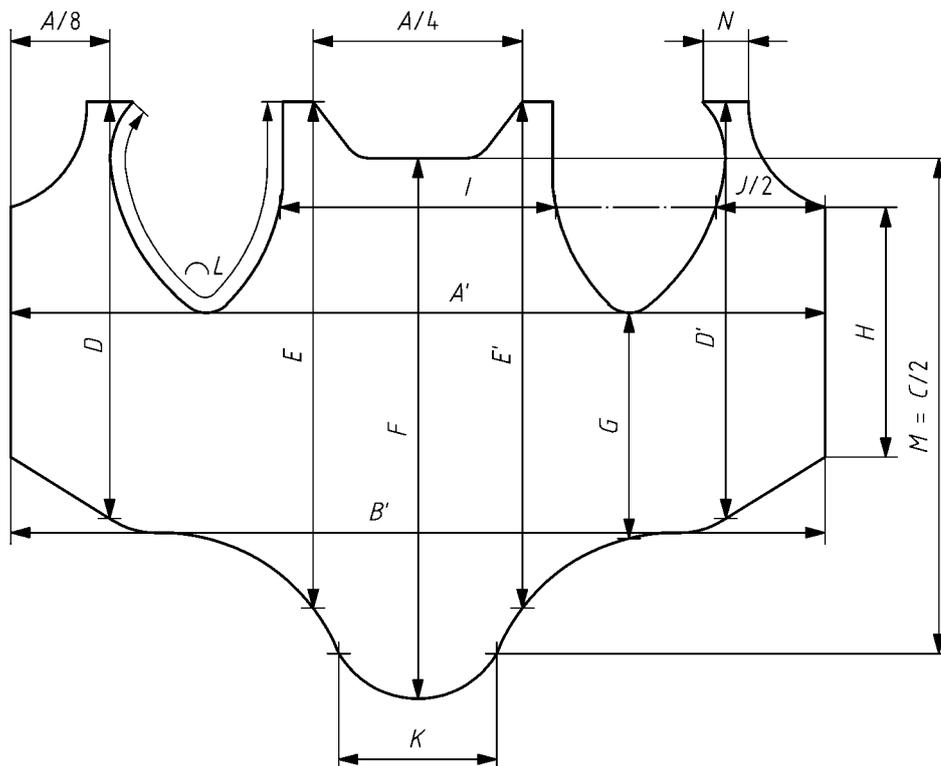
Protective jackets and body protectors that have removable parts such as tail pieces or shoulder protectors shall meet the requirements for coverage of torso protection without the removable parts or shoulder protectors fitted.

The central 200 mm wide section (the value of 200 mm is for a user with dimension A_{max} of 1 000 mm and shall be scaled *pro rata* for other sizes) of the back panels corresponding to minimum dimension F of body protectors and protective jackets shall be constructed so that they cannot be taken apart or shortened by a user except by the cutting of material or other destructive process not sanctioned by the manufacturer (see Clause 7 l). Removable tail-pieces extending the back beyond the required length of dimension F are permitted providing the garment has a back length exceeding F without the tail-piece fitted.



a) Body dimensions

NOTE 1 The positions for measurement of the control dimensions A , B and C stated by the manufacturer and used in sizing the protective clothing.



b) Diagram of the protective material in a protective jacket or body protector

NOTE 2 The positions for measuring the dimensions of protective material in body protectors and the torso regions of protective jackets. A' , B' and L are measured on the inside of the protective clothing. D to K , M and N are measured on the outside of the protective clothing.

Figure 1 — Body dimensions and dimensions of protective material in the torso region of protective jackets and body protectors

Table 1 — Requirements for dimensions of protective material in protective jackets and body protectors

Values in percentage

Dimension	Control dimension	Requirement, as a percentage of the control dimension	
		Protectors for horse riders and those working with horses	Protectors for horse drivers and passengers
A_{\max}^I	A_{\max}	> 103	> 103
A_{\min}^I	A_{\min}	< 107	< 107
B_{\max}^I	B_{\max}	> 102	> 102
B_{\min}^I	B_{\min}	< 110	< 110
D and D^I	C_{\max}	> 43	> 43
E and E^I	C_{\max}	> 57	> 48
F	C_{\max}	> 52	> 43
G	C_{\max}	> 15	> 15
H	C_{\max}	> 28	> 28
I	A_{\max}	> 27	> 27
J	A_{\max}	> 20	> 20
K	A_{\max}	> 20	No requirement
L	A_{\max}	< 80	< 80
M	C_{\max}	50	No requirement
N	A_{\max}	> 4	> 4
A_{\max}	is the chest girth or bust girth given by the manufacturer for the largest user.		
A_{\min}	is the chest girth or bust girth given by the manufacturer for the smallest user.		
B_{\max}	is the waist girth given by the manufacturer for the largest user.		
B_{\min}	is the waist girth given by the manufacturer for the smallest user.		
C_{\max}	is the over-the-shoulder length given by the manufacturer for the largest user.		
C_{\min}	is the over-the-shoulder length given by the manufacturer for the smallest user.		
A_{\max}^I	is the maximum internal girth of the garment below the armholes.		
A_{\min}^I	is the minimum internal girth of the garment below the armholes.		
B_{\max}^I	is the maximum internal girth of the garment at the lower edge of the protective material.		
B_{\min}^I	is the minimum internal girth of the garment at the lower edge of the protective material.		
D and D^I	are vertical lines on the chest separated by a distance of 25 % of A .		
E and E^I	are vertical lines on the back separated by a distance of 25 % of A .		
F	is the centre back length.		
G	is the height of the side below the armhole.		
H	is the centre front length.		
I	is the width across the back between the armholes measured at a level half-way down the armhole opening.		
J	is the width across the chest between the armholes measured at a level half-way down the armhole opening.		
K	is the width of the back at a distance equal to 50 % of dimension C_{\max} from the neck inlet.		
L	is the circumference of the armhole.		
M	is the distance below the centre of the back of the neck of the garment at which dimension K is measured. ($M = 0,5 C_{\max}$).		
N	is the smallest width of the shoulder strap.		

4.2.3 Exceptions to the requirements in 4.2.2

The exceptions listed in (a) to (e) below are permitted. Exception (a) relates to the calculation in Formula (1) and exception (b) to the calculation in Formula (2). Examination and measurement of the exceptions shall be carried out according to 5.4. The areas and dimensions relate to a protective jacket or body protector to fit a person with a chest girth of 1 000 mm. Except where stated, the areas and dimensions shall be graded *pro rata* with the size of the protector:

$$l_d = \frac{l_x \times l_a}{1000 \text{ mm}} \quad (1)$$

where

l_d is the linear dimension on a protector, in millimetres;

l_x is the length stated in Table 2, in millimetres;

l_a is the actual largest user's chest girth, in millimetres.

$$A_p = \frac{A_x \times l_a^2}{1000000 \text{ mm}^2} \quad (2)$$

where

A_p is the area of protection, in square millimetres;

A_x is the area stated below, in millimetres;

l_a is the actual largest user's chest girth, in millimetres.

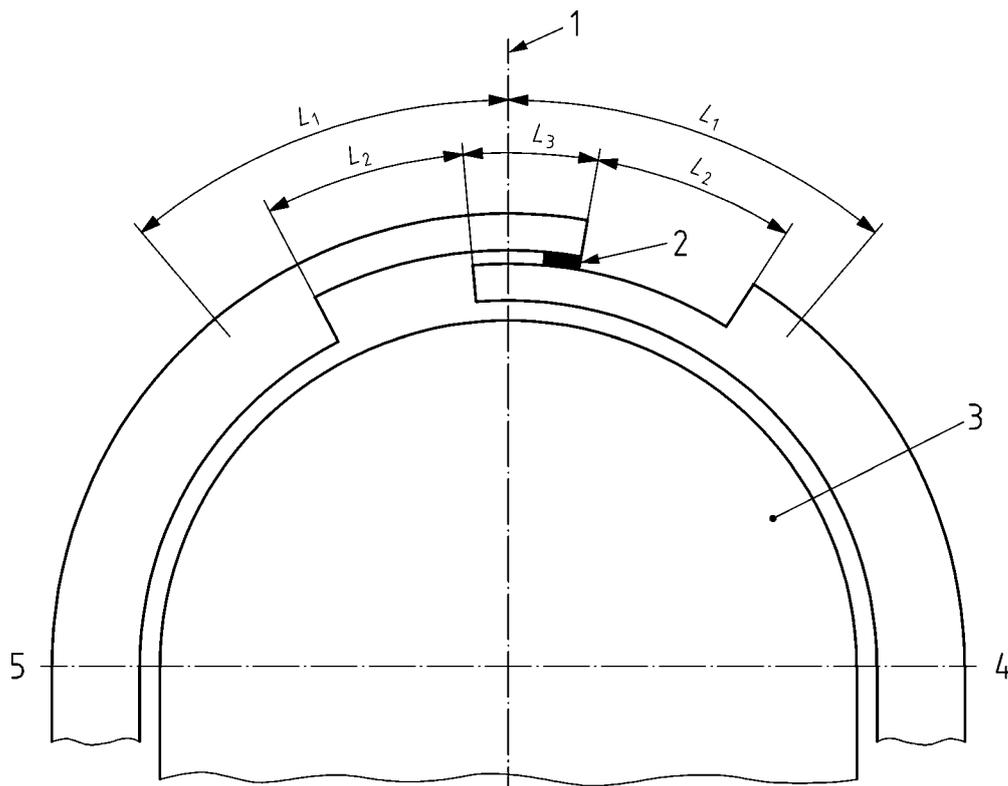
Protective material is permitted to be reduced to 50 % of its normal thickness in specified areas providing all layers are the same material. If the layers are of unequal thickness and the "50 % thickness" area is thinner than 45 % of the total, or the layers are of different construction or are of different composition, it shall be shown by impact testing that the "50 % thickness" construction meets the impact requirements when two layers (100 % thickness) are tested together.

- a) Protective material over the top of the shoulder may be reduced to 50 % of its normal thickness in two areas on each shoulder permitting adjustment of the shoulder by overlapping 50 % thickness areas by varying amounts. The maximum length of each area along the waist to waist over-the-shoulder dimension line shall not exceed 35 mm at maximum opening. 50 % thickness material shall not be present more than the distance specified in Table 2 from the shoulder top line when measured as described in 5.4.1.2. At maximum opening of adjusters there shall be at least 25 mm of overlapping 50 % thickness protective material in all sizes of protector (not scaled). This is illustrated in Figure 2.

Table 2 — Maximum distance that 50 % thickness material shall extend from the top of the shoulder line

Dimensions in millimetres

Range of chest girth sizes of user the protector is stated to fit	Maximum distance that 50 % thickness material shall extend from the top of the shoulder line
< 500	58
500 to 550	59
551 to 600	60
601 to 650	61
651 to 700	62
701 to 750	63
751 to 800	64
801 to 850	65
851 to 900	66
901 to 950	67
951 to 1 000	68
1 001 to 1 050	69
1 051 to 1 100	70
1 101 to 1 150	71
1 151 to 1 200	72
> 1 200	73



Key

- 1 midline of the shoulder; the line marking the top of the shoulder on the protective jacket or body protector is on this line
- 2 coloured warning marker
- 3 shoulder
- 4 front of shoulder
- 5 back of shoulder
- L_1 is the maximum distance 50 % thickness material shall extend from the top of the shoulder (68 mm on a protector intended to fit users with a maximum chest girth of 1 000 mm)
- L_2 is the maximum length of 50 % thickness material that shall be present on the front and back of the shoulder ($0,035 \times A_{\max} + 8 \text{ mm}$)
- L_3 > 25 mm on all sizes of protectors

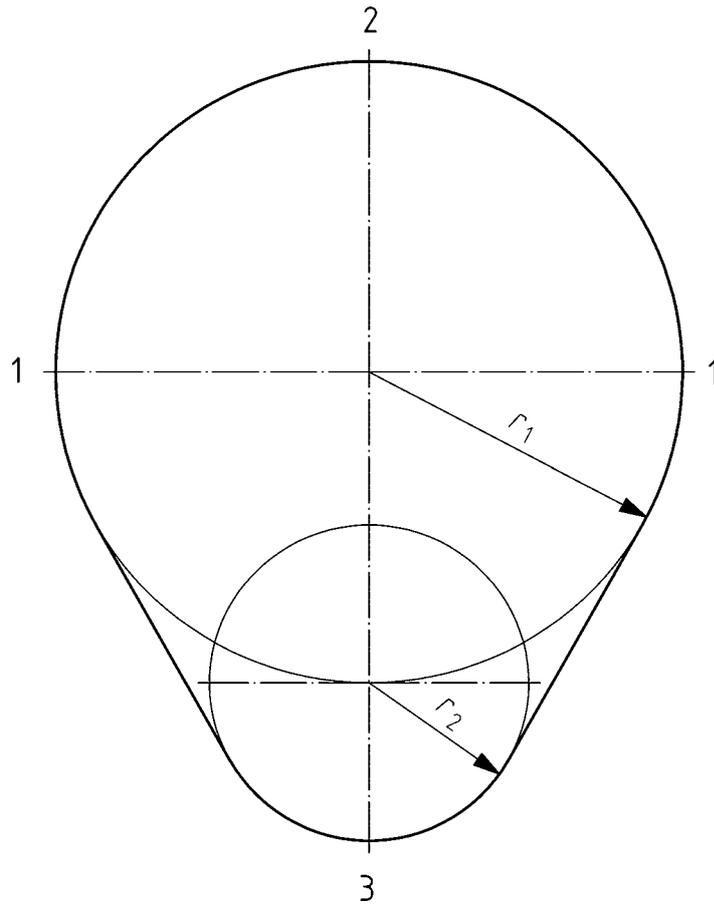
Figure 2 — Diagram of the adjuster at the shoulder on a protective jacket or body protector showing the maximum allowance of 50 % thickness material permitted in 4.2.3 a)

- b) If the garment does not have side adjustment as described in (c) below protective material below each arm hole may be reduced to 50 % of its normal thickness in an area not exceeding 2 500 mm².
- c) Protective material may be reduced to 50 % of its normal thickness in areas at the side of the body, to permit adjustment of the girth of the garment provided that when the adjustment is set at its widest position, the total width of the area of 50 % thickness of protective material on the right side and the left side of the garment together does not exceed 200 mm (typically distributed in four areas approximately 50 mm wide on a protector with a maximum chest girth of 1 000 mm). At maximum opening of adjusters, there shall be at least 25 mm of overlapping 50 % thickness protective material in the centre of the adjuster in all sizes of protector.

- d) Protective material may be absent from torso areas of a protective jacket or body protector, that are overlaid by shoulder protectors provided that when an appropriate subject wears the jacket, or the body protector and shoulder protectors, no gaps in protection open up between the shoulder and body protectors when the arms are raised laterally and outstretched to positions at angles of 60° to the torso and are swung forward and up to point straight ahead. The shoulder protectors in such combinations shall be irremovable, or the body protector shall carry a warning label that shoulder protectors shall be worn to provide the protection claimed for the garment.
- e) Perforations in protective material are permitted providing the perforated protective material meets the impact requirements in 4.6, and the maximum hole diameter is not above 15 mm.

4.2.4 Shoulder protectors and the shoulder regions of protective jackets

Shoulder protectors and the shoulder regions of protective jackets shall contain protective material in an area that exceeds the template shown in Figure 3. The dimension r_1 is 0,08 times the maximum value of the chest girth or under bust girth (dimension A_{max}), of the users the manufacturer states the shoulder protectors will fit, and $r_2 = 0,5 r_1$. Shoulder protection may be shaped or have cut away segments for ergonomic reasons, provided coverage in the area covered by the template is complete when the upper arm is at 30° to the torso and in the same plane as the torso. Figure 4 shows a sketch of the normal position of a shoulder protector. The design and testing of shoulder protectors that attach to body protectors and protective jackets may take the presence of the shoulder protective material in such garments into account.

**Key**

1 front or back

2 neck

3 arm

 r_1 either $0,035 \times$ "under bust girth" for women or $0,08 \times A_{\max}$ r_2 $0,5 \times r_1$

Figure 3 — Shape of the template for examining the extent of protective material in shoulder protectors

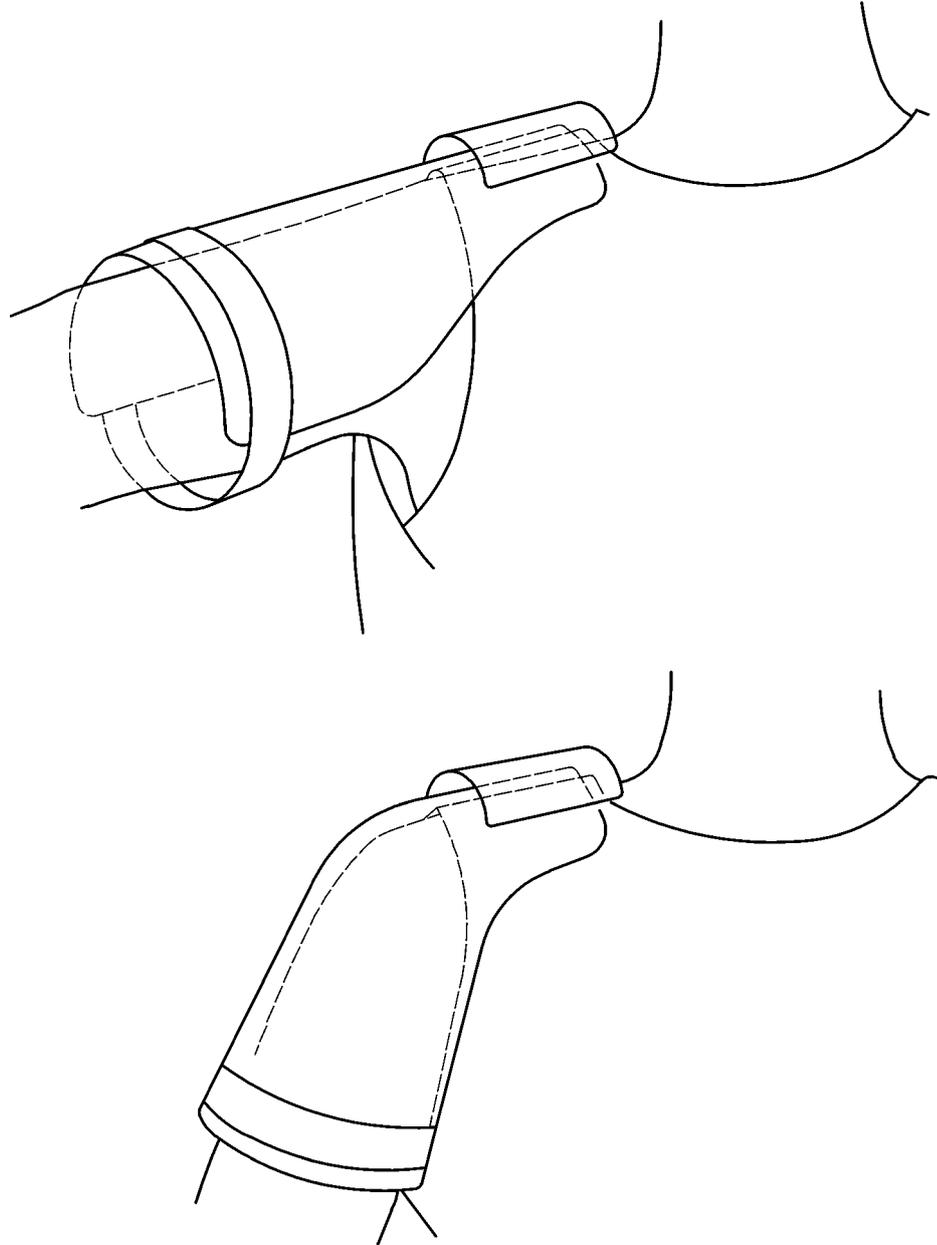


Figure 4 — Shoulder protector

4.2.5 Adaptability and adjustability

Protective jackets and body protectors for horse riders and those who work with horses, and for horse drivers and passengers, shall have a construction that permits adjustment of the fit around the torso.

For protectors that are made for a range of users the range of adjustment or adaptation shall be $\geq 5\%$ of dimension *A*; the chest girth of the largest user that the garment is designed and marked to fit (see 4.2.2) or 80% of the difference between the chest girths of the largest and smallest users that the garment is designed and marked to fit, if this value is greater.

For protectors that are made-to-measure for a particular user the range of adjustment or adaptation shall be $\geq 5\%$ of the chest girth, dimension *A* (see Figure 1). Testing shall be done according to 5.4.1.4 and 5.4.1.5.

Protective jackets and body protectors shall have protective material meeting the impact performance requirements of 4.6 in the areas defined by the linear dimensions in Figure 1b and Table 1, at all settings of all adjusters and closures present. The exceptions permitted (see 4.2.3) shall not be exceeded at any setting of an adjuster or closure.

Warning markers with a strong colour contrast ≥ 10 mm wide shall be incorporated into all adjustment systems to indicate when the widest permitted setting of the adjusters has been exceeded. The warning markers shall become visible if the widest setting has been exceeded. Manufacturers shall provide written warnings in labels attached to the protector and in the information supplied, to inform the users of the correct way to wear the garment and the dangers of adjusting it incorrectly. The colour of the warning markers shall be stated.

Warning markers for use on dark garments shall be bright colours such as red, orange or yellow, and on lighter garments shall be highly contrasting colours such as bright green on a red garment. Colours used for High Visibility garments are suitable. Colours such as grey, brown or olive green are not high contrast colours and shall not be used. White and black are not suitable as they are not associated with warnings.

Warning markers are not required if the adjusters cannot physically be opened further than the permitted maximum and this restriction cannot be over-ridden by the user.

4.2.6 Size marking of protective jackets, body protectors and shoulder protectors

Body protectors and protective jackets for horse riders and those who work with horses, and for horse drivers and passengers, shall be marked with a size. The garment's size shall be determined by three dimensions. These dimensions shall be:

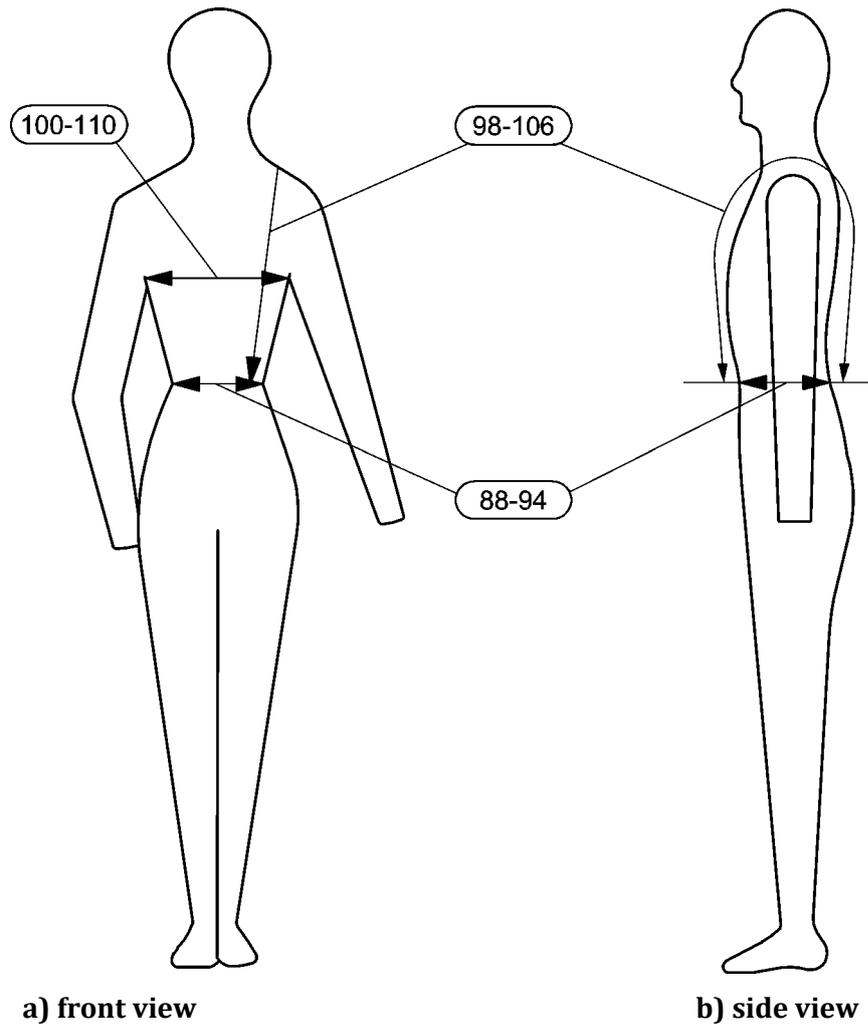
- a) the largest and smallest chest girth, or bust girth as appropriate;
- b) the largest and smallest waist girth;
- c) the largest and smallest waist to waist over-the-shoulder length.

Made to measure protectors shall be marked with the user's name instead of a size.

Shoulder protectors for horse riders and those who work with horses, and for horse drivers and passengers, shall be marked with a size. The size shall be determined by the chest girths or the under bust girths of the intended users.

Figure 5 shows the pictograms that shall be used to show these dimensions. They shall be used on a garment label and in the information supplied by the manufacturer.

The size of the torso regions of protective jackets and body protectors shall be examined according to 5.4.1 and the shoulder regions of protective jackets and shoulder protectors according to 5.4.2.



NOTE The numbers shown are examples only.

Figure 5 — Sizing pictograms

4.3 Movement of protective material blocks, and gaps between them

Protective jackets, body protectors and shoulder protectors for horse riders and those who work with horses, and for horse drivers and passengers, shall be constructed throughout the protective area so that gaps between blocks of padding held in quilting or otherwise cannot be separated by ≥ 15 mm, when a force of 25 N is applied downwards between them as described in 5.5.

4.4 Restraint

Protective jackets and body protectors for horse riders and those who work with horses, and for horse drivers and passengers, shall be provided with closures, such that the closure is not opened and no gap occurs at any point between protective material, when forces of 50 N are applied as described in 5.6 when the adjusters are maximally open.

Body protectors shall be provided with restraining straps or other constructions such that the protector is not displaced by more than a distance equal to one tenth of dimension A_{max} as defined in Table 1 and scaled as in 4.2.3, when forces of 50 N are applied as described in 5.6.

Shoulder protectors in protective jackets and those designed and marked to be exclusively worn under tightly fitting clothing shall be attached to the protective jacket or body protector such that a pull of 10 N away from the point of the shoulder in any direction in the plane of the surface of the protector does not remove them.

Shoulder protectors designed to be worn without tightly fitting outer clothing shall be attached to the body protector or other garment and restrained to the body in such a way that they cannot be displaced by more than a distance equal to r_1 as defined in 4.2.4, when a pull of 25 N is applied in any direction in the plane of the surface of the protector away from the point of the shoulder and backwards over the point of the shoulder, as described in 5.6.

4.5 Ergonomic requirements

Protective jackets, body protectors and/or shoulder protectors for horse riders and those who work with horses, and for horse drivers and passengers, shall be designed to minimize the discomfort of wearing them. The edges of protective material may be shaved down outside the minimum protective areas given in Table 1. Softer material may be included to fill out the shape of the protector outside the minimum protective area. Hard bulky buckles, hard edges and rough edges shall not be present. Protective jackets, body protectors and/or shoulder protectors shall not unduly restrict arm movements. Examination shall be made according to 5.7.1 and 5.7.2.

4.6 Impact performance requirements

4.6.1 General

If shoulder protectors can be used alone, they shall be tested according to 5.8.

If shoulder protectors can only be used being attached to the garment, they shall be tested with garment according to 5.8.

4.6.2 Protective jackets and body protectors for horse riders and those who work with horses, and horse drivers and passengers

Impact performance requirements apply to the whole surface of body protectors and protective jackets for horse riders and those who work with horses, and for horse drivers and passengers, defined in Table 1 excluding the exceptions permitted in 4.2.3. All constructions present in > 10 % of the surface area of a protector shall be separately tested with six impacts under each test condition.

Protective jackets and body protectors shall have protective material meeting the impact performance requirements in the areas defined by the linear dimensions in 4.2.2, at all settings of all adjusters and closures present.

Types of construction that may be weak such as front zip closures, hinging points between panels of protective material, wide quilting seams or closures outside the exceptions in 4.2.3 shall be tested with two impacts under each test condition. The narrow bar impactor shall be orientated along any perceived line of weakness. The mean peak force recorded below the anvil in each test described in 5.8.2 and 5.8.3 for body protectors, the same torso region of protective jackets, for all construction types and all "weak points" added together shall be < 4 kN, and any single values shall be ≤ 6 kN. If either criterion is not met in either test the protector fails to meet the requirements of the Performance Level of the test conducted. In order to be shown to meet a lower Performance Level further test specimens of the protector shall be tested to the parameters of this lower Performance Level and shall meet the above test criteria.

Protective material that has been reduced to “50 % of its normal thickness” in specified areas but has layers that are of unequal thickness and the “50 % thickness” area is < 45 % of the total thickness, or in which the layers are of different construction or are of different composition, shall be impact tested according to 5.8.2 and 5.8.3 using test specimens prepared from two layers of “50 % thickness” material in a fabric cover like that of the protector (if present). The test specimens shall be tested with six impacts under each test condition.

The mean peak force recorded below the anvil in each test described in 5.8.2 and 5.8.3 for test specimens prepared from two layers of “50 % thickness” material shall be < 4 kN, and all single values shall be ≤ 6 kN.

Garments designed to conform with Performance Level 1 in Table 3 are specifically designed for professional racing applications where the regulations governing the racing permit such garments. Performance level 1 garments shall be marked in accordance with Clause 6.

Protective clothing for normal use shall be impact tested at (20 ± 2) °C as specified in 5.3, but protective clothing specified to be usable at high ambient temperatures (>28 °C) shall additionally meet this requirement when impact tested at (30 ± 2) °C, according to 5.8.6.

The impact energies used in the tests shall be as in Table 3.

4.6.3 Shoulder protectors for horse riders and those who work with horses, and for horse drivers and passengers

Impact performance requirements apply to the whole surface of shoulder protectors. All constructions present in > 20 % of the surface area of a protector shall be separately tested with five impacts. Types of construction occupying < 20 % of the surface that may be weak shall be tested with two impacts.

The mean peak force recorded below the anvil in the test described in 5.8.4 for all impact tests on shoulder protectors and the same shoulder region of protective jackets shall be < 25 kN, and all single values shall be ≤ 30 kN.

The impact energies used in the tests shall be as in Table 3.

4.7 Innocuousness

Protective jackets, body protectors and shoulder protectors for horse riders and those who work with horses, and for horse drivers and passengers, shall conform to the innocuousness requirements.

Protective clothing shall not adversely affect the health or hygiene of the user. The materials shall not, in the foreseeable conditions of normal use, release substances generally known to be toxic, carcinogenic, mutagenic, allergenic, toxic to reproduction or otherwise harmful.

The examination shall determine whether the claim that the materials are suitable for use in the protective clothing or protective equipment is justified.

The following list is given as information and as examples of documents to be examined:

- a) the manufacturer’s technical file,
- b) materials specifications from the materials producers, and certificates of conformity,
- c) safety data sheets relating to the materials,
- d) certificate 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.

A statement of the procedures the manufacturer will use for ensuring traceability of all materials in the protective equipment shall be examined.

The results of the examinations shall be included in the test report. If there is doubt about the safety of any constituent materials of the protective clothing it fails to meet the requirements.

Records shall be maintained that permit the tracing of all components of protective clothing and protective equipment to particular batches or deliveries of materials or chemicals and to their certificates of conformance with a stated specification.

5 Test methods

5.1 General

Measuring instruments unless otherwise specified shall be accurate to $\pm 2\%$ of the pass/fail level of the characteristic being measured.

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

NOTE It is anticipated values of U_m will usually be between 2 % and 5 % of the measured value for force and length measurements.

5.2 Garments for testing

Protective jackets, body protectors and shoulder protectors shall be supplied by manufacturers or their agents complete with labels, or copies of the proposed labels, and the information to be supplied by the manufacturer with the products. At least seven sizes of protective jackets, body protectors and shoulder protectors shall be supplied if as many are produced. These shall include the largest or one that fits a user with 1 000 mm chest girth, the smallest and a middle size from the manufacturer's size range. If measurements made according to 5.4.1 or 5.4.2 reveal any of the sizes initially submitted do not comply with the requirements in 4.2.2, 4.2.3 and 4.2.4, all sizes shall be supplied by the manufacturer and measured according to 5.4.1 or 5.4.2.

All sizes submitted shall be assessed according to 5.4. One or more sizes may be used for other tests. At least the smallest, middle and largest size manufactured shall be included in impact testing according to 5.8.

5.3 Conditioning of garments

Protective jackets, body protectors and shoulder protectors shall be cleaned for the maximum number of times the manufacturer specifies the protective clothing may be cleaned (see 7 o), or for five times if no maximum is specified, by the method(s) specified in the information supplied by the manufacturer, except that this shall not be required where only trivial surface cleaning treatments are recommended or the impact attenuating materials are excluded from the cleaning processes by being removed from the protective clothing.

The protectors shall be hung on a clothes hanger in an atmosphere of $(20 \pm 2)^\circ\text{C}$ and $(65 \pm 5)\%$ relative humidity for ≥ 48 h before testing. Before examination and measurement protectors shall be shaken to ensure that loose components like foam are settled at the bottom of bags or covers as they are likely to be after a period of use. Examination and measurements shall be carried out in the conditioning

environment or within 10 min of removal from that environment. Impact testing shall be carried out in the conditioning environment.

Protectors specified to be usable at high ambient temperatures shall also be conditioned at $(30 \pm 2) ^\circ\text{C}$ and $(37 \pm 5) \%$ relative humidity for ≥ 48 h before impact testing according to 5.8.5. Impact testing shall be carried out in the conditioning environment.

5.4 Examination and measurement of sizes, and of protective material extent

5.4.1 Protective jackets and body protectors

5.4.1.1 Size marking

The validity of the size of a protective jacket or body protector marked on it shall be checked by comparing the measurements of its actual dimensions with the values for dimensions calculated according to Table 1 and the permitted exceptions in 4.2.3. The size marking is correct if all measurements meet the requirements.

The values of dimensions A^I_{\max} , A^I_{\min} , B^I_{\max} and B^I_{\min} shall be determined from the Information supplied by the manufacturer. The values of all dimensions in Table 1 (A^I_{\max} to N) shall be calculated for each size of protective jacket or body protector. The linear dimensions of protective material D to K , M and N shall be measured on the outside of each size of protective jacket or body protector according to 5.4.1.2. The maximum and minimum internal girths of each size of protective jacket or body protector and the arm-hole circumference shall be measured on a cone as described in 5.4.1.3 and 5.4.1.4.

5.4.1.2 Protective material dimensions

The dimensions of the protective material shall be measured with all adjustable closures and adjusters set at their widest settings as indicated by the warning markers placed on the protectors by the manufacturer.

Mark the top of the shoulder line as required in 4.2.3; manufacturers shall clearly indicate the line midway between the front and back of the protector.

Place the protective jacket or body protector on a dummy, cone or other support and shaped as it would be when being worn. The line mid-way between the front and back of the protector shall be marked on the top of the shoulder line as required in 4.2.3.

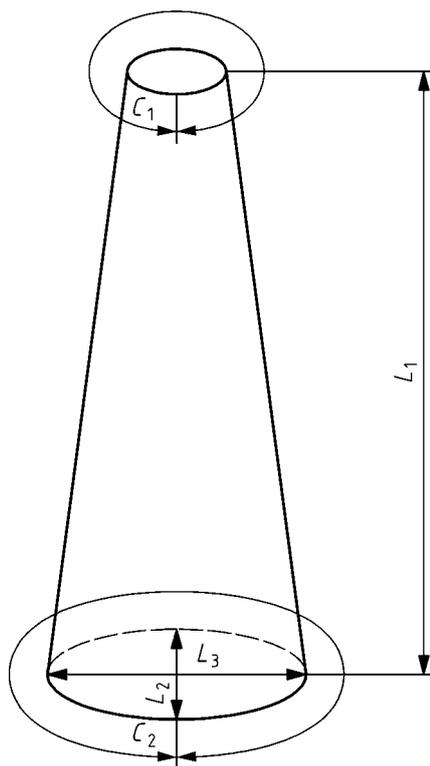
Where the test house identifies a measured line which is ≥ 10 mm either side of the manufacturer's indicated line, the test house's line shall be used. Otherwise the manufacturer's indicated line shall be used.

Use this line to measure the front and back lengths and the distance to the end of half thickness foam areas. Place marks on the front and back panels half way down the arm-hole openings of the protector. Use these marks for measuring the front and back panel widths.

The protector shall be marked at the lower edge of the front and back panels and on the transverse top of the shoulder line to show the separation of lines D and D^I and E and E^I . The markings shall be equidistant from the centre lines of the back and front panels of the protector. The position of point M shall be marked on the central back line.

Dimensions D to K , M and N shall be measured with a tape-measure on the outside of the protector while it is either on a table or other surface, or is supported on a cone.

Annex A shows guidance on the construction of a cone.

**Key**

L_1 is a length of at least 1 500 mm

$L_3 = 1,4 \times L_2$

C_1 is a circumference of < 400 mm

C_2 is a circumference of $\geq 1\,300$ mm

Figure 6 — Cone for measuring internal girths

5.4.1.3 Measuring cone dimensions

Measurement cones shall be constructed out of smooth rigid materials. Cones shall be mounted vertically so that protectors can be gently pushed down on to them to expand them. A length of at least 1 500 mm is recommended. The minimum circumference shall be 100 mm below that of the smallest girth to be measured and the maximum circumference shall be ≥ 200 mm above the size of the largest girth to be measured. Two cones to cover the whole size range of horse riders' body protectors are advantageous as it is easier to obtain accurate measurements on a slowly tapering cone. The cross section profile of the cone should approximate human torsos with a width 1,4 times the depth. A cone is shown in Figure 6.

The horizontal circumferences of the cone in 10 mm steps shall be marked with horizontal lines around the cone or on scales on the sides of the cone on lines equivalent to lines from the hips to the armpits of a user of a body protector.

See Annex A for more information on making suitable cones.

5.4.1.4 Use of a cone to measure internal girths

Protective jackets and body protectors shall be measured with closed shoulder regions and shoulder straps without closures cut open or with shoulder closures open. Protectors without elastic adjusters or elastic panels shall be measured by gently pushing the upright protector onto the cone until it is in firm contact with the cone and will not go any further. It shall then be pulled up and lowered until the whole lower edge is in contact with the cone. Slight downward pressure will be required. The value of the circumference just covered at the side of the protector shall be read off as B^I . It will be the same both sides if the protector is level. Similarly, the chest girth A^I of an inverted protector shall be measured on the cone. If the side closures of the protector are loose as in some lace designs and the normal relationship of the front and back panels is distorted by the procedure, clamps, staples, pins or other means shall be used to secure the closures in a 'natural' position for the measurement.

Measurements shall be made at the maximum and minimum settings of the adjusters, thereby providing values for A^I_{max} , A^I_{min} , B^I_{max} and B^I_{min} . The maximum setting shall be determined by the positions of the coloured markers or by the physical restraint imposed by the design of the closure. The minimum setting shall be determined by the design of the adjuster and the manufacturer's information for users.

The minimum setting will preferably be when the 50 % thickness foam areas have closed up providing entirely 100 % thickness of protective material. However if the design of the adjuster/closure permits tightening and secure closure beyond this point (over-tightening) so that there is protective material of 150 % thickness this shall be examined if the required values of A^I_{min} or B^I_{min} have not been achieved with the preferred setting.

The range of adjustment of the torso girth available shall be determined from the maximum and minimum readings on the cone.

Protective jackets and body protectors with elastic straps or elastic panels partially or completely controlling their adjustment, shall first be measured as for non-elastic protectors to obtain the minimum values of A^I and B^I . Then they shall be adjusted to their maximum settings and measured after the application of a downward force to pull them onto the cone and stretch the elastic. For each size of protector the force applied in Newton shall be according to Formula (3).

$$F = 50 \times l_c \times l_s - F_G \quad (3)$$

where

F is the force applied, in newtons;

l_c is the maximum chest girth, in metres;

l_s is the maximum over the shoulder length, in metres;

F_G is the force due to gravity on the protector ($m \cdot g$), in newtons.

Half the force (± 5 %) shall be applied to front and back of the protector to pull it further onto the cone. The value of the circumference just covered at the side of the protector shall be read off as the 'stretched' or maximum value. These values shall be used as A^I_{max} or B^I_{max} as appropriate.

The arm-hole circumferences of protective jackets and body protectors shall be measured with the waist and shoulder adjusters on the side of the protector being measured, set to their maximum settings. Those on the other side or on the front usually need to be open. Front and back panels shall be secured to each other with clamps, staples, pins or other means if necessary to maintain their 'natural' relationship during the measurement. The protector shall be placed on a cone so that the arm-hole edge is as far as possible horizontal. The protector shall be allowed to slide down the cone under its own weight. Slight downward force shall then be applied to ensure contact between the inside of the arm-hole and the cone. The value of the circumference of the cone just covered by the lowest part of the arm-hole of the protector on the cone shall be read off as its internal circumference.

5.4.1.5 Measurement of adjustability

The range of adjustment of the torso girth shall be determined from the maximum and minimum readings on the cone A_{\max}^I , A_{\min}^I , B_{\max}^I and B_{\min}^I . The measured range of adjustability shall be compared to the required values calculated according to 4.2.5.

5.4.1.6 Measurement of 50 % thickness dimensions

The dimensions of areas of 50 % thickness protective material on the tops of the shoulder and down the sides of the torso shall be measured with the closures and adjusters set at their widest positions. Before measurement the protectors shall be shaken to ensure that loose components like foam are settled at the bottom of bags or covers as they are likely to be after a period of use. The areas on the tops of the shoulders shall be measured while the protector is shaped as it will be while being worn. The areas at the sides of the torso shall be measured while the protector is on a cone or similar support. The measurement shall be made of the greatest extent of half thickness material within the calculated minimum required width of the component. That is dimension G at the side of the torso and dimension N on the shoulder. The minimum width of the 50 % thickness area shall be measured by inserting two flat rigid probes into the gap in full thickness foam and moving them apart to press against the edges of full thickness foam and recording the distance between their outer edges. To this value shall be added any correction because the opposing edges of the full thickness foam are curved or irregular within the minimum required width of dimension G or N . The distance 50 % thickness material extends from the top of the shoulder shall be measured on the outside of the garment. The results shall be compared to the allowances in the exceptions in 4.2.3. If the allowances are exceeded the protector fails.

5.4.1.7 Examination of construction in the torso zone of protection

The extent of protective material shall be further examined by determining the distribution of all constructions occupying more than 10 % of the surface area of a protector within the area defined in Figure 1 by dimensions D to K and N . These areas shall be marked on the protector with the closures set at their maximally open positions. All points within the area defined in Figure 1 by dimensions D to K and N , with the exclusion of the exceptions allowed in 4.2.3, which have a reduced thickness of protective material or no protective material at all, or have other potential weak constructions such as zip closures, hinge structures or wide quilting seams shall be marked for further examination for block separation 5.5 and impact testing 5.8.

5.4.2 Protective jackets and shoulder protectors

The area and size of protective material in the shoulder region of protective jackets and in shoulder protectors shall be verified in the following way. A shoulder protector template shall be cut based on the dimensions of the garment as given in 4.2.4 and illustrated in Figure 3. The template shall be applied to the outside of the shoulder protectors or jacket and adjusted so that the intersection of the lines 1 – 1 and 2 – 3 in Figure 3 would lie on the point of the shoulder of a user. A line shall be drawn around the template edge on the protector outer surface. The enclosed area is the impact test area. The area the template covered shall be examined for the presence of protective material. If any part of the area lacks protective material, the protector fails to meet the requirement in 4.2.4.

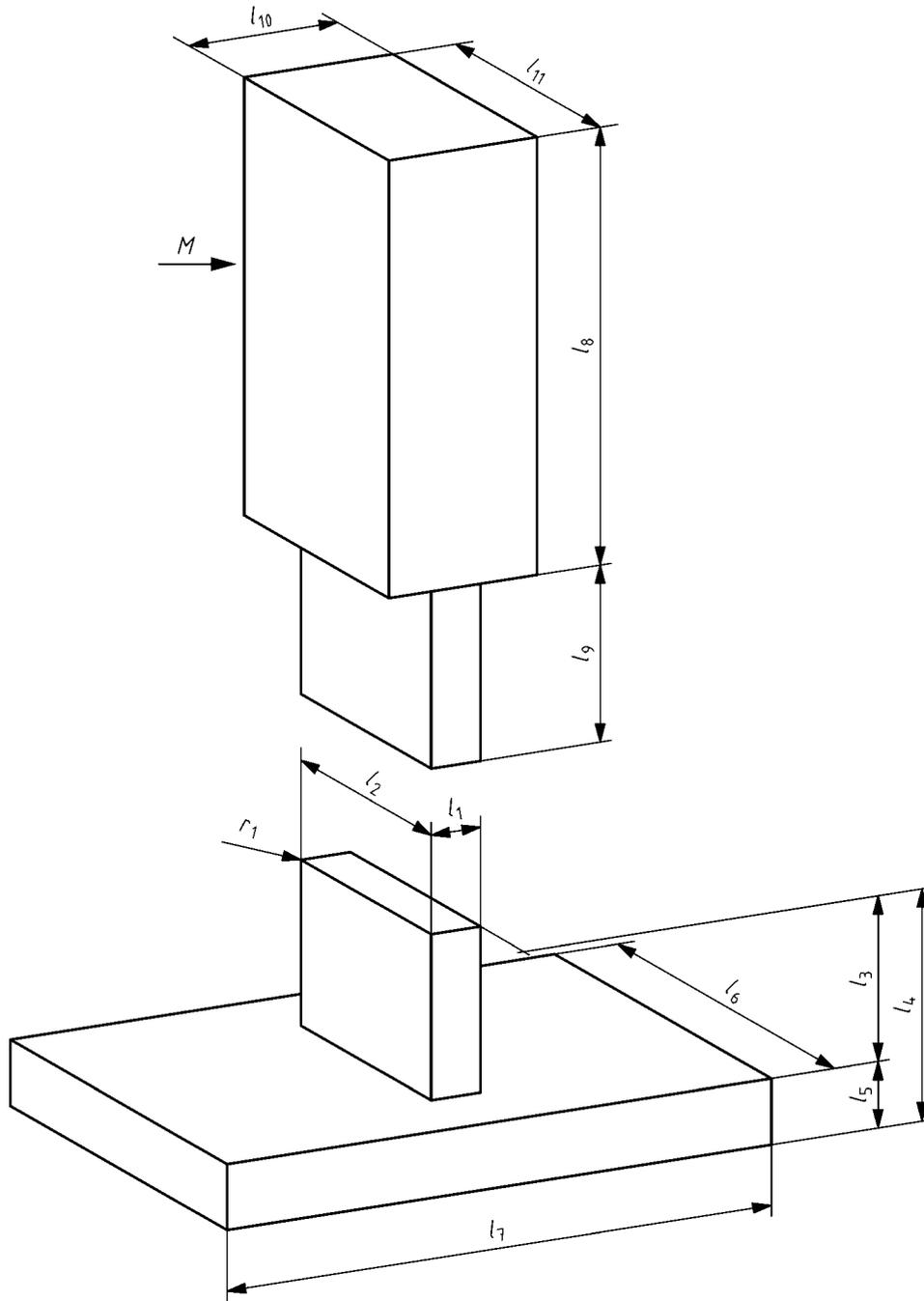
The jacket or a body protector with attached shoulder pads, shall then be worn by a suitable subject if one is available or examined on a table. The location of the shoulder protection shall be assessed with the jacket or body protector configured as if the upper arm was at approximately 30° to the torso. Examination shall be made to determine whether there would be protective material over the front and back of the shoulder joints and that no gap would exist between the protection provided by the shoulder and torso protection, or within the impact test area of the shoulder protector. If gaps occur the protector does not meet the requirements of 4.2.4.

The examination shall be repeated with the jacket or body protector configured as if the upper arm was at an angle of approximately 60° to the torso and raised laterally. Then it shall be observed what would happen if the arms were swung forward and up to point ahead. The appearance of any gap in protection in the impact test area during these movements shall be noted and marked as a weak point for impact testing according to 5.8. The results shall be recorded.

Construction types occupying more than 20 % of the surface of the test area shall be marked together with all 'weak points' that have been located.

5.5 Separation of protective material blocks

The inside of an area of the protective clothing to be tested shall be laid on a vertical metal bar with a cross section of (15 ± 1) mm \times (45 ± 2) mm with rounded corners (approximately 0,5 mm radius) which stands (70 ± 1) mm up from a bench surface. The protective clothing shall be allowed to drape naturally over the bar and to be supported by the bench. A groove or gap in the protective material to be tested is aligned along the top of the bar. A similar metal bar of mass $(2,55 \pm 0,05)$ kg shall be placed in the groove between the blocks of protective material on the outer surface of the protector above the fixed vertical bar and gently rocked from side to side by an inclination of $(20 \pm 2)^\circ$ to the vertical each way times 5 oscillations. See Figure 7 and Figure 8. If the blocks of protective material permit the bars to come into effective contact with each other with only fabric or a zip or other non-protective material between them, the fact is recorded and the site marked: the protective clothing has failed the test.

**Key**

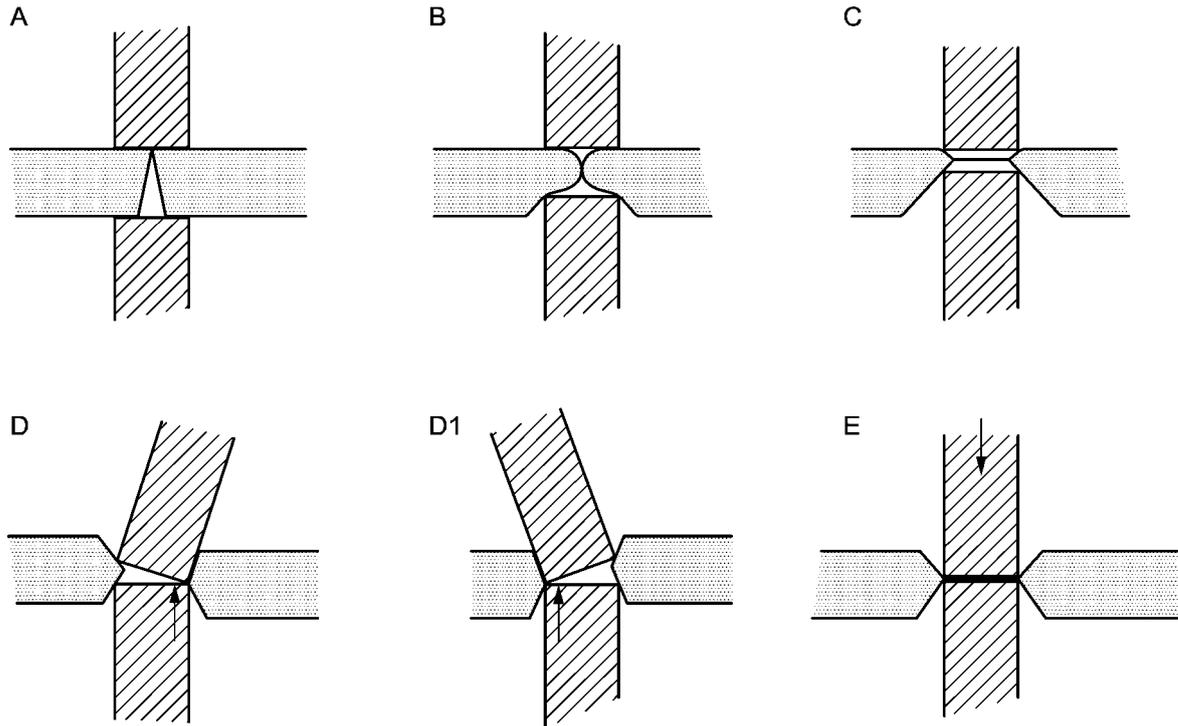
Normative dimensions:

l_1	(15 ± 1) mm
l_2	(45 ± 2) mm
$l_3 + l_5 = l_4$	(70 ± 1) mm
r_1	0,5 mm (approximative)
M	$(2,55 \pm 0,05)$ kg

Informative dimensions, when using steel:

l_3, l_{11}	50 mm
l_5	20 mm
l_6	75 mm
l_7	165 mm
l_8	132 mm
l_9	55 mm
l_{10}	45 mm

Figure 7 — Block separation tester



Key

A, B and C are pass results
 D, D1 and E are fail results

Figure 8 — Examples of test results from testing protective material block separation

5.6 Testing the restraint of protective jackets, body protectors and shoulder protectors

Protective jacket and body protector closures and restraints, and shoulder protector attachments, shall be tested using a spring balance or force gauge. The device to be used shall be clamped to the surface or to a free edge of the protector, or hooked around an edge while the protector is worn by a suitable subject or dummy. The test force of 50 N shall be gently applied and held for (30 ± 5) seconds, and the result observed, measured as necessary and compared to the requirements in 4.4 to determine whether the sample passes or fails. All closures shall be tested at right angles to the line of the closure. The closures and adjusters shall be set to their widest adjustment shown by the warning markers and according to the information supplied by the manufacturer.

The lower edge of a protective jacket or a body protector shall be tested by being pulled up the body at four points in turn at the middle of the back and front, and the sides. The shoulder area shall be tested by pulling the armhole edge forwards, upwards and backwards at 90° to the edge of the armhole and at 90° to the surface of the body protector or jacket.

Shoulder protectors shall be tested by being pulled in the plane of the protector away from their attachment if they are worn under clothing, and they shall also be pulled backwards over the point of the shoulder in a peeling manner, if they are designed to be worn without clothing over them. The test forces shall be applied to shoulder protectors in three directions, forwards, backwards and laterally.

The results shall be recorded and compared to the requirements in 4.4 to determine whether the protective clothing passes or fails.

5.7 Ergonomic assessment of protective jackets, body and shoulder protectors

5.7.1 Rough and hard components

The protectors shall be examined visually and by feel, and any rough or hard edges noted. Hard structures such as buckles are to be identified, and if they are likely to cause bruising to underlying tissues in a fall the fact is to be recorded as a failure of the protector.

5.7.2 Coverage and restriction of movements

Adult sizes only shall be used for the assessment. Two subjects shall assess one garment each that is appropriate for their size. Subjects shall be chosen that have chest girths and over-the-shoulder lengths within size range of users given by the manufacturer. Their waist girths shall be within the range given by the manufacturer. The genders and general physique of the subjects shall be appropriate to the model being assessed. The subjects shall wear underwear, trousers, a long sleeved shirt or tee-shirt, footwear, and a riding helmet. They shall also wear any other clothing the manufacturer specifies in their information for users as necessary for use with the protective clothing.

The protective clothing shall be donned by each subject. The subject shall stand upright, raise their outstretched arms sideways until their wrists are level with the top of their head, swing their arms forward at the same height until their hands meet, and then swing their outstretched arms down and to behind them. The subject shall sit on a low stool such that their thighs are slightly inclined upwards towards their knees. The subject shall bend forwards at their waist to bring their shoulders close to their knees. They shall look down as in opening a gate and also straight ahead as in a racing position. All movements shall be carried out five times. Then while standing each subject shall take a number of maximal inspirations and breath out fully between them.

The tester and the subjects shall carefully consider the following:

- a) Whether the subjects can single-handedly don the protective clothing, adjust it to obtain a comfortable close fit and then remove it, or if appropriate, with help adjust the protective clothing to fit, and then don and doff it single-handedly. If either cannot do so, or the clothing obviously cannot be adjusted to fit, the protective clothing fails.
- b) Whether after the sequence of movements the torso protection provided by protective jackets and body protectors covers the parts of the body specified in Annex B. If it does not do so on either subject, the protective clothing fails.
- c) Whether after the sequence of movements the shoulder protection provided by protective jackets and shoulder protectors covers the parts of the body specified in Annex B. If it does not do so on either subject, the protective clothing fails.
- d) Whether during the movements there is firm contact with the protective clothing around the arm-hole, at the waist, or on the back of the neck. If pain is caused each time a movement is carried out by either subject, the protective clothing fails.
- e) Whether there is firm contact with the protective clothing on the front of the neck or underside of the chin when the seated leaning forward movement is carried out. If firm contact occurs on any occasion the movement is carried out by either subject, the protective clothing fails.
- f) Whether the head, neck and arm movements of the rider would be so restricted that they cannot perform the movements detailed above. If the movements cannot be performed, the protective clothing fails.
- g) Whether maximal inspiration is possible, is restricted, or is made tiring by the need for increased effort by the protective clothing, or whether any severe discomfort is caused. If inspiration is detectably restricted, or the effort is increased, or there is any severe discomfort experienced by either subject the protective clothing fails.

- h) Whether the protective item fits correctly. If one of the two results is a fail, a third subject should be used. If the third subject finds a suitable fit, the result is a pass.

The comments made and conclusions shall be recorded as a pass or fail for the protective clothing. Protectors only available in children's sizes shall be examined on a suitable child if available or visually and by hand. The likely restrictions of movement will be assessed by manipulating the protective clothing and considering the needs of the users.

5.8 Impact energy transmission measurement

5.8.1 General

Horse riders' protective clothing shall be impact tested with impactors designed to represent the hazards of falling to the ground, and of being struck by a hoof or hitting a narrow pole. The drop height of the impactors above the protective clothing being tested, shall be adjusted so that the impact velocity provides an impact energy as specified in Table 3. The impactors shall be mounted on appropriate guided falling masses so that the centre of the impactor is in line with the centre of the anvil ± 2 mm.

Table 3 — Impact energy for testing to Performance Levels 1, 2 and 3

Test Conditions	Clause	Impact energy for the Performance Level		
		J ^a		
		Level 1	Level 2	Level 3
Flat impactor on body protectors and the torso region of protective jackets. Guard ring, 0 mm.	5.8.2	25	30	35
Narrow bar impactor on body protectors and the torso region of protective jackets. Guard ring, 10 mm.	5.8.3	20	32,5	45
Wide bar impactor on shoulder protectors and the shoulder region of protective jackets. No guard ring.	5.8.4	60	60	60
^a with accuracy of ± 5 %				

The anvils and guard ring system are designed to represent the profiles of body parts and, in part, their responses to impact. Each anvil shall be mounted directly onto a stiff load cell or force transducer, such as a piezo-electric load cell. The frequency response of the load transducer shall be ≥ 10 kHz. The anvil and load cell shall be bolted or clamped to a concrete or similar massive base of ≥ 1 000 kg. The anvil shall be made of steel and the mass above the load cell shall be $(10 \pm 1,5)$ kg. The recording system shall show a continuous force with time, or shall have a peak force detection capability. Digital sampling systems shall have a rate of ≥ 10 kHz. The complete system shall be able to measure forces ≤ 50 kN with an accuracy of 0,1 kN between 1 kN and 10 kN.

5.8.2 Flat impactor and anvil for testing body protectors and the torso region of protective jackets

A flat face impactor with a steel face (80 ± 2) mm in diameter and at least 10 mm thick mounted on a metal carriage with a combined mass of $(2\ 500 \pm 25)$ g shall be used. The corners between the striking face and sides of the impactor shall have a radius of curvature of $(0,5 \pm 0,1)$ mm. The anvil shall be (100 ± 1) mm in diameter with a (150 ± 5) mm radius of curvature domed top. The anvil shall be surrounded by a metal guard ring with an internal diameter of (120 ± 2) mm and a wall thickness of (20 ± 1) mm. The guard ring shall be solidly mounted to the concrete mass. The top of the ring shall be adjusted to be $(0 \pm 0,2)$ mm above the anvil, see Figure 9 which illustrates the bar impactor.

5.8.3 Narrow bar impactor and anvil for body protectors and the torso region of protective jackets

The narrow bar impactor shall be made of steel. The impactor face shall be rectangular (80 ± 2) mm in length, and (20 ± 1) mm in width, with ($0,5 \pm 0,1$) mm radius corners and at least 10 mm thick. The impactor shall be mounted on a metal carriage with a combined mass of ($2\ 500 \pm 25$) g. The anvil shall have a (150 ± 5) mm radius domed top. The guard ring shall be adjusted to ($10 \pm 0,2$) mm above the anvil. See Figure 9.

5.8.4 Wide bar impactor and anvil for testing shoulder protectors and the shoulder region of protective jackets

The wide bar impactor shall be made of steel. The impactor face shall be (80 ± 1) mm in length, and ($40 \pm 0,5$) mm in width, with 5 mm radius edges and ≥ 20 mm thick. The impactor shall be mounted on a metal carriage with a combined mass of ($5\ 000 \pm 50$) g. The anvil shall be (100 ± 1) mm in diameter with a hemispherical top with a (50 ± 1) mm radius of curvature. No guard ring shall be used.

5.8.5 Procedures for impact testing

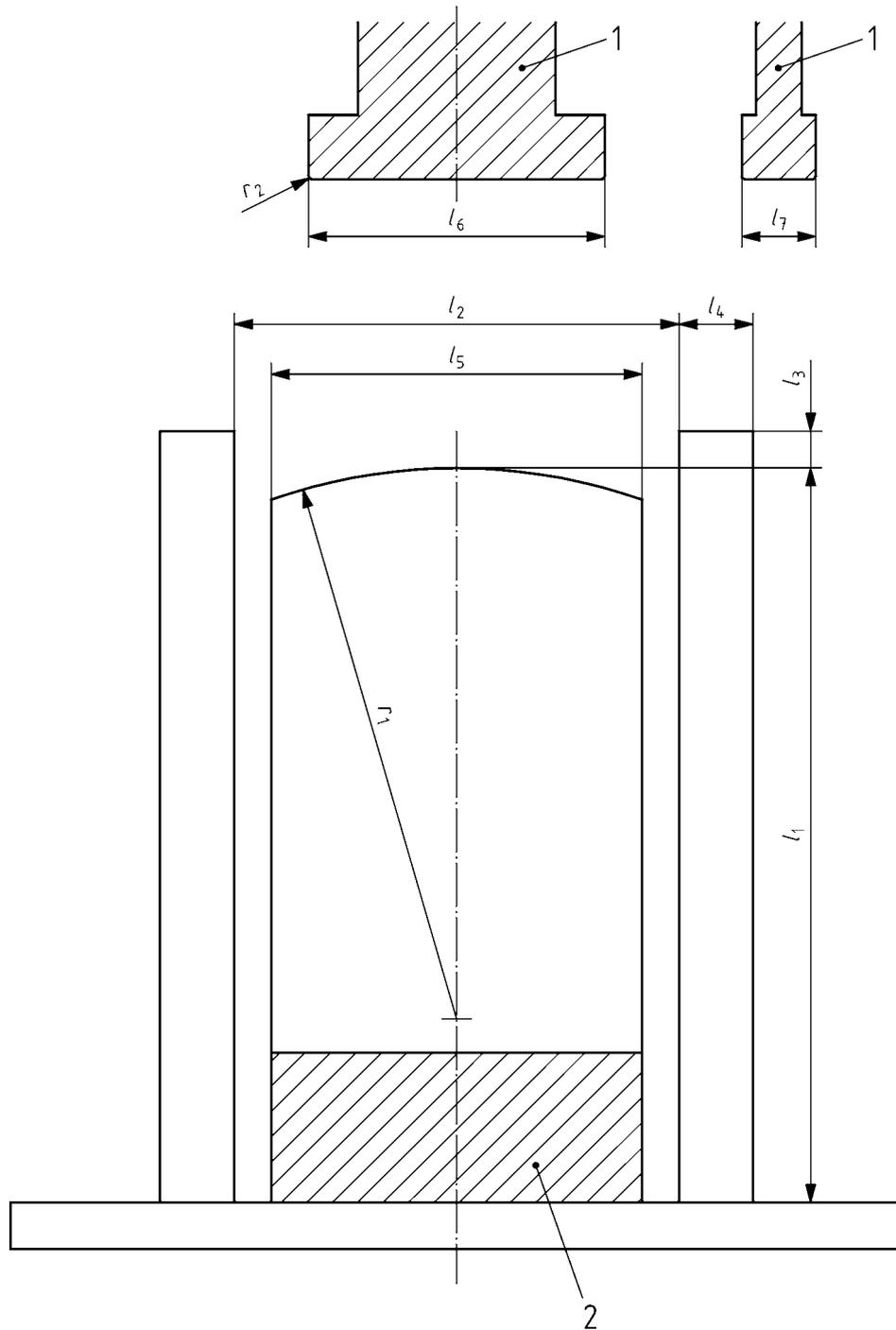
Protective jackets and body protectors shall be tested intact whenever possible. The samples shall be according to 4.6.1. The item under test should be laid flat on the guard ring, with its outer face up. If they have to be cut, the cut edges shall be bound with adhesive tape to retain the normal relationship between the components of the protector. Six impacts shall be made under each of the conditions 5.8.2 and 5.8.3 at the appropriate energy level on all constructions occupying $> 10\%$ of the surface area of the protector. Two impacts shall be made on each type of weak point identified in 5.4.1.7. Impact sites shall be marked so that no area is impacted twice. The centres of impacts shall be ≥ 100 mm from any free edge of the protector such as the neck, armhole or lower edge, and 200 mm from any other impact centre. This determines the number of impacts for each garment. Individual peak force values shall be recorded. The mean peak force for all impacts on a protector shall be calculated.

Impact testing shall be repeated on double layers of "50 % thickness" material if required (see 4.6).

Shoulder protectors and the shoulder region of protective jackets examined and marked according to 5.4.2 shall be used. Five impacts shall be made on constructions occupying areas $> 20\%$ under the conditions in 5.8.4. Two impacts shall be made on each type of 'weak' point. Before being impacted, the test sample shall be approximately curved into the shape it would have during riding and allowed to relax on the anvil. It shall not be fixed in a curved shape by any artificial means such as adhesive tape, pins or staples. Individual peak force values shall be recorded. Impact sites shall be marked so that no area is impacted twice. The centres of impacts shall be ≥ 30 mm from any free edge of the protector and ≥ 60 mm from any other impact centre. This determines the number of impacts for each garment. The mean peak force for the series of impacts shall be calculated.

5.8.6 Impact testing of protective clothing specified to be usable at high ambient temperatures

Impact testing using impactors according to 5.8.2, 5.8.3 and 5.8.4 shall be repeated on protective clothing conditioned at (30 ± 2) °C and (37 ± 5) % relative humidity for ≥ 48 h. Testing shall be carried out in that environment.



Key

1 impactor with a flat bar shaped striking face and a mass of $(2\,500 \pm 25)$ g

2 load cell or force transducer

l_1 > 200 mm

l_2 (120 ± 2) mm

l_3 $(10 \pm 0,2)$ mm

l_4 (20 ± 1) mm

l_5 (100 ± 2) mm

l_6 (80 ± 2) mm

l_7 (20 ± 1) mm

r_1 (150 ± 5) mm

r_2 $(0,5 \pm 0,1)$ mm

Figure 9 — Principle of the design of the bar impactor and the anvil with a guard ring for testing body protectors

6 Marking

Protective jackets, body and shoulder protectors shall be permanently and conspicuously marked with at least the following:

- a) the name or trademark of the manufacturer;
- b) designation of the product type, commercial name or code that uniquely identifies the item;
- c) the size designation of the protector. The pictograms in Figure 5 shall be used. The size shall be shown on both the front and the back panels of body protector garments in which the panels may be separated and combined in different combinations or on the protector (if designed to be used alone);
- d) the number of this Standard, i.e. EN 13158, and the level of performance of the protector;
- e) an instruction to see the information supplied by the manufacturer provided with the protector;
- f) the year of manufacture of the product;
- g) a warning that the coloured warning markers in the closures should not be visible when the protector is worn. A statement of the colour of these markers;
- h) the following words, or their translation into one or more of the official languages of the state or region in which the body protector or protective jacket is placed on the market, shall always be included in the marking permanently attached to level 1 protectors:

WARNING — This level 1 protector is designed to meet the weight restrictions that apply to professional jockeys while racing. It is not intended for use in general horse riding as it provides significantly less protection than a level 2 protector, which is the minimum recommended for normal riding.

- i) the following words, or their translation into one or more of the official languages of the state or region in which the body protector or protective jacket is placed on the market, shall always be included in the marking permanently attached to protectors for horse drivers and passengers:

WARNING — This protector is designed to meet the needs of horse drivers and passengers. It does not provide adequate coverage of the back for those riding horses or those working with them.

The following information should be given on the product:

- j) the type of use for which the protectors are intended. Any type of use for which the protectors are specifically not intended;
- k) the hazards specific to horse riding or working with horses or horse driving against which some protection is given;
- l) the hazards specific to horse riding or working with horses or horse driving against which protection is NOT given;
- m) international care label symbols (negative labels are important).

7 Information supplied by the manufacturer

Protective jackets, body protectors and shoulder protectors shall be supplied with information and with instructions for fitting and use that will promote their safe and effective use. The information shall be precise and comprehensible and in the official language(s) of the country of destination. The information shall include at least the following:

- a) all information required in Clause 6;
- b) sizing pictogram;
- c) how to select protective clothing of the correct level of performance:
 - 1) an explanation of the performance levels of protective clothing available under this European Standard;
 - 2) an explanation of the tests performed on the protective clothing;
 - 3) an explanation of any pictogram attached to the protective clothing or included in this information supplied by the manufacturer;
- d) how to choose the correct size of protective clothing and check its fit:
 - 1) how to ensure the protective clothing is suitable for the anticipated body movements during use;
 - 2) the ordinary clothing that should be worn under the protective clothing;
 - 3) details of the sizes of protective clothing available and the body dimensions to which they relate;
 - 4) details of which sizes of back and front panels are compatible in designs where they may be interchanged;
- e) how to adjust the protective clothing including an explanation of the meaning of the coloured warning markers in adjusters, including a statement of the colour of the warning markers;
- f) advice to adjust the body protector to give a close fit on the torso;
- g) advice about wearing other personal protective equipment such as a helmet to provide the protection intended;
- h) warning about changes in environmental conditions such as temperature that would significantly reduce the performance of the protective clothing;
- i) information about the performance of the protective clothing if it has been impact tested at a temperature of 30 °C.
- j) warning that no protective clothing can offer full protection against injury, including a specific warning that spinal injuries will not be prevented by the body protector or protective jacket;
- k) warning about any contamination, alteration to the protective clothing, or misuse that would dangerously reduce the performance of the protective clothing;

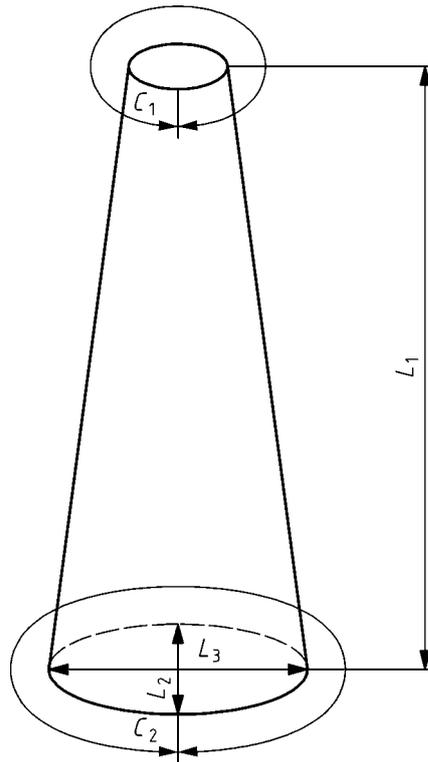
- l) text of any additional warnings placed on the protective clothing not otherwise required to be in the information supplied by the manufacturer;
- m) detailed instructions for storing, caring for and cleaning the protective clothing:
 - 1) maximum number of cleaning cycles the protective clothing may be subject to if the impact attenuating materials are not removed before cleaning;
 - 2) if this information (see 7, m) 1)) is absent and if impact attenuating materials are not removed before cleaning, a statement that the performance level of the protective clothing was determined after five cleaning cycles;
- n) year of manufacture of the protective clothing;
- o) instructions concerning inspection and repair of the protective clothing, including how to decide that it should be thrown away because it may no longer provide adequate protection due to damage, wear or age;
- p) statement which advises that no single size of a body protector will fit all body dimensions;
- q) textile and material types in the protector.

Annex A (informative)

Guidance on cone construction and use

A.1 Design of cones

The Figure A.1 shows a generalized cone (Figure 6 in 5.4.1.2).



Key

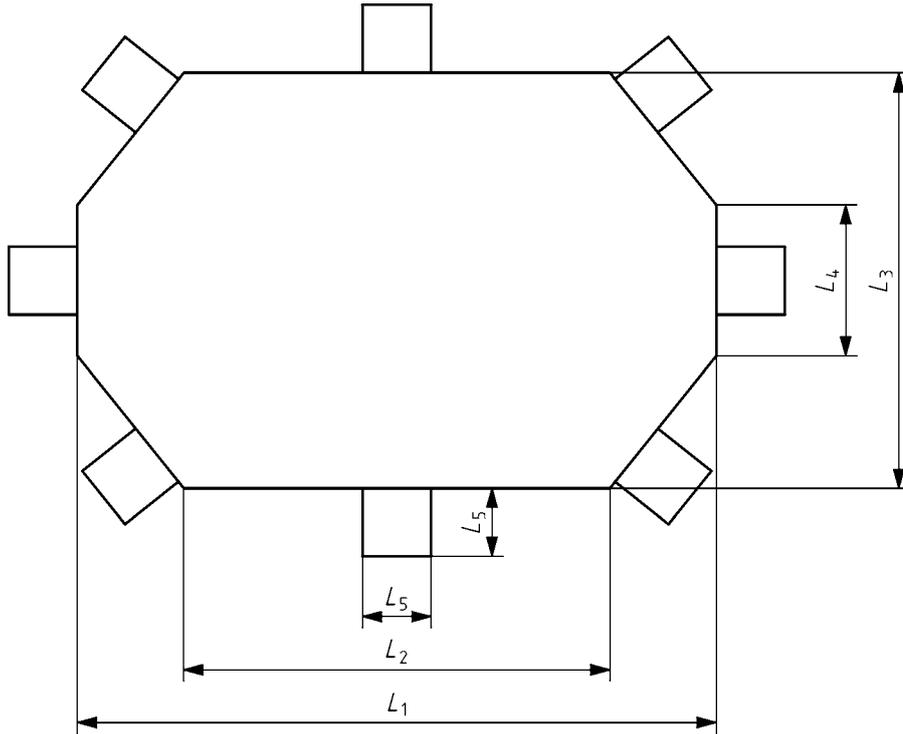
- L_1 is a length of at least 1 500 mm
- $L_3 = 1,4 \times L_2$
- C_1 is a circumference of less than 400 mm
- C_2 is a circumference of at least 1 300 mm

Figure A.1 — Cone for measuring internal girths

A.2 Cone construction

Cones may be made out of any materials that will result in a smooth rigid cone. The frame-work may conveniently be made out of timber. The final cones should be clad in plastic or metal sheet to give a completely smooth outer surface.

The cones illustrated below were built around shaped boards. One for the base and one or more placed higher up. The long timbers were screwed to the shaped boards. This essentially completes the frame except for the narrowest cones where the long timbers had to be shaped where they came together.



NOTE Approximate dimensions in millimetres are given in Table A.1.

Figure A.2 — Cone base board

Figure A.2 shows the large cone base board in scale with the long timbers. The values in the Table A.1 for all the boards have been measured from prototype cones. The values are approximate and are provided as a guide to developing cones from local materials. As the boards get smaller the long timbers would appear proportionately larger if similar diagrams to Figure A.2 were drawn.

Table A.1 — Base, middle and upper cone board dimensions

Dimensions in millimetres

Dimension	Large cone boards		Smaller cone boards	
	Base	Upper	Base	Top
L_1	420	225	335	145
L_2	280	155	220	75
L_3	275	137	240	90
L_4	100	48	75	45
L_5	45	45	45	45
Vertical separation of boards	880		540	—
			920	



Figure A.3 — Two cones

Figure A.3 shows two cones. The left-hand one is finished, the right-hand one shows the timber framework before cladding and marking with circumference lines.

When the cones are complete and polished, two people should use a calibrated tape measure to mark say the circumferences 100 mm apart. The distance between them can then be divided into 10 divisions. In the measurements great care shall be taken to keep the tape horizontal and taught.

A.3 Use of cones in measurements

Elastic closures are a problem in measurements. A procedure has thus been devised to take into account the force a user may be able to accept on their chest before they feel too uncomfortable or find their breathing is restricted. Literature search and some measurements suggest adults may accept a tension of 20 N around their rib cage. Small children can probably only accept 5 N. There will be significant variability in a population but a 'standard' procedure is required for a Standard. This is provided in the text in 5.4.1.4.

Annex B (normative)

Coverage to be provided by protective jackets, body protectors, and shoulder protectors, and the dimensions of protective material in the protectors

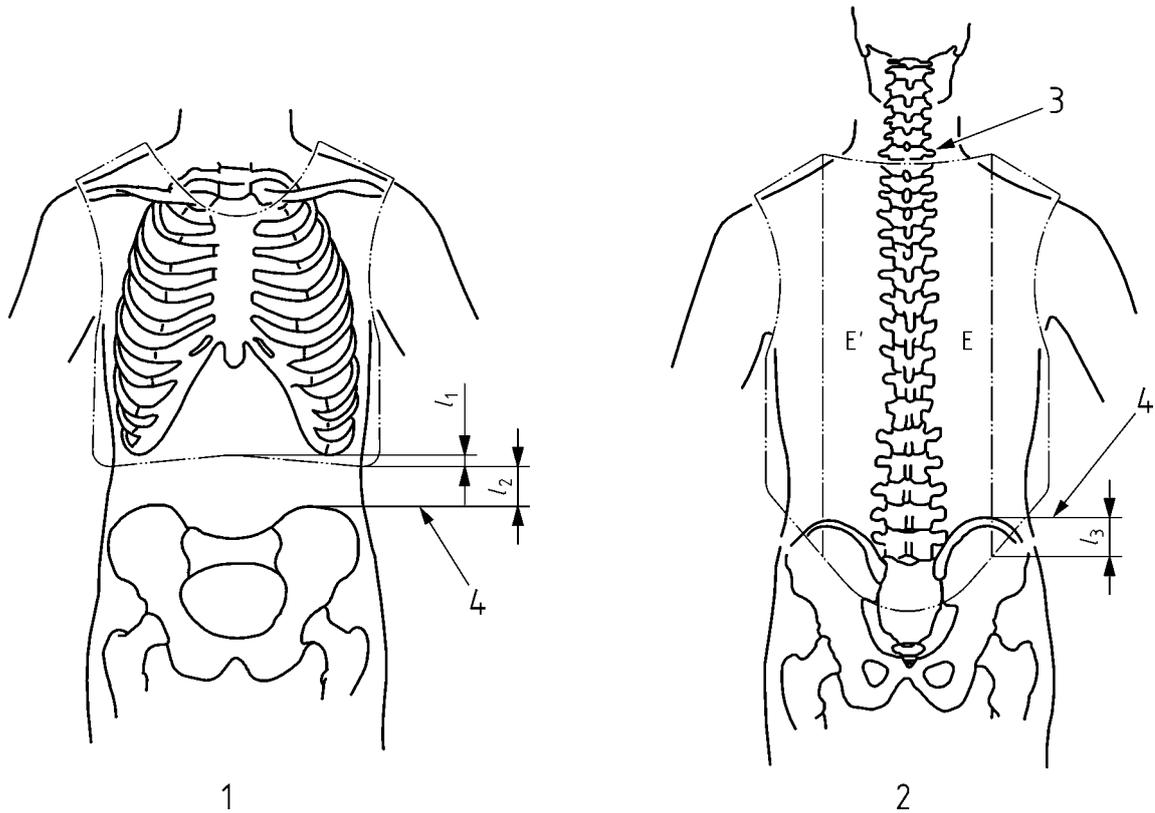
B.1 Protectors for horse riders and those working with horses

When correctly worn a protective jacket, or a body protector for horse riders and those working with horses shall cover the following area of the body as shown in Figure B.1. The numerical dimensions are for a user with an over-the-shoulder length of 1 000 mm and shall be scaled *pro rata* for users with different over-the-shoulder lengths.

- a) the whole circumference of the torso;
- b) the bottom edge of the protector shall be ≥ 25 mm below the rib cage anteriorly, and shall reach a level ≤ 30 mm above the iliac crests of the pelvis at the side of the body. Posteriorly the points at which the lines *E* and *E'* (see Figure B.1) meet the bottom edge, shall be ≥ 50 mm below the level of the iliac crests;
- c) the top of the protective material on the back shall just reach the level of the seventh cervical vertebra (the prominent bone at the base of the neck);
- d) the top of the protective material on the chest shall reach to within 25 mm of the top of the sternum.
- e) the shoulder straps of a body protector or protective jacket shall cover the central 50 % of the clavicle (collar bone).

When correctly worn the protective material in the shoulder of a protective jacket or in shoulder protectors, shall cover the point of the shoulder and extend as follows:

- f) to cover the lateral 75 % of the collar bone (clavicle);
- g) to cover the upper 25 % of the lateral aspect of the humerus;
- h) to cover the anterior of the shoulder joints (glenohumeral and acromioclavicular joints);
- i) to cover the posterior of the shoulder joints.



Key

- 1 front view
- 2 back view
- 3 the seventh cervical vertebra
- 4 level of the top of the iliac crests
- l_1 minimum length of protective material below the ribcage (25 mm for a protector for a user with an over-the-shoulder length of 1 000 mm)
- l_2 maximum distance between the lower edge of protective material and the iliac crest at the side of the body (30 mm for a protector for a user with an over-the-shoulder length of 1 000 mm)
- l_3 minimum length of protective material below the level of the iliac crests at the points the lines E and E' (see 4.2.2) intercept the bottom edge of the protective material (50 mm for a protector for a user with an over-the-shoulder length of 1 000 mm)

Figure B.1 — Coverage to be provided by a horse rider's body protector

B.2 Protectors for horse drivers and passengers

When correctly worn, a protective jacket, or a body protector for horse drivers and passengers shall cover the following area of the body. The numerical dimensions are for a user with an over-the-shoulder length of 1 000 mm and shall be scaled *pro rata* for users with different over-the-shoulder lengths.

- a) the whole circumference of the torso;
- b) the bottom edge of the protector shall be ≥ 25 mm below the rib cage anteriorly, and shall reach a level ≤ 30 mm above the iliac crests of the pelvis laterally. Posteriorly the points at which the lines E and E' (see Figure B.1) meet the bottom edge, shall be ≥ 30 mm below the level of the iliac crests;

- c) the top of the protective material on the back shall reach the level of the seventh cervical vertebra (the prominent bone at the base of the neck);
- d) the top of the protective material on the chest shall reach to within 25 mm of the top of the sternum;
- e) the shoulder straps of a body protector or protective jacket shall cover the central 30 % of the clavicle (collar bone).

When correctly worn the protective material in the shoulder of a protective jacket or in shoulder protectors, shall cover the point of the shoulder and extend as follows:

- f) to cover the lateral 70 % of the clavicle;
- g) to cover the upper 25 % of the lateral aspect of the humerus;
- h) to cover the anterior of the shoulder joints (glenohumeral and acromioclavicular joints);
- i) to cover the posterior of the shoulder joints.

Annex C
(informative)

**Significant technical changes between this European Standard and
EN 13158:2009**

The significant technical changes are listed in Table C.1.

Table C.1 — Significant technical changes between this European Standard and EN 13158:2009

Clause/paragraph/table/figure	Change
Clause 4	Edited to improve clarity and remove ambiguity
Clause 5	Edited to improve clarity
Table 2	Modified
Annex A	Former Annex A now incorporated into requirements and test methods
Annex ZA	Updated

Annex ZA (informative)

Relationship between this European Standard and the essential requirements of Regulation EU 2016/425 aimed to be covered

This European Standard has been prepared under a Commission's standardization request to provide one voluntary means of conforming to essential requirements of Regulation EU 2016/425 Personal Protective Equipment (PPE).

Once this standard is cited in the Official Journal of the European Union under that Regulation, 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 Regulation EU 2016/425

Essential Requirements of Directive	Clause(s)/subclause(s) of this EN	Remarks/Notes
1.1.1 Ergonomics	4.5	
1.1.2.1 Highest level of protection possible	4.5	
1.1.2.2 Classes of protection appropriate to different levels of risk	5.8.1 (Table 3)	
1.2.1 Absence of risk of other inherent nuisance factors	4.4, 4.2.2, 4.2.3, 4.2.4, 4.3, Annex B	
1.2.1.1 Suitable constituent materials	4.7	
1.2.1.2 Satisfactory surface condition of all parts of PPE in contact with user	4.5	
1.2.1.3 Maximum permissible user impediment	4.5	
1.3.1 Adaptation of PPE to user morphology	4.2.5, 4.4, 4.2.6	
1.3.4 Protective clothing containing removable protectors	4.6	
1.4 Information supplied by the manufacturer	6, 7	
2.1 PPE incorporating adjustment systems	4.5	
2.4 PPE subject to ageing	6, 7	
2.12 PPE bearing one or more identification or recognition marks directly or indirectly relating to health and safety	6	
3.1.1 Impact caused by falling or projecting objects and collision of parts of the body with an obstacle	4.6	

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.

Bibliography

EN ISO 13688, *Protective clothing - General requirements (ISO 13688)*