BRITISH STANDARD

BS EN 471:2003 +A1:2007

High-visibility warning clothing for professional use — Test methods and requirements

ICS 13.340.10

BSI British Standards

National foreword

This British Standard is the UK implementation of EN 471:2003+A1:2007. It supersedes BS EN 471:2003 which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by ⟨A1⟩ ⟨A1⟩.

WARNING

The UK as a member of CEN, is obliged to publish EN 471:2003 as a British Standard. However, attention is drawn to the fact that during the later stages of the development of this European Standard, changes were incorporated which were the subject of objection by the UK. As a consequence the UK voted against approval as a European Standard.

The reason for this objection is that during discussion of this standard by BSI Committee PH/3/7, which mirrors the work of CEN Committee, TC 162/WG7, several UK experts expressed the opinion that a number of the changes may discriminate against a range of materials currently in use resulting in serious implications for manufacturers of garments to this standard.

The UK participation in its preparation was entrusted by Technical Committee PH/3, Protective clothing, to Subcommittee PH/3/7, High-visibility clothing, visual performance.

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

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

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 21 April 2004

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EUROPEAN STANDARD

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English Version

High-visibility warning clothing for professional use - Test methods and requirements

Vêtements de signalisation à haute visibilité pour usage professionnel - Méthodes d'essai et exigences

Warnkleidung - Prüfverfahren und Anforderungen

This European Standard was approved by CEN on 1 August 2003 and includes Amendment 1 approved by CEN on 10 November 2007.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

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Foreword

This document (EN 471:2003+A1:2007) 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 document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2008 and conflicting national standards shall be withdrawn at the latest by June 2008.

This document includes Amendment 1 approved by CEN on 2007-11-10.

This document supersedes ⟨A1⟩ EN 471:2003 ⟨A1⟩.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ⟨A1⟩ ⟨A1⟩.

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.

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

Introduction

This European Standard provides a solution that enables the major issues to be resolved. The performance of the conspicuous materials to be used in "high visibility clothing" is specified together with minimum areas and placement of the materials.

Conspicuity is enhanced by high contrast between the clothing and the ambient background against which it is seen; and by larger areas of the conspicuous materials specified.

Three areas of background and combined performance material colours are defined in an appropriate manner for clothing material, all of which will confer conspicuity against most backgrounds found in urban and rural situations in daylight. However users should consider the prevailing ambient background in which protection is required and select the colour that provides the preferred contrast.

Two levels of separate performance retroreflective materials are included. Higher levels of retroreflection provide greater contrast and visibility of warning clothing when seen in headlights during darkness. When greater conspicuity is required the higher level of retroreflecting material should be used.

Design requirements illustrating the disposition of retroreflective materials are included within the standard. The ergonomics of the wearer should be considered when selecting the most appropriate configuration of retroreflective materials within the garment.

Three classes of warning clothing are specified in terms of the minimum areas of the materials to be incorporated. Whilst the area comprising clothing is obviously dictated by the type of clothing and also the size of the wearer, it should be noted that class 3 clothing offers greater conspicuity against most urban and rural backgrounds than class 2 garments which in turn are significantly superior to class 1 clothing.

Selection and use of high-visibility warning clothing can vary among European countries. It should be based on a risk assessment of the condition in which the warning clothing is to be used. This will involve consideration of the requirements necessary for an observer to understand that a wearer is present. The observer needs both to perceive and to recognise the wearer and then to decide to take appropriate avoidance action. The wearing of a high-visibility garment does not guarantee that the wearer will be visible under all conditions.

Test methods ensure that a minimum level of protection is maintained when the garments are subjected to care procedures. Test methods detailed in this standard are for new materials and not intended for products in use.

Attention is drawn to EN 1150, which specifies characteristics and properties for visibility clothing for non-professional use.

1 Scope

This European Standard specifies requirements for protective clothing capable of signalling the user's presence visually, intended to provide conspicuity of the user in hazardous situations under any light conditions by day and under illumination by vehicle headlights in the dark.

Performance requirements are included for colour and retroreflection as well as for the minimum areas and for the disposition of the materials in protective clothing.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 340, *Protective clothing — General requirements*

〚A1〛 EN 343:2003+A1, *Protective clothing - Protection against rain* 〚A1〛

EN 530:1994*, Abrasion resistance of protective clothing material — Test methods*

EN 31092, *Textiles — Determination of physiological properties - Measurement of thermal and water- vapour resistance under steady-state conditions (sweating guarded - hotplate test) (ISO 11092:1993)*

EN ISO 3175-2:1998, *Textiles — Dry cleaning and finishing — Part 2: Procedures for tetrachloroethene (ISO 3175-2:1998)*

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

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

EN ISO 13934-1, *Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method (ISO 13934-1:1999)*

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

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

ISO 105-A03*, Textiles — Tests for colour fastness — Part A03: Grey Scale for assessing staining*

ISO 105-B02:1994, *Textiles — Tests for colour fastness — Part B02: Colour fastness to artificial light: Xenon Arc fading lamp test*

ISO 105-C06, *Textiles — Tests for colour fastness — Part C06: Colour fastness to domestic and commercial laundering*

ISO 105-D01, *Textiles — Tests for colour fastness — Part D01: Colour fastness to dry cleaning*

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

ISO 105-N01, *Textiles — Tests for colour fastness — Part N01: Colour fastness to bleaching: Hypochlorite*

ISO 105-X11, *Textiles — Tests for colour fastness — Part X11: Colour fastness to hot pressing*

ISO 105-X12, *Textiles — Tests for colour fastness — Part X12: Colour fastness to rubbing*

ISO 4674:1977, *Fabrics coated with rubber or plastics; - Determination of tear resistance*

ISO 4675, *Rubber- or plastics-coated fabrics — Low-temperature bend test*

ISO15797:2002, *Textiles — Industrial washing and finishing procedures for testing of workwear*

CIE 15.2:1986, *Colorimetry*

CIE 17.4:1987, *International lighting vocabulary*

CIE 54.2:2001, *Retroreflection: Definition and measurement*

3 Terms and definitions

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

3.1
high-visibility warning clothing
warning clothing intended to provide conspicuity at all times

3.1.1
fluorescent material
material that emits optical radiation at wavelengths longer than absorbed

3.1.2
background material
coloured fluorescent material intended to be highly conspicuous, but not intended to comply with the requirements of this standard for retroreflective material

3.1.3
retroreflective material
material which is a retroreflector but which is not intended to comply with the requirements of this standard for background material

3.1.4
separate-performance material
material intended to exhibit either background or retroreflective properties but not both

3.1.5
combined-performance material
material intended to exhibit both background and retroreflective properties

3.1.6
orientation sensitive material
material having coefficients of retroreflection that differ by more than 15 % when measured at the two rotation angles $\varepsilon_1 = 0°$ and $\varepsilon_2 = 90°$

3.2
photometric terms
NOTE the photometric terms used in this document are defined in CIE Publication No 17.4:1987 and No 54.2:2001

4 Design

4.1 Types and classes

The warning clothing is grouped into three classes. Each class shall have minimum areas of visible materials incorporated in the garment in accordance with Table 1. Garments shall comprise the required areas of background material and retroreflective material or alternatively shall comprise the required area of combined performance material. Examples are illustrated in Annex A. The area shall be measured on the smallest garment size available and fastened to the smallest configuration possible.

Table 1 — Minimum required areas of visible material in m²

	Class 3 garments	Class 2 garments	Class 1 garments
Background material	0,80	0,50	0,14
Retroreflective material	0,20	0,13	0,10
Combined performance material	-	-	0,20

The proportion of the required background material shall be 50 % ± 10 % on the front and backside of the garment. The garment is to be measured flat on the table including torso, arms and legs.

4.2 Specific design requirements

4.2.1 The background material shall encircle the torso, and, where applicable, the sleeves and trouser legs.

4.2.2 Bands of retroreflective material shall be not less than 50 mm wide; but for harnesses they shall be not less than 30 mm wide as shown in Figure A.9.

4.2.3

a) Coveralls shall have two horizontal bands of retroreflective material not less than 50 mm apart encircling the torso with a maximum inclination of ± 20°.

b) Jackets, waistcoats, shirts, coats and tabards shall have two bands of retroreflective material with a maximum inclination of ± 20° not less than 50 mm apart encircling the torso and bands of retroreflective material joining the uppermost torso band from the front to the back over each shoulder. The bottom of the bottom torso band shall be not less than 50 mm above the bottom edge of the jacket, waistcoat, tabard or shirt.

Or/alternatively

c) Jackets, waistcoats, shirts, coats and tabards shall have one band of retroreflective material with a maximum inclination of ± 20° encircling the torso and bands of retroreflective material joining the torso band from the front to the back over each shoulder. The bottom of the torso band shall be not less than 50 mm above the bottom edge of the jacket, waistcoat, tabard or shirt.

Or/alternatively

d) Jackets, waistcoats, shirts, coats and tabards shall have two bands of retroreflective material with a maximum inclination of ± 20° not less than 50 mm apart encircling the torso. The bottom of the bottom torso band shall be not less than 50 mm above the bottom edge of the jacket, waistcoat, tabard or shirt.

4.2.4 The full length sleeves of coveralls, jackets and coats shall be encircled by two bands of retroreflective material not less than 50 mm apart. The bottom of the lower band shall not be less than 50 mm from the bottom of the sleeve.

4.2.5 Coveralls, bib and brace trousers and waistband trousers shall have two bands of retroreflective material with a maximum inclination of ± 20° not less than 50 mm apart, encircling each leg. The bottom of the lower band shall be not less than 50 mm above the bottom of the trouser leg.

4.2.6 Bib and brace trousers classes 2 and 3 shall have one band of retroreflective material encircling the torso with a maximum inclination of ± 20° from the horizontal.

4.2.7 Tabards shall be constructed so that a person of the size for which they are designed can wear the tabard so that any gaps at the sides shall be not greater than 50 mm horizontally.

4.2.8 Any gap (to enable fastening or fixation of seams) in the lengthwise continuity of each band of retroreflective or combined performance material shall not be greater than 50 mm, measured parallel to the direction of the band, and the total of such gaps shall not be greater than 100 mm in any one band around the torso and 50 mm around sleeves and legs.

4.2.9 Harnesses shall comprise a retroreflective band (separate or combined performance materials) encircling the waist and other retroreflective bands (separate or combined performance materials) joining the waistband from the back to the front over both shoulders, the bands not less than 30 mm wide.

NOTE Harnesses complying with this standard are not intended to provide protection against fall from height.

4.3 Sizes

The size designation shall be in accordance with the requirements of EN 340.

5 Requirements for background material, non-fluorescent material and combined performance materials

5.1 Colour performance requirements of new materials

5.1.1 Background material

The chromaticity shall lie within one of the areas defined in Table 2 and the luminance factor shall exceed the corresponding minimum in Table 2.

5.1.2 Combined performance material

The chromaticity shall lie within one of the areas defined in Table 2 and the luminance factor shall exceed the corresponding minimum in Table 2.

The mean luminance factor of orientation sensitive retroreflective material shall comply with the requirements of Table 2 when measured at the two rotation angles defined in 7.3.

The chromaticity of orientation sensitive retroreflective material shall comply with the requirements of Table 2 when measured at the two rotation angles defined in 7.3.

Table 2 — Colour requirements for background and combined performance material

Colour	Chromaticity coordinates x	Chromaticity coordinates y	Minimum luminance factor $ß_{min}$
Fluorescent yellow	0,387 0,356 0,398 0,460	0,610 0,494 0,452 0,540	0,70
Fluorescent orange-red	0,610 0,535 0,570 0,655	0,390 0,375 0,340 0,345	0,40
Fluorescent red	0,655 0,570 0,595 0,690	0,345 0,340 0,315 0,310	0,25

5.2 Colour after xenon test

The colour after exposure shall be within the areas defined by the coordinates in Table 2 for background materials and combined performance materials and its luminance factor shall exceed the minimum value for the luminance factor of the colour that is obtained on exposure to xenon light e.g. a fluorescent red is acceptable if after exposure to xenon light its colour-co-ordinates are within the tolerated area for orange-red and if its luminance factor is higher than 0,4. The exposure of the test sample shall be performed according to ISO 105-B02:1994, method 3. Exposure shall continue until the blue scale control standard number 5 has changed to step 3 for red and orange-red materials and for yellow materials the blue scale control standard number 4 has changed to step 4 of the grey scale.

If the colour can change from one colourbox to another, this shall be mentioned in the instructions for use.

5.3 [A1] Colour fastness of background material and all non-fluorescent material layers after test exposure [A1]

5.3.1 Colour fastness to rubbing

[A1] The colour fastness (dry) when determined in accordance with ISO 105-A02 shall be at least step 4 of the grey scale. [A1] The test shall be conducted in accordance with ISO 105-X12.

5.3.2 Colour fastness to perspiration

The colour fastness when determined in accordance with ISO 105-A02 shall be at least step 4 of the grey scale for the colour change of the specimen; and when determined in accordance with ISO 105-A03 at least step 3 with respect to staining. The test shall be conducted in accordance with ISO 105-E04.

5.3.3 Colour fastness - when laundered, dry cleaned, hypochlorite bleached and hot pressed

[A1] According to the care recommendation of the garment the colour fastness shall be determined in accordance with the performance requirements and test methods of Table 3.

Table 3 — Colour fastnesses

Care process	Fastness grade of the grey scale at least		Test method
	Background material	Non-fluorescent material without reflective material and combined material	
Laundry	Colour change: 4 to 5 Staining: 4	Staining: 4 to 5	Domestic ISO 105-C06[a] or Industry ISO 105-C06, E 2S
Dry cleaning	Colour change: 4 Staining: 4	Staining: 4 to 5	ISO 105-D01
Hypochlorite bleaching	Colour change: 4		ISO 105-N01
Hot pressing	Colour change: 4 to 5 Staining: 4	Staining: 4	ISO 105-X11
[a] according to care recommendations			

NOTE In order to determine the colour fastness of non-fluorescent material it is recommended to select the single fibre adjacent fabric corresponding directly to the fibres of background material.

Specimens shall be dried hanging in air at a temperature not exceeding 60 °C with parts in contact only at the lines of the stitching. A1

5.4 Dimensional change of background material and non-fluorescent material

5.4.1 The requirements and testing procedures for dimensional change on materials shall comply with EN 340.

5.4.2 For knitted materials the dimensional change shall not exceed ± 5 % in both length and width.

5.5 Mechanical properties of background materials

5.5.1 Tensile strength of woven material

The tensile strength in weft and warp direction shall fulfil the following requirement:

— Tensile strength (in N) divided by specific fabric mass (in g/m^2) shall be ≥ 2 with a minimum of at least 400 N;

— Tensile strength shall be tested in accordance with EN ISO 13934-1.

5.5.2 Bursting strength of knitted materials

The minimum bursting strength shall be 800 kN/m². Bursting strength shall be tested in accordance with EN ISO 13938-1 using sample specimens of 30 mm diameter.

5.5.3 Tensile strength and tear resistance of coated fabrics and laminates

Background materials for high-visibility warning clothing shall fulfil the requirements of 5.5.1 for tensile strength. For materials with an elongation of more than 50 % this requirement is not applicable. Tear resistance shall be determined according to ISO 4674:1977, method A1, and have a minimum of 25 N.

5.6 〚A1〛 Water vapour resistance 〚A1〛

5.6.1 General

Background material for high-visibility warning clothing with the exception of harnesses, tabards and waistcoats shall be tested. The test shall be performed in accordance with EN 31092.

5.6.2 Background material made from coated fabrics or laminates

〚A1〛 The water vapour resistance shall be classified in accordance with EN 343:2003+A1. 〚A1〛

5.6.3 Background material made from textile fabrics

〚A1〛 The water vapour resistance shall not exceed 5 (m² · Pa/W). 〚A1〛

5.7 Ergonomics

The ergonomic requirements of EN 340 shall be met.

6 Photometric and physical performance requirements for the retroreflective material and combined performance material

6.1 Retroreflective performance requirements of new material

Separate performance retroreflective material and combined performance material shall comply with the requirements of [A1] Tables 4 or 5 and 6 [A1], as applicable, before test exposures. Measurements shall be made by the method described in 7.3.

When measured at the two rotation angles $\varepsilon_1 = 0°$ and $\varepsilon_2 = 90°$ materials having coefficients of retroreflection that differ by more than 15 % are defined as orientation sensitive.

Orientation sensitive material shall comply with the minimum requirements for the coefficient of retroreflection stated in [A1] Table 4 or 5 or Table 6 [A1], as appropriate, at one of the two rotation angles described in 7.3; and shall be not less than 75 % of the values stated in Table 4 or 5 or Table 6, as appropriate, at the other rotation angle.

[A1] Table 4 [A1] — Minimum coefficient of retroreflection in cd/(lx · m²) for separate performance material, level 2

Observation angle	Entrance angle $ß_1$ ($ß_2 = 0$)			
	5°	20°	30°	40°
12'	330	290	180	65
20'	250	200	170	60
1°	25	15	12	10
1°30'	10	7	5	4

[A1] Table 5 [A1] — Minimum coefficient of retroreflection in cd/(lx · m²) for separate performance material, level 1

Observation angle	Entrance angle $ß_1$ ($ß_2 = 0$)			
	5°	20°	30°	40°
12'	250	220	135	50
20'	120	100	75	30
1°	25	15	12	10
1°30'	10	7	5	4

[A1] Table 6 [A1] — Minimum coefficient of retroreflection in cd/(lx · m²) for combined performance material

Observation angle	Entrance angle $ß_1$ ($ß_2$ = 0)			
	5°	20°	30°	40°
12'	65	50	20	5
20'	25	20	5	1,75
1°	5	4	3	1
1°30'	1,5	1	1	0,5

The values for combined performance materials are for any colour.

6.2 Retroreflective performance requirements after test exposure

6.2.1 General

The samples tested in accordance with 6.1 shall be exposed as specified in [A1] Table 7 [A1]. After exposure each test specimen shall fulfil the photometric requirements of 6.2.2, 6.2.3 and 6.2.4, as applicable.

[A1] Table 7 [A1] — Test exposure

Exposure	**Separate performance retroreflective material**	**Combined performance material**
Abrasion	7.4.1	7.4.1
Flexing	7.4.2	7.4.2
Folding at cold temperatures	7.4.3	7.4.3
Temperature variation	7.4.4	7.4.4
Washing	7.4.5.2	7.4.5.2
Dry cleaning	7.4.5.3	--
Influence of rainfall	7.5	7.5

6.2.2 Separate performance material

The coefficient of retroreflection R' for separate performance retroreflective materials shall exceed 100 cd/(lx · m²) measured at observation angle 12' and entrance angle 5°.

6.2.3 Combined performance material

The coefficient of retroreflection R' for combined performance material shall exceed 30 cd/(lx · m²) measured at observation angle 12' and entrance angle 5°. When determining the influence of rainfall in accordance with clause 7.5, coefficient of retroreflection shall exceed 15 cd/ (lx · m²).

6.2.4 Orientation sensitive materials

The coefficient of retroreflection R' for orientation sensitive material after exposure shall comply with the same requirements of clause 6.2.2 or 6.2.3, as appropriate, at one of the two orientations described in 7.3 and shall be not less than 75 % of those required values at the other orientation.

7 Test methods

7.1 Sampling and conditioning

Specimens: Test specimens shall be taken at random from commercially available quantities representative of commercially available quality.

Specimens preparation: The size, shape and quantity, shall be as required for each test procedure.

Number of tests: Unless otherwise specified, one specimen of each material must be tested and must comply with the minimum requirements.

Conditioning of specimens: The specimens shall be conditioned for at least 24 h at (20 ± 2) °C and (65 ± 5) % relative humidity. If the test is carried out in other conditions, the test shall begin within 5 min after withdrawal from the conditioning atmosphere.

7.2 Determination of colour

The colour shall be measured in accordance with the procedures defined in CIE publication No. 15.2, using an instrument with polychromatic illumination (CIE D65 illuminant). The instrument shall have a 45/0 illuminating and viewing geometry. The colour coordinates shall be determined using CIE standard illuminant D65 and 2° standard observer (=CIE 1931 standard colorimetric observer). The specimen shall be measured with a single layer including any backing or lining used in its constructions and backed by a black underlay with a reflectance of less than 0,04.

7.3 Method for determination of retroreflective photometric performance

The coefficient of retroreflection R' shall be determined in accordance with the procedure defined in CIE publication No. 54.2. Measurements shall be made on square samples of 10 cm x 10 cm or of the size of the pre-tested samples.

R' for the sample shall be measured at two positions of the rotation angle ε, 0° and 90° and at an observation angle of 12' with an entrance angle of 5°. The Position 0° is determined by one of the following means:

— a clear datum mark on each sample;

— a clear instruction given by the manufacturer of the material;

If no mark or instruction exists, the position ε = 0° can be chosen at random.

7.4 Retroreflection after exposure

7.4.1 Abrasion

The test sample shall be abraded in accordance with EN 530:1994, method 2, using the woolen fabric abradant. The specimens shall be measured after 5 000 cycles and at a pressure of 9 kPa.

7.4.2 Flexing

The test sample shall be flexed in accordance with EN ISO 7854:1997 method A. The specimens shall be measured after 7 500 cycles.

7.4.3 Folding at cold temperatures

The test sample shall be exposed and folded in accordance with ISO 4675 at a temperature of (-20 ± 1)°C.

Measurements shall be made after reconditioning to the atmosphere in accordance with 7.1 for at least 2 h.

7.4.4 Exposure to temperature variation

Specimens of the size of 180 mm x 30 mm shall be exposed continuously to a cycle of changing temperatures:

a) for 12 h at (50 ± 2) °C immediately followed by

b) 20 h at (-30 ± 2) °C

c) Conditioning for at least 2 h in accordance with 7.1.

7.4.5 Washing, dry cleaning

7.4.5.1 General

When the care label in the garment indicates that it is suitable for washing, the procedure defined in 7.4.5.2 shall be applied. When the care label in the garment indicates that it is suitable for dry cleaning, the procedure defined in 7.4.5.3 shall be applied. When the care label indicates that the garment is suitable for both washing and dry cleaning, the procedure defined in 7.4.5.2 and 7.4.5.3 shall be applied separately on separate test samples.

7.4.5.2 Washing according to care label

3 background material specimen 300 mm x 250 mm shall be prepared with 2 stripes of retroreflective material, each 250 mm x 50 mm, distance between the two stripes 50 mm.

a) Separate performance retroreflective material:

   The test samples shall be washed in accordance with EN ISO 6330:2000, method 2A.

   The specified wash cycle shall be applied to the test sample for the number of times stated in the label (see clauses 8 and 9). After the last wash cycle the samples will be dried, stress free, at (50 ± 5) °C.

b) Combined performance material:

   The test samples shall be washed in accordance with EN ISO 6330:2000, method 5A.

The specified wash cycle shall be applied to the test sample for the number of times stated in the label (see clauses 8 and 9). After the last wash cycle the samples will be dried, stress free at (50 ± 5) °C.

7.4.5.3 Dry cleaning according to care label

Samples are prepared in accordance with 7.4.5.2.

The test sample shall be dry cleaned in accordance with EN ISO 3175-2:1998, method 8.1. The test sample shall be cleaned for the number of cleaning cycles stated in the care label (see clauses 8 and 9).

7.4.5.4 Industrial laundering according to manufacturers recommendations

The test procedure is described in [A1] Annex B [A1].

7.5 Retroreflective performance in rainfall

Samples shall be tested in accordance with [A1] Annex C [A1] of this standard.

If the material is orientation-sensitive when dry, measurements shall be made at the rotation angle which gave the lowest measured performance when dry.

8 Marking

The marking requirements defined in EN 340 shall be met.

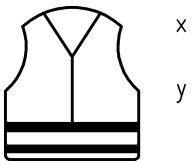


Figure 1 — Pictogram

NOTE The first number beside the pictogram (here X) indicates the garment class in accordance with Table 1, the second number (here Y) indicates the level of retroreflective material performance in accordance with [A1] Table 4 [A1] or [A1] Table 5 [A1].

9 Information supplied by the manufacturer

The requirements defined in EN 340 shall be met.

Annex A
(informative)

Examples for positioning of bands of retroreflective material

The following examples may be used for the design as indicated in 4.1.

Note Other models may also comply.

Dimensions in millimetres

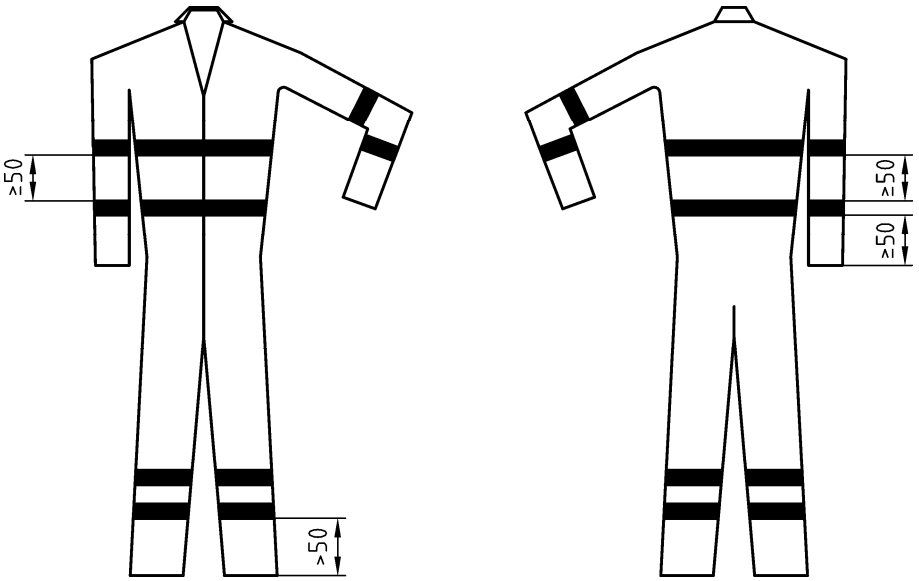


Figure A.1 — Example of a coverall

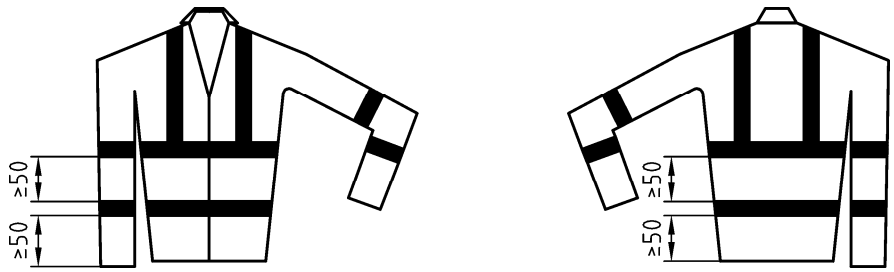


Figure A.2 — Example of a jacket

Dimensions in millimetres

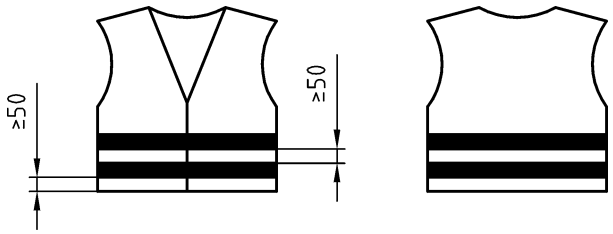


Figure A.3 — Example of a waistcoat

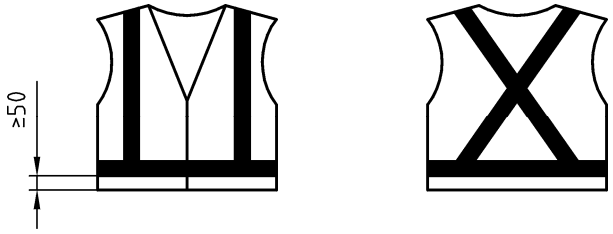


Figure A.4 — Example of a waistcoat

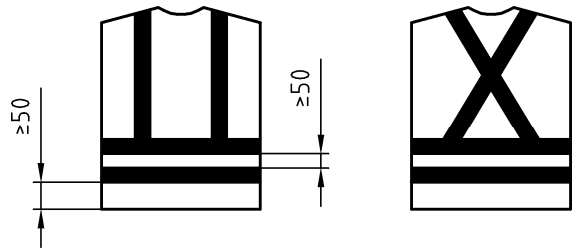


Figure A.5 — Example of a tabard

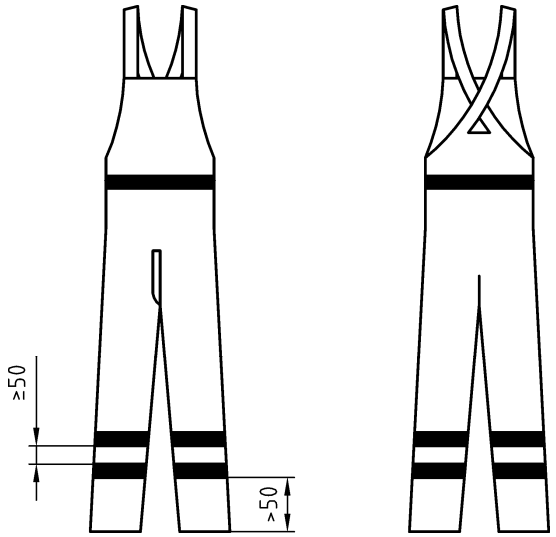


Figure A.6 — Example of a bib and brace trouser

Dimensions in millimetres

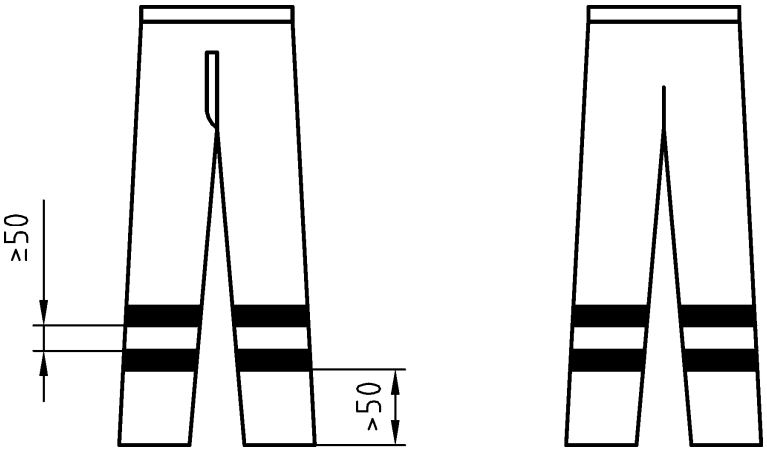


Figure A.7 — Example of a waistband trouser

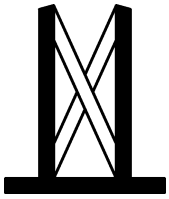


Figure A.8 — Example of a harness

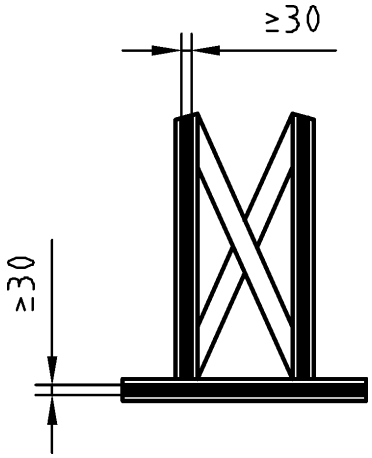


Figure A.9 — Example of a harness

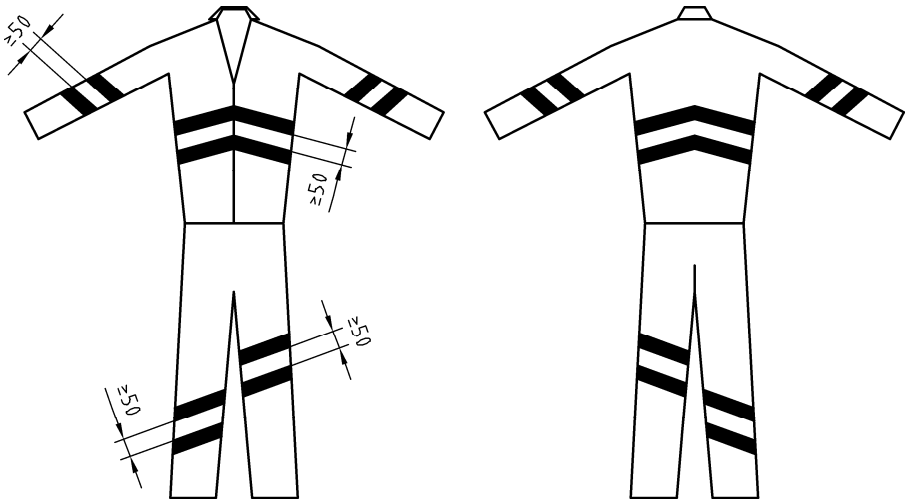


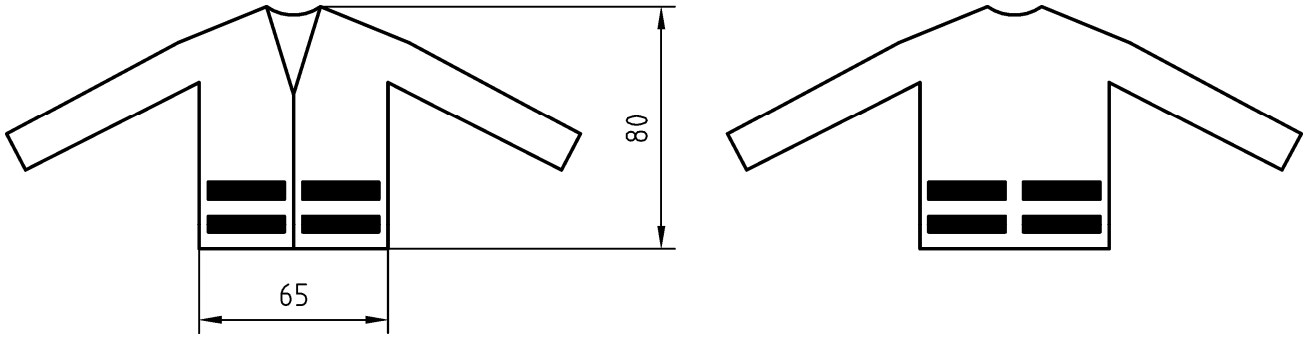
Figure A.10 — Example of coverall (with bands of retroreflective material at an inclination ≤ 20°)

〚A1〉 *deleted text* 〈A1〛

Annex B
(normative)
Positioning of bands of retroreflective material on jackets

Bands of retroreflective materials 250 mm x 50 mm shall be applied on a jacket. The positioning of the bands shall be as shown on the drawing. The distance between the bands and to the bottom edge should be at least 50 mm.

Dimensions in centimetres



〈A1〉 Figure B.1 〈A1〉— Jacket for industrial wash test

The specimen shall be washed according to ISO 15797:2002, Table 4, Method 8, for 5 cycles. Neutralisation shall be in accordance with the manufacturer's recommendation in order to reach the pH of 5,5 minimum. The coefficient of retroreflection R' shall be calculated as average of measurement on the 8 bands and shall fulfil the photometric requirements of 6.2.2, 6.2.3 and 6.2.4, as applicable.

Annex C
(normative)

Method of measuring wet retroreflective performance

C.1 Principle

A specimen of the material is mounted in a vertical plane and subjected to a continuous spray of water droplets.

Measurements are made of the coefficient of retroreflection of the wetted surface while the spray is maintained, simulating the optical behaviour of a surface in a shower of rain.

C.2 Apparatus

A suitable apparatus for mounting the specimen in the spray of water is illustrated in [A1] Figure C.1 [A1].

The specimen 1 is supported on the vertical specimen holder 2 above the catch trough 3 and drain 4. The specimen holder is rigidly attached to the goniometer table (not shown) but is held away from it. The spray nozzle 5 is rigidly supported in a position which is fixed relative to the specimen and is supplied with tap water at constant but adjustable pressure through a flexible joint 6 or hose.

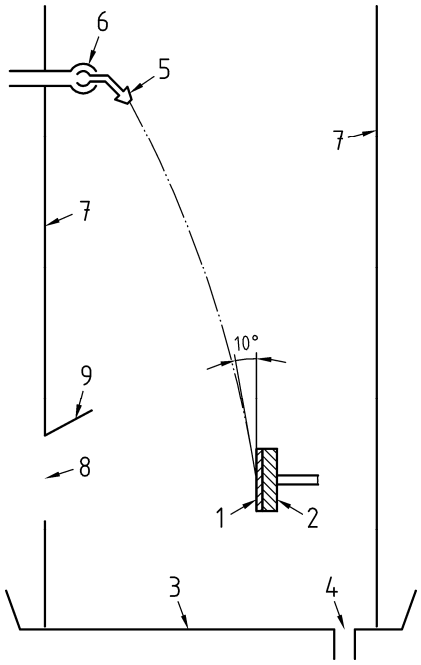
The nozzle is one metre from the specimen and is so angled that the spray strikes the specimen at an angle of 10° to the vertical. The specimen, specimen holder and spray nozzle are enclosed in a cover 7 designed to protect the optical apparatus from water.

Preferably, the cover is made of or incorporates large areas of rigid transparent plastics material for visibility and has at least one removable panel or door for access. A square aperture 8 of side 150 mm is provided for the light path and a gutter 9 protects this aperture from falling water. The region of the cover near to this aperture is painted matt black to reduce stray reflections. The nozzle consists of an orifice of diameter 1,19 mm with an appropriately designed feed pipe producing a substantially uniform solid cone spray.

C.3 Procedure

Calibrate the apparatus for measuring the coefficient of retroreflection R', with the wet testing apparatus in place, under both dry and wet conditions and determine a correction for change in stray light between these two conditions.

Mount a flat, square specimen of the material of side not less than 50 mm in a vertical plane on the vertical specimen holder so that the holder does not protrude beyond the edge of the specimen at any point. If the material is orientation sensitive when dry, as described in 6.1, mount it so that measurements can be made at the orientation which gave the lowest performance when dry. Adjust the nozzle and water supply to subject the specimen to a spray of ordinary tap water such that the whole face of the specimen is within the envelope of the spray, the angle 8 between the surface of the specimen and the water striking it is not less than 5°, and the flow rate striking the specimen is equivalent to a rainfall, in millimetres per hour, of $50/\tan \Theta$ as measured in a horizontal collector. Maintain the spray in a steady state for at least 2 min before and throughout the measurement.



Key

1 Specimen
2 Holder
3 Catch through
4 Drain
5 Spray nozzle
6 Flexible joint
7 Cover
8 Aperture
9 Gutter

Figure C.1 — Apparatus for the wet retroreflection test

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 Free 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 clauses of this European Standard given in Table ZA.1 are likely to support requirements of Directive 89/686/EEC, Annex II:

Table ZA.1 — Correspondence between this European Standard and EU Directive 89/686/EEC

Basic Requirement of EU Directive 89/686/EEC, Annex II	Clauses of this standard
1.1.1. Ergonomics	4.2
1.1.2.1. Highest level of protection possible	4.2
1.1.2.2. Classes of protection appropriate to different levels of risk	4.1
1.3.1. Adaptation of PPE to user morphology	4.3
1.3.2. Lightness and design strength	5.5
2.2. PPE "enclosing" the parts of the body to be protected	5.6
2.4. PPE subject to ageing	5.2; 5.3; 5.4; 6.2
2.12. PPE bearing one or more identification or recognition marks directly or indirectly relating to health and safety	8
2.13. PPE capable of signalling the users presence visually	5.1; 6.1; 7.5

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

Bibliography

[A1] *deleted text* [A1]

EN 1150, *Protective clothing - Visibility clothing for non- professional use - Test methods and requirements*

[A1] EN ISO 3758, *Textiles - Care labelling code using symbols (ISO 3758:2005)* [A1]

EN ISO 3759, *Textiles —Preparation, marking and measuring of fabric specimens and garments in tests for determination of dimensional change (ISO 3759:1994)*

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