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Dobro vidna opozorilna obleka za poklicno uporabo – Preskusne metode in zahteve

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

Warnkleidung - Prüfverfahren und Anforderungen

Vetements de signalisation a haute visibilité pour usage professionnel - Méthodes d'essai et exigences

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

Vêtements de signalisation à haute visibilité - Méthode d'essai et exigences

Warnkleidung - Prüfverfahren und Anforderungen

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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 Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This document (EN 471:2003) 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of an identical text or by endorsement, at the latest by March 2004, and conflicting national standards shall be withdrawn at the latest by March 2004.

This document supersedes EN 471:1994.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

Annexes C and D are normative and Annexes A and B are informative.

This document includes a Bibliography.

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

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

EN 340, *Protective clothing — General requirements*

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 to 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		Minimum luminance factor
	x	y	β_{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 Colour fastness of background material and non-fluorescent material after test exposure

5.3.1 Colour fastness to rubbing

The colour fastness (dry and wet) when determined in accordance with ISO 105-A02 shall be at least step 4 of the grey scale. 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

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, with the exception of the domestic laundry test, where the minimum water temperature shall be 60°C.