



**SLOVENSKI STANDARD**  
**SIST EN 471:2003+A1:2008**  
**01-maj-2008**

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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

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

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**Ta slovenski standard je istoveten z: EN 471:2003+A1:2007**

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**ICS:**

13.340.10

**SIST EN 471:2003+A1:2008**

**en,fr,de**

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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.

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**Contents**

Page

Foreword.....4

Introduction .....5

1 Scope .....6

2 Normative references .....6

3 Terms and definitions .....7

4 Design .....8

4.1 Types and classes .....8

4.2 Specific design requirements.....8

4.3 Sizes .....9

5 Requirements for background material, non-fluorescent material and combined performance materials .....9

5.1 Colour performance requirements of new materials .....9

5.1.1 Background material .....9

5.1.2 Combined performance material.....9

5.2 Colour after xenon test .....10

5.3 **A1** Colour fastness of background material and all non-fluorescent material layers after test exposure **A1** .....10

5.3.1 Colour fastness to rubbing .....10

5.3.2 Colour fastness to perspiration .....10

5.3.3 Colour fastness - when laundered, dry cleaned, hypochlorite bleached and hot pressed .....10

5.4 Dimensional change of background material and non-fluorescent material .....12

5.5 Mechanical properties of background materials .....12

5.5.1 Tensile strength of woven material .....12

5.5.2 Bursting strength of knitted materials.....12

5.5.3 Tensile strength and tear resistance of coated fabrics and laminates .....12

5.6 **A1** Water vapour resistance **A1** .....12

5.6.1 General.....12

5.6.2 Background material made from coated fabrics or laminates.....12

5.6.3 Background material made from textile fabrics .....12

5.7 Ergonomics .....12

6 Photometric and physical performance requirements for the retroreflective material and combined performance material .....13

6.1 Retroreflective performance requirements of new material .....13

6.2 Retroreflective performance requirements after test exposure .....14

6.2.1 General.....14

6.2.2 Separate performance material .....14

6.2.3 Combined performance material.....15

6.2.4 Orientation sensitive materials .....15

7 Test methods.....15

7.1 Sampling and conditioning.....15

7.2 Determination of colour .....15

7.3 Method for determination of retroreflective photometric performance .....15

7.4 Retroreflection after exposure .....16

7.4.1 Abrasion .....16

7.4.2 Flexing .....16

7.4.3 Folding at cold temperatures .....16

7.4.4 Exposure to temperature variation .....16

7.4.5 Washing, dry cleaning.....16

7.5	<b>Retroreflective performance in rainfall</b> .....	17
8	<b>Marking</b> .....	17
9	<b>Information supplied by the manufacturer</b> .....	17
	<b>Annex A (informative) Examples for positioning of bands of retroreflective material</b> .....	18
	<b>Annex B (normative) Positioning of bands of retroreflective material on jackets</b> .....	23
	<b>Annex C (normative) Method of measuring wet retroreflective performance</b> .....	24
C.1	<b>Principle</b> .....	24
C.2	<b>Apparatus</b> .....	24
C.3	<b>Procedure</b> .....	24
	<b>Annex ZA (informative) Clauses of this European Standard addressing essential requirements or other provisions of EU Directives</b> .....	26
	<b>Bibliography</b> .....	27

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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.

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## 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.

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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*

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

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  $\varepsilon_1 = 0^\circ$  and  $\varepsilon_2 = 90^\circ$

#### 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 m<sup>2</sup>**

	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 %  $\pm$  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  $\pm 20^\circ$ .
- b) Jackets, waistcoats, shirts, coats and tabards shall have two bands of retroreflective material with a maximum inclination of  $\pm 20^\circ$  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  $\pm 20^\circ$  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  $\pm 20^\circ$  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  $\pm 20^\circ$  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  $\pm 20^\circ$  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.

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### 4.3 Sizes

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

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## 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.