SLOVENSKI STANDARD
SIST EN 471:1996

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Dobro vidna opozorilna obleka

High-visibility warning clothing

Warnkleidung

Vetements de signalisation a haute visibilité

Ta slovenski standard je istoveten z: EN 471:1994

ICS:

13.340.10 Varovalna obleka Protective clothing

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English version

High-visibility warning clothing

Vêtements de signalisation à haute visibilité — Hochsichtbare Warnkleidung

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CEN

European Committee for Standardization
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Europäisches Komitee für Normung

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Foreword

This European Standard has been prepared by the Technical Committee CEN/TC 162 "Protective clothing including hand and arm protection and lifejackets", the secretariat of which is held by DIN.

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

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of an identical text or by endorsement, at the latest by September 1994, and conflicting national standards shall be withdrawn at the latest by September 1994.

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given only for information. In this standard, annex A is normative and annex B is informative.

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

0 Introduction

Regulations for the design and use of High-visibility warning clothing vary among European Countries.

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 classes 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 class of retroreflecting material should be used.

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.

Attention is drawn to a draft European Standard, prEN 1150, which specifies characteristics and properties for high-visibility garments for non-professional use.

1 Scope

This standard specifies requirements for 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. Test methods ensure that a minimum level of protection is maintained when the garments are subjected to care procedures.

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.

EN 340 :1993	Protective clothing - General requirements
prEN 343 :1993	Protective clothing against Foul Weather
prEN 530 :1991	Abrasion resistance of protective clothing material
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	Textiles - Tests for colour fastness - Part B02: 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-N	Textiles - Tests for colour fastness - Part N: Colour fastness to bleaching agencies
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 2960	Textiles - Determination of bursting strength and bursting distension - Diaphragm method
ISO 3175	Textiles - Determination of dimensional change on dry cleaning in perchlorethylene - Machine method
ISO 3758	Textiles - Care labelling code using symbols
ISO 3759:1984	Textiles - Preparation, marking and measuring of fabric specimens and garments in tests for determination of dimensional change
ISO 4675	Rubber- or plastics-coated fabrics - Low-temperature bend test
ISO 5081	Textiles - Woven fabrics - Determination of breaking strength and elongation (Strip method)

ISO 6330	Textiles - Domestic washing and drying procedures for textile testing
ISO 7854	Rubber or plastic coated fabrics - Determination of resistance to damage by flexing (dynamic method)
CIE 15.2 :1968	Colorimetry
CIE 17.4 :1987	International lighting vocabulary
CIE 54 :1982	Retroreflection: Definition and measurement

3 Definitions

For the purposes of this standard, the following 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.

3.2. Photometric terms

The photometric terms used in this document are defined in CIE Publication No 17.4:1987 and No 54:1982.

4 Design

4.1 Types and classes

The warning clothing is grouped into three classes. Each class shall have minimum areas of materials incorporated in the garment in accordance with table 1. Garments shall comprise the required areas of background material and retroflective material or alternatively shall comprise the required area of combined performance material. Examples are illustrated in annex B.

Table 1: Minimum areas of visible material in m²

	Class 3 garments	Class 2 garments	Class 1 garments
Background material	0,8	0,50	0,14
Retroreflective material	0,2	0,13	0,10
Combined performance material	—	—	0,20

4.2 Specific design requirements

4.2.1 With the exception of tabards, background material shall encircle the torso and sleeves and trouser legs horizontally.

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.

4.2.3 a) Coveralls shall have two horizontal bands of retroreflective material not less than 50 mm apart around the torso.

b) Jackets, waistcoats and tabards shall have two horizontal bands of retroreflective material not less than 50 mm apart around 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 or tabard.

Or/alternatively

c) Jackets, waistcoats and tabards shall have one horizontal band of retroreflective material around 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 or tabard.

Or/alternatively

d) Jackets, waistcoats and tabards shall have two horizontal bands of retroreflective material not less than 50 mm apart around the torso. The bottom of the bottom torso band shall be not less than 50 mm above the bottom edge of the jacket, waistcoat or tabard.

4.2.4 Coveralls and jackets with full length sleeves shall be encircled by two bands of retroreflective material which shall be placed at the same height on the garment as those on the torso. The upper band shall encircle the upper part of the sleeves between the elbow and the shoulder, 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 not less than 50 mm apart, encircling horizontally each leg, so that the top of the upper band shall be not more than 350 mm above the bottom of the trouser leg and 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 shall have one band of retroreflective material around the torso.

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 Gaps in retroreflective, combined performance and background materials to enable fastening shall be not more than 50 mm horizontally.

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 sizes shall be in accordance with the requirements of EN 340:1993.

5 Requirements for background material and combined performance materials

5.1 Colour

5.1.1 New 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 New combined performance material

The chromaticity shall lie within one of the areas defined in table 3 and the luminance factor shall exceed the corresponding minimum in table 3.

The mean luminance factor of orientation sensitive retroreflective material shall comply with the requirements of table 3 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 3 when measured at the two rotation angles defined in 7.3

Table 2: Colour, background material

Colour	Chromaticity co-ordinates x	Chromaticity co-ordinates y	Minimum luminance factor β_{min}
fluores-cent Yellow	0,387 0,356 0,398 0,460	0,610 0,494 0,452 0,540	0,76
fluores-cent Orange-Red	0,610 0,544 0,579 0,655	0,390 0,376 0,341 0,344	0,40
fluores-cent Red	0,655 0,579 0,606 0,690	0,344 0,341 0,314 0,310	0,25

Table 3: Colour, combined performance material

Colour	Chromaticity co-ordinates x	Chromaticity co-ordinates y	Minimum luminance factor β_{min}
fluores-cent Yellow	0,387 0,356 0,398 0,460	0,610 0,494 0,452 0,540	0,70
fluores-cent Orange-Red	0,610 0,535 0,570 0,655	0,390 0,375 0,340 0,344	0,40
fluores-cent Red	0,655 0,570 0,595 0,690	0,344 0,340 0,315 0,310	0,25

5.1.3 Colour after xenon test

The colour after exposure shall be within the areas defined by the coordinates in table 2 for background materials and table 3 for combined performance materials and the luminance factor shall be not less than the corresponding minimum values in table 2 and table 3.
The light fastness of the test sample shall be determined in accordance with ISO 105-B02 Method 1. 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.

5.2 Colour fastness of background material

5.2.1 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.

5.2.2 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.

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

When the Care label requirements are as specified in table 4 the colour fastness shall be determined in accordance with the performance requirements and test methods stated in table 4.

Table 4: Colour fastnesses

Care process	Fastness grade of the grey scale at least	Test method
domestic and commercial laundry	Colour change: 4 to 5 Staining: 3	ISO 105-C06 C2S
dry cleaning	Colour change: 4	ISO 105-D01
Hypochlorite bleaching	colour change: 4	ISO 105-N01
hot pressing	Colour change: 4 to 5 Staining: 4	ISO 105-X11