BRITISH STANDARD

BS EN
1150:1999

# Protective clothing — Visibility clothing for non-professional use — Test methods and requirements

The European Standard EN 1150:1999 has the status of a British Standard

ICS 13.340.10

# National foreword

This British Standard is the English language version of EN 1150:1999.

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, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

**Cross-references**

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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**Summary of pages**

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 8, an inside back cover and a back cover.

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EUROPEAN STANDARD

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# EN 1150

January 1999

ICS 13.340.10

Descriptors: personal protective equipment, accident prevention, garments, protective clothing, signalling, visibility, design, reflecting materials, characteristics, colour, colourfastness, physical properties, photometric properties, tests, maintenance, labelling, marking, graphic symbols

English version

# Protective clothing — Visibility clothing for non-professional use — Test methods and requirements

Vêtements de protection — Vêtements de visualisation à utilisation non professionnelle — Méthodes d'essai et exigences

Schutzkleidung — Warnkleidung für den nicht professionellen Gebrauch — Prüfverfahren und Anforderungen

This European Standard was approved by CEN on 20 December 1998.



**CEN**

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

**Central Secretariat: rue de Stassart 36, B-1050 Brussels**



Ref. No. EN 1150:1999 E

## Foreword

This European Standard 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 July 1999, and conflicting national standards shall be withdrawn at the latest by July 1999.

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(s).

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

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, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

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## Introduction

This European Standard provides details on the performance of high visibility warning clothing for non-professional use together with minimum areas and placement of material to achieve enhanced conspicuity against most background conditions found in urban and rural situations both day and night.

The area of material is dependant on the size of the wearer and conspicuity is enhanced by high contrast between the garment and the ambient background.

This standard is not intended to comply with the requirements of clothing used by professionals, attention should be drawn to EN 471 "High-visibility warning clothing", which specifies characteristics and properties for high-visibility warning clothing intended for the work-area, that is for professional use.

A European Standard for requirements and test methods for high-visibility accessories for non-professional use is under preparation.

## 1 Scope

This standard specifies the optical performance requirements for high-visibility clothing to be worn by adults and by juveniles, and designed for non-professional use. High-visibility clothing for non-professional use is intended to signal the user's presence visually in any daylight condition and when illuminated by vehicle headlights or search lights in the dark as well as lit up in urban roads.

This standard is not applicable to accessories to be carried by persons or attached to garments.

## 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, *Protective clothing — General requirements.*

EN 471:1994, *High-visibility warning clothing.*

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

EN 20105-B02, *Textiles — Tests for colour fastness — Part B02: Colourfastness to artificial light (Xenon arc fading lamp test).*
(ISO 105-B02:1988)

EN 23758, *Textiles — Care labelling code using symbols.*
(ISO 3758:1991)

EN ISO 105-C06:1997, *Textiles — Tests for colour fastness — Part C06: Colour fastness to domestic and commercial laundering.*
(ISO 105-C06:1994)

EN ISO 105-D01, *Textiles — Tests for colour fastness — Part D01: Colour fastness to dry cleaning.*
(ISO 105-D01:1993)

EN ISO 105-X11, *Textiles — Tests for colour fastness — Part X11: Colour fastness to hot pressing.*
(ISO 105-X11:1994)

EN ISO 3175:1995, *Textiles — Evaluation of stability to machine dry-cleaning.*
(ISO 3175:1995)

prEN ISO 6330:1997, *Textiles — Domestic washing and drying procedures for textile testing.*
(ISO/DIS 6330:1997)

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

ISO 7854:1995, *Rubbers- or plastics-coated fabrics — Determination of resistance to damage by flexing.*

CIE 15.2:1986, *Colorimetry.*

CIE 17.4:1987, *International lighting vocabulary.*

CIE 54:1982, *Retroreflection — Definition and measurement.*

## 3 Definitions

For the purposes of this standard the definitions for photometric terms according to CIE 17.4:1987 and CIE 54:1982 and the following definitions apply.

**3.1**

**high-visibility garment**

high-visibility garment, worn on the body, arms and the legs, intended to provide conspicuity at all times

NOTE Coats, jackets, suits and waistcoats are typical examples of high-visibility garments.

**3.2**

**fluorescent material**

material that absorbs optical radiation at shorter wavelengths and emits optical radiation at longer wavelengths

**3.3**

**background material**

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

**3.4**

**retroreflective material**

material from which the reflected rays are preferentially returned in the direction close to the opposite of the direction of the incident rays

**3.5**

**separate performance material**

material intended to be used as either background or retroreflective material

**3.6**

**combined performance material**

material intended to exhibit both background and retroreflective properties

**3.7**

**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 $\varepsilon_2 = 90°$

## 4 Design

### 4.1 General

Garments shall comprise the required areas of background materials and retroreflective materials or alternatively shall comprise the required area of combined performance material as given in Table 1. In the latter case the area of background material can be reduced by the applied area of combined performance material.

**Table 1 — Minimum areas of exposed material**

| Height $h$ cm | Area of background material $m^2$ | Area of retroreflective material $m^2$ | Area of combined performance material $m^2$ |
|---|---|---|---|
| $h \leq 104$ | 0,14 | 0,06 | 0,09 |
| $h \leq 121$ | 0,18 | 0,07 | 0,11 |
| $h \leq 140$ | 0,24 | 0,08 | 0,12 |
| $h \leq 158$ | 0,32 | 0,09 | 0,13 |
| $h \leq 176$ | 0,36 | 0,09 | 0,14 |
| $h > 176$ | 0,40 | 0,10 | 0,15 |

### 4.2 High-visibility clothing manufactured incorporating separate and combined performance material

#### 4.2.1 *Background material*

The total area of background material may comprise smaller areas of various colours as defined in Table 2.

The material shall be evenly distributed around the body and shall be applied so that the minimum width is not less than 50 mm. Any gap for fastening shall not be greater than 50 mm. The total of such gaps shall not be greater than 100 mm in any one band.

NOTE Maximum 360° visibility is achieved by applying the background material as a coherent area evenly distributed around the body at chest height.

#### 4.2.2 *Retroreflective material*

The retroreflective material shall be evenly distributed to all aspects of the body covered by the background material.

Retroreflective material may be applied in band, logo or other shape form. The individual minimum area of retroreflective material shall be not less than 25 $cm^2$ and the minimum width shall be not less than 25 mm. If the garment has sleeves retroreflective material shall be applied to the outer side of or around the arm corresponding to the amount of a 25 mm material band.

The material shall be evenly distributed to all aspects of the body covered by background material.

#### 4.2.3 *Combined performance material*

The material shall comply with the requirements of **4.2.1** or **4.2.2** according to the intended use.

## 5 Requirements for background material and combined performance material

### 5.1 General requirements

All requirements specified in EN 340 shall be fulfilled.

NOTE The small sizes are not specifically included in EN 340.

### 5.2 Colour

#### 5.2.1 *Colour of new background and combined performance material*

The colour and the luminance factor of new background and combined-performance material shall be within the regions given in Table 2 when tested in accordance with **7.2**.

**Table 2 — Colour coordinates for background material and combined performance material**

| Colour | Chromaticity coordinates | | Minimum luminance factor $\beta_{min}$ | |
|---|---|---|---|---|
| | x | y | Background material | Combined performance material |
| Fluorescent green | 0,026<br>0,170<br>0,285<br>0,201 | 0,399<br>0,364<br>0,441<br>0,776 | 0,40 | 0,33 |
| Fluorescent yellow-green | 0,201<br>0,285<br>0,356<br>0,387 | 0,776<br>0,441<br>0,494<br>0,610 | 0,50 | 0,40 |
| Fluorescent yellow | 0,387<br>0,356<br>0,398<br>0,460 | 0,610<br>0,494<br>0,452<br>0,540 | 0,76 | 0,70 |
| Fluorescent yellow-orange | 0,460<br>0,427<br>0,494<br>0,545 | 0,540<br>0,493<br>0,426<br>0,454 | 0,60 | 0,50 |
| Fluorescent orange | 0,545<br>0,494<br>0,544<br>0,610 | 0,454<br>0,426<br>0,376<br>0,390 | 0,50 | 0,40 |
| Fluorescent orange-red | 0,610<br>0,544<br>0,579<br>0,655 | 0,390<br>0,376<br>0,341<br>0,345 | 0,40 | 0,40 |
| Fluorescent red | 0,655<br>0,579<br>0,606<br>0,690 | 0,345<br>0,341<br>0,314<br>0,310 | 0,25 | 0,25 |
| Fluorescent pink | 0,655<br>0,435<br>0,372<br>0,495 | 0,345<br>0,335<br>0,272<br>0,155 | 0,40 | 0,30 |

**Table 3 — Colour fastness**

| Care process | Test method | Fastness grade of the grey scale at least |
|---|---|---|
| Domestic and commercial laundering | EN ISO 105-C06:1997, method C2S | Colour change: 4 to 5<br>Staining: 3 |
| Dry cleaning | EN ISO 105-D01 | Colour change: 4 |
| Hot pressing | EN ISO 105-X11 | Colour change: 4 to 5<br>Staining: 4 |

#### 5.2.2 *Colour for background and combined performance material after xenon test*

The colour after exposure shall be within the areas defined by coordinates given in the relevant Table 2. The luminance factor shall be not less than the values given in Table 2. The light fastness of the test sample shall be determined in accordance with EN 20105-B02. Exposure shall continue until the blue scale control standard number 4 has changed to step 4 of the grey scale.

### 5.3 Colour fastness of background material

When the care label requirements are as specified in Table 3 the colour fastness shall be determined in accordance with the performance requirements and test methods stated in Table 3.

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.

Hot pressing: samples shall be pressed in the dry state only. The hot pressing shall be tested in accordance with the ironing instructions on the garment care label.

“ • ” (110 ± 2) °C;
“ • • ” (150 ± 2) °C;
“ • • • ” (200 ± 2) °C.

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

### 6.1 Retroreffective performance requirements of new material

Retroreflective and combined performance material shall comply with the requirements of Table 4 or Table 5, as applicable, before the test exposure.

**Table 4 — Minimum coefficient of retroreflection for retroreflective material**

Values in cd $lx^{-1}$ $m^{-2}$

| Observation angle | Entrance angle $\beta_1$ ($\beta_2$ = 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 |

**Table 5 — Minimum coefficient of retroreflection for combined performance material**

Values in cd $lx^{-1}$ $m^{-2}$

| Observation angle | Entrance angle $\beta_1$ ($\beta_2$ = 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 |

Orientation sensitive materials shall comply with the minimum requirements for the coefficient of retroreflection (Tables 4 and 5) at one of the two orientations described in **7.3** and shall not be less than 75 % of the table values at the other orientation.

### 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 Table 6. After exposure each test specimen shall fulfill the photometric requirements of **6.2.2**, **6.2.3** and **6.2.4**, as applicable.

**Table 6 — Test exposure**

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

#### 6.2.2 *Retroreflective material*

The coefficient of retroreflection $R'$ for retroreflective material shall exceed 100 cd $lx^{-1}$ $m^{-2}$ 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 $lx^{-1}$ $m^{-2}$ measured at observation angle 12′ and entrance angle 5°. When determining the influence of rainfall in accordance with **7.5**, the coefficient of retroreflection for retroreflective material shall exceed 15 cd $lx^{-1}$ $m^{-2}$.

#### 6.2.4 *Orientation sensitive material*

The coefficient of retroreflection $R'$ for orientation sensitive material after exposure shall comply with the same requirements of **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: samples shall be taken at random from commercially available quantities representative of commercially available quality.

Samples preparation: the size, shape and quantity shall be as required for each specific test method.

Number of tests: unless otherwise specified, one sample of each material shall be tested and shall comply with the minimum requirements.

Conditioning of samples: the specimens shall be conditioned for at least 24 h at (20 ± 2) °C and (65 ± 5) % relative humidity. If the tests are carried out in other conditions, the tests shall be conducted 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 15.2:1986 with polychromatic standard illuminate $D_{65}$ and 45/0 geometry and for the CIE 2° standard observer. The samples shall have a black underlay with a luminance factor 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 54:1982.

Measurements shall be made on square samples of 100 mm × 100 mm or of the size of the pretested samples.

R′ for the sample shall be measured at two positions of the rotation angle $\varepsilon = 0°$ 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 two means:

a) a clear datum mark on each sample;

b) a clear instruction given by the manufacturer of the material.

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

### 7.4 Retroreflection after exposure

#### 7.4.1 *Abrasion*

The test samples shall be abraded in accordance with method 2 of EN 530:1994, using the woollen fabric abradant. The specimens shall be measured after 5 000 cycles.

#### 7.4.2 *Flexing*

The flexing pretreatment shall be done according to method A of ISO 7854:1995. The specimens shall be tested for 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 × 30 mm shall be exposed continuously to 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 according to **7.1**.

#### 7.4.5 *Washing and 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 the procedure in **7.4.5.3** shall be applied separately on separate test samples.

##### 7.4.5.2 *Washing*

Three clothing fabric specimens 300 mm × 250 mm of separate performance material or combined performance material, suitable for a washing temperature of 60 °C, shall be prepared with two stripes of separate performance or combined performance material, each 250 mm × 50 mm, distance between the two stripes: 50 mm.

The samples shall be washed in accordance with method 2A of prEN ISO 6330:1997.

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, stressfree, at (50 ± 5) °C.

##### 7.4.5.3 *Dry cleaning*

The test samples are prepared in accordance with **7.4.5.2**.

The test samples shall be dry cleaned according to method 9.1 of EN ISO 3175:1995. The test samples shall be cleaned for the number of cleaning cycles stated in the care label (see clauses **8** and **9**).

### 7.5 Retroreflective performance in rainfall

The material shall be tested in accordance with annex A of EN 471:1994.

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 Care labelling

Washing or cleaning instructions shall be indicated in accordance with EN 23758 as relevant.

The maximum number of processes shall be stated after "max." next to the care labelling.

Example: max. 25 ×

## 9 Marking

### 9.1 General

If the manufacturer intends to indicate that the manufacturer's instructions have to be consulted, then an "i" in a square frame shall be placed in front of the care symbols of EN 23758.

### 9.2 General marking

Each piece of protective clothing shall be marked.

The marking shall be:

a) on the product itself or printed on labels attached to the product;

b) affixed so as to be visible and legible;

c) durable for the appropriate number of cleaning processes.

The marking shall not use characters smaller than 2 mm and should be clearly legible. It is recommended that they should be black on a white background.

### 9.3 Specific marking

The marking shall include the following information:

a) name, trade mark or other means of identification of the manufacturer or his authorized representative;

b) designation of the product type, commercial name or code;

c) size designation according to EN 340;

d) number of this European Standard (EN 1150).

## 10 Information supplied by the manufacturer

Warning clothing shall be supplied to the customer accompanied by information written in the official language(s) of the state of destination.

The following information shall be provided as a minimum:

a) the means of donning and removing the garment;

b) an indication of the environment in which the garment is to be used;

c) cautionary note on any limitations on use of the garment;

d) storage advice;

e) procedures for washing and dry cleaning;

f) recommended maintenance checks including their frequency;

g) statutory note concerning misuse.

## 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 standard.

The following clauses of this standard are likely to support requirements of Directive 89/686/EEC, Annex II:

| EU Directive 89/686/EEC, Annex II | Clauses of this standard |
|---|---|
| 1.1 Design principles | **4** and **5** |
| 1.3 Comfort and efficiency | See clauses **3**, **4** and **5** of EN 340 |
| 1.4 Information supplied by the manufacturer | **8**, **9** and **10** |
| 2.2 PPE "enclosing" the parts of the body to be protected | **4** and **5** |
| 2.4 PPE subject to ageing | **5** |
| 2.13 PPE in the form of clothing capable of signalling the user's presence visually | **4**, **5** and **6** |

Compliance with the clauses of this standard provides one means of conforming with the specific essential requirements of the Directive concerned and associated EFFA regulations.

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