

BS 8442:2015



BSI Standards Publication

# Miscellaneous road traffic signs and devices – Requirements and test methods

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## Contents

Foreword *iii*

1	Scope	1
2	Normative references	1
3	Terms and definitions	2
4	Information and requirements to be agreed and documented	4
5	Self-supporting rigid portable signs, other than barriers	4
6	Portable barriers	5
7	Self-supporting flexible portable signs	6
8	Manually operated portable "Stop/Go" and "Stop Works" signs	6
9	Portable school crossing patrol signs	7
10	Portable flat traffic delineators (FTDs)	7
11	Fixed, permanent, manually operated flap signs	8
12	Fixed, permanent pedestrian crossing and refuge beacons and twin amber flashing lights	8
13	Retroreflective self-righting bollards (RSRBs)	14
14	Marking and information	19
15	Information to be supplied by the manufacturer	20

### Annexes

Annex A (normative)	Retroreflective sheeting materials	21
Annex B (normative)	Ballast for self-supporting rigid and flexible portable signs, and classification and labelling of barrier units	23
Annex C (normative)	Calculation of minimum recommended ballast required to resist overturning and sliding of self-supporting rigid portable signs	25
Annex D (informative)	Classes of wind speed	27
Annex E (normative)	Test for overturning and sliding performance of self-supporting rigid portable signs	27
Annex F (informative)	Calculation of minimum recommended ballast required to resist overturning and sliding of barrier units	29
Annex G (normative)	Test for impact resistance of flat traffic delineators (FTDs) at low temperature	30
Annex H (normative)	Test for bending resistance of flat traffic delineators (FTDs)	31
Annex I (normative)	Test for fatigue resistance of flat traffic delineators (FTDs)	32
Annex J (normative)	Measurement of the luminance of internally illuminated posts	33
Annex K (normative)	Determination of mean luminance and uniformity of luminance	34

Bibliography 35

### List of figures

Figure 1	– Projected area	3
Figure 2	– Luminance measurement	10
Figure 3	– Adhesion test	16
Figure 4	– Location of the central sign centre	18
Figure C.1	– Overturning moment diagram	26
Figure E.1	– Test apparatus for stability and sliding performance	28
Figure F.1	– Resistance to overturning diagram	29

### List of tables

Table 1	– Classification of effective wind speeds $V_e$	4
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Table 2 – Physical properties of substrate material	6
Table 3 – Chromaticity coordinates and luminance factors of globes	9
Table 4 – Luminance of posts	12
Table 5 – Chromaticity of amber light units	13
Table 6 – Projected area of the conspicuity panels	15
Table 7 – Daytime chromaticity and luminance factor	16
Table 8 – Surface protection	17
Table 9 – Mean luminance, $L$ , $\text{cd}\cdot\text{m}^{-2}$	17
Table 10 – Luminance contrast, $K$ , lit traffic sign	18
Table 11 – Protection from foreign objects and water	18
Table A.1 – Minimum coefficient of retroreflection (Class R3B-UK) (unit $\text{cd}\cdot\text{lx}^{-1}\cdot\text{m}^{-2}$ )	22
Table A.2 – Exposure period for accelerated natural weathering	23
Table B.1 – Ballast required for wind resistance of temporary signs	24
Table B.2 – Ballast required for wind resistance of barrier assembly	24
Table C.1 – Values of $C_w$	25
Table C.2 – Values of $S$	25

### Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 36, an inside back cover and a back cover.

## Foreword

### Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 November 2015. It was prepared by Subcommittee B/509/3, *Construction of road traffic signs*, under the authority of Technical Committee B/509, *Road equipment*. A list of organizations represented on these committees can be obtained on request to their secretary.

### Supersession

This British Standard supersedes BS 8442:2006, which is withdrawn.

### Product certification/inspection/testing

Users of this British Standard are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this British Standard. Appropriate conformity attestation arrangements are described in BS EN ISO/IEC 17025. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

### Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

Requirements in this standard are drafted in accordance with *Rules for the structure and drafting of UK standards*, subclause J.1.1, which states, "Requirements should be expressed using wording such as: 'When tested as described in Annex A, the product shall ...'". This means that only those products that are capable of passing the specified test will be deemed to conform to this standard.

### Contractual and legal considerations

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.

Particular attention is drawn to the following specific regulations:

- a) The Traffic Signs Regulations and General Directions (TSRGD) [1]
- b) The School Crossing Patrol Sign (Scotland) Regulations 2002 [2]
- c) The School Crossing Patrol Sign (England and Wales) Regulations 2006 [3]
- d) The Low Voltage Directive (LVD) 2006/95/EC [4]
- e) The Zebra, Pelican and Puffin Pedestrian Crossings Regulations and General Directions 1997 [5]



## 1 Scope

This British Standard specifies requirements and tests (see Note) for rigid and flexible portable signs, barriers, self-supporting portable signs, "Stop/Go" and "Stop/Works" signs, school crossing patrol signs, flat traffic delineators, flap signs, pedestrian crossing and refuge beacons, internally illuminated posts, twin amber flashing light units, non-retroreflecting road studs and retroreflective self-righting bollards.

Non-retroreflecting road studs incorporating an active light source are not covered by this standard.

*NOTE* The tests given in this standard are suitable for both initial type testing and production testing.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 3424-5:1982, *Testing coated fabrics – Part 5: Methods 7A, 7B and 7C – Methods for determination of tear strength*

BS 7263-1, *Precast concrete flags, kerbs, channels, edgings and quadrants – Precast, unreinforced concrete paving flags and complementary fittings – Part 1: Requirements and test methods*

BS EN 40-2:2004, *Lighting columns – Part 2: General requirements and dimensions*

BS EN 485-1, *Aluminium and aluminium alloys – Sheet, strip and plate – Part 1: Technical conditions for inspection and delivery*

BS EN 12332-1, *Rubber- or plastics-coated fabrics – Determination of bursting strength – Part 1: Steel ball method*

BS EN 12665, *Light and lighting – Basic terms and criteria for specifying lighting requirements*

BS EN 12767:2007, *Passive safety of support structures for road equipment – Requirements, classification and test methods*

BS EN 12899-1:2007, *Fixed, vertical road traffic signs – Part 1: Fixed signs*

BS EN 13032-1, *Light and lighting – Measurement and presentation of photometric data of lamps and luminaires – Part 1: Measurement and file format*

BS EN 50293, *Road traffic signal systems – Electromagnetic compatibility*

BS EN 55014-1, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

BS EN 60529, *Degrees of protection provided by enclosures (IP code)*

BS EN 60598-1:2000, *Luminaires – Part 1: General requirements and tests*

BS EN ISO 877-1:2010, *Plastics – Methods of exposure to solar radiation – Part 1: General Guidance*

BS EN ISO 877-2:2010, *Plastics – Methods of exposure to solar radiation – Part 2: Direct weathering and exposure behind window glass*

BS EN ISO 1421, *Rubber- or plastics-coated fabrics – Determination of tensile strength and elongation at break*

BS EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods*

BS EN ISO 2286-2:1998, *Rubber- or plastics-coated fabrics – Determination of roll characteristics – Part 2: Methods for determination of total mass per unit area, mass per unit area of coating and mass per unit area of substrate*

BS EN 10240, *Internal and/or external protective coatings for steel tubes – Specification for hot dip galvanized coatings applied in automatic plants*

CIE <sup>1)</sup> 15, *Colorimetry*

CIE 17.4, *International lighting vocabulary*

CIE 54.2, *Retroreflection: definition and measurement*

### 3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in CIE 17.4 and the following apply.

#### 3.1 coefficient of retroreflection

$R_A$

luminous intensity of a surface in the direction of observation, divided by the product of the illuminance on a plane perpendicular to the direction of incident light and the area of the surface

*NOTE*  $R_A$  is expressed in candelas per lux per square metre ( $\text{cd}\cdot\text{lx}^{-1}\cdot\text{m}^{-2}$ ).

#### 3.2 conspicuity panel

part of the body of a self-righting bollard that enhances its conspicuity in all lighting conditions

#### 3.3 entrance angle

$\beta$

angle between the illumination axis and the retroreflector axis

*NOTE* In signing applications the entrance angle is less than 90°.

#### 3.4 fluorescent

materials that exhibit fluorescence which is an attribute of daytime appearance based on absorption of light at shorter wavelengths and emission at longer wavelengths

#### 3.5 ground line

level of surface on which a device is mounted

#### 3.6 luminance

physical measure of optical stimulus that produces the sensation of brightness measured by the luminous intensity of light emitted or reflected in a given direction from a surface element divided by the area of the element projected in the same direction

*NOTE* The unit of measurement is candelas per square metre ( $\text{cd}\cdot\text{m}^{-2}$ ).

<sup>1)</sup> All CIE documents are available from the International Commission on Illumination, CIE Central Bureau, Kegelstrasse 27, A-1030 Vienna. AUSTRIA +43 (01) 714 31 87/0 or [www.cie.co.at](http://www.cie.co.at)



**3.7 luminance factor** $\beta$ 

ratio of the luminance of a surface to that of a perfect diffuse reflector, identically illuminated and viewed

**3.8 observation angle** $\alpha$ 

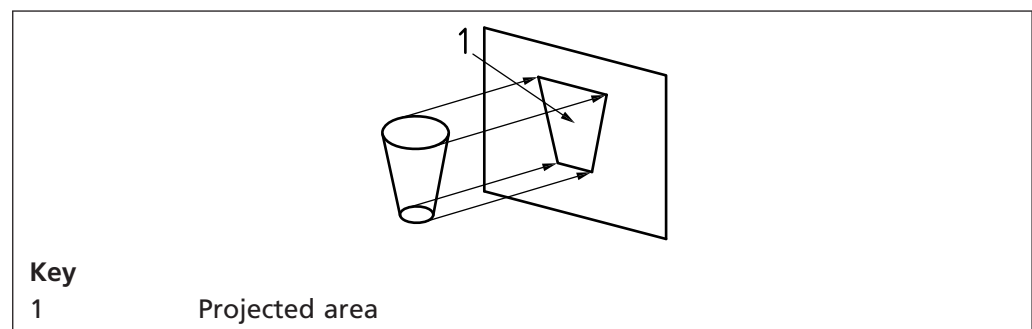
angle between the illumination axis and the observation axis

**3.9 projected area**

area of a three-dimensional object when projected on to a plane surface at right angles to the direction of viewing

*NOTE* See Figure 1 for an example of projected area.

Figure 1 Projected area

**3.10 retroreflection**

reflection in which the reflected rays are preferentially returned in directions close to the opposite of the direction of the incident rays, this property being maintained over wide variations in the direction of the incident rays

**3.11 retroreflective self-righting bollard (RSRB)**

retroreflective self-righting device normally mounted on a refuge or a traffic island

*NOTE* An RSRB may contain a prescribed traffic sign or a plain white area. It incorporates conspicuity panels made from fluorescent yellow to enhance both daytime and night-time visibility. It is level 4 "non-harmful" (see BS EN 12767:2007, Table 5) when tested for passive safety, and the depth of the body is limited so that when deflected under impact a vehicle can pass over it.

**3.12 road stud**

device that is bonded to or anchored within the road surface in order to warn, guide or inform road users

**3.13 RSRB body**

part of an RSRB above the lower edge of the front conspicuity panel

**3.14 substrate**

material that supports the sign face

**3.15 traffic sign**

any object or device, whether fixed or portable, for conveying, to traffic on roads or any specified class of traffic, warnings, information requirements, restrictions or prohibitions of any description

## 4 Information and requirements to be agreed and documented

### 4.1 Information to be obtained from the purchaser

The following information shall be obtained from the purchaser when ordering to ensure products supplied are suitable for intended use:

- a) the properties of the microprismatic material (see A.3.2.2);
- b) the level of protection against electric shock (see 12.1);
- c) the degree of ingress protection required if it is higher than that specified in 12.2.1, 12.3.1 and 12.4.1;
- d) the length of a zebra crossing or refuge beacon post above ground (see 12.3.2.1 and 12.3.2.2);  
*NOTE This should be within the limits prescribed by the TSRGD [1].*
- e) the method of securing a flashing amber light unit to a post (see 12.4.1); and
- f) the substrate to which sign face material is to be applied if other than 3 mm aluminium sheet (see A.2.2).

## 5 Self-supporting rigid portable signs, other than barriers

### 5.1 General

The sign shall be constructed in such a way that, when erected, the lowest edge of the sign, or of any supplementary plate, shall be not less than 300 mm above the supporting surface. The sign shall be so constructed that, when erected, the sign face is either normal to the supporting surface or inclined so that the top of the sign leans away from the viewer, at an angle not greater than 22.5° from the normal to the supporting surface when observed from the front.

*NOTE 1 Retroreflective materials are designed to provide more reflected light to drivers when mounted vertically.*

The sign assembly shall be designed to enable ballasting so that the sign resists the wind forces in its intended location. The sign assembly manufacturer shall indicate the minimum recommended ballast required, and its positioning on the sign assembly's supports, for the sign assembly to resist the wind speed class(es) for which it is designed [see Table 1, 14.1e) and Annex B].

The minimum recommended ballast required for the sign assembly to resist Class A, Class B and Class C wind speeds shall be calculated using the methods described in Annex C.

*NOTE 2 Attention is drawn to the TSRGD [1] where the front of any backing board or background against which the sign is displayed is required by the TSRGD [1] to be grey or yellow.*

Table 1 Classification of effective wind speeds  $V_e$

Class of wind speed	Effective wind speed $V_e$ ms <sup>-1</sup>
A	26.3
B	17.6
C	8.7

*NOTE 3 Pressure due to passing vehicles is small by comparison and is not included in the calculation of effective wind speed. A guide to wind speed classes is given in Annex D.*

## 5.2 Visual performance of sign face material

The visual performance of the sign face material shall conform to **A.3**.

*NOTE The retroreflective classes from which specifiers can choose characterize reflective performance when mounted vertically. However, temporary traffic signs are often mounted non-vertically in use. The retroreflective performance of a sign mounted non-vertically is lower than that provided if that same sign was installed vertically. As no method exists to test reflective performance in non-vertical orientation, specifiers are encouraged to mount signs vertically whenever possible. Where non-vertical mounting is unavoidable, specifiers should take into account the resulting reduced reflective performance when determining the reflective class to specify.*

## 5.3 Physical performance of the sign face

The physical performance of sign face material shall conform to **A.4**.

## 5.4 Physical performance of the sign assembly

When tested in accordance with Annex E, the sign assembly shall not:

- a) begin to overturn by rotating at the back of the base when the force is applied from the front;
- b) begin to overturn by rotating at the front of the base when the force is applied from the back; or
- c) slide along the surface if the force is applied in either direction.

# 6 Portable barriers

## 6.1 General

Barrier units, comprising barrier boards, tapping rails, supports and bases, shall be capable of being incorporated into systems that are used to mark part of a highway that is closed to traffic or to guide traffic or pedestrians past an obstruction.

The barrier unit shall be constructed so as to allow the use of ballasting. The manufacturer shall indicate the minimum recommended ballast required, and its positioning on the barrier assembly's supports, for the barrier assembly to resist the wind speed class(es) for which it is designed [see Table 1, **14.1e**) and Annex B].

*NOTE 1 Barrier units incorporating traffic signs intended to close a traffic lane, or guide traffic or pedestrians past works, are regulated by the TSRGD [1].*

*NOTE 2 The minimum recommended ballast required for the barrier assembly to resist Class A, Class B and Class C wind speeds should be calculated in accordance with Annex F.*

## 6.2 Visual performance

The visual performance of any traffic sign incorporated into portable barriers shall conform to **A.3**.

## 6.3 Physical performance

The physical performance of portable barriers shall conform to **A.4**.

## 7 Self-supporting flexible portable signs

### 7.1 General

The self-supporting portable sign shall be constructed in such a way that, when erected, the lowest edge of the sign or of any supplementary plate shall be not less than 300 mm above the supporting surface. The sign shall be so constructed that, when erected, the sign face is either normal to the supporting surface or inclined so that the top of the sign leans away from the viewer at an angle not greater than 22.5° from the normal to the supporting surface when observed from the front.

*NOTE 1 The self-supporting portable sign should be designed in such a way that ingress of moisture does not impair the photometric or colorimetric performance of the sign.*

*NOTE 2 Vertical mounting should be used as this improves the retroreflective performance of virtually all sign face materials.*

When tested in accordance with Annex E, the sign assembly shall conform to 5.4.

*NOTE 3 The front of any backing board or background against which the sign is displayed is required by the TSRGD [1] to be grey or yellow.*

### 7.2 Visual performance

The visual performance shall conform to A.3.

### 7.3 Physical properties of substrate material

The properties of the substrate to which the sign face is applied shall conform to the properties specified in Table 2, when tested in accordance with the relevant standards specified in Table 2.

*NOTE 1 As these signs are generally transported and stored folded or rolled, the performance and legibility of the sign should remain intact after being transported.*

*NOTE 2 Substrate material is not required to conform to A.4.*

Table 2 Physical properties of substrate material

Property	Value	Test method
Minimum mass per unit area	500 g/m <sup>2</sup>	BS EN ISO 2286-2:1998, Method B
Minimum tensile strength	1 000 N/50 mm	BS EN ISO 1421
Maximum extension at break	15%	BS EN ISO 1421
Minimum tongue tear strength	400 N	BS 3424-5:1982, Method 7A
Minimum bursting strength	2 750 kN/m <sup>2</sup>	BS EN 12332-1

## 8 Manually operated portable "Stop/Go" and "Stop Works" signs

### 8.1 General

The sign shall be supported on a stand or pole constructed in such a way that the height to the centre of the sign measured from the road surface is between 1.2 m and 1.8 m.

Where a stand is provided, it shall be so constructed that the operator can rotate the sign about a vertical axis to present either face to an adjacent observer. Where specified by a purchaser, a device shall be incorporated in the stand that halts the movement of the sign in one direction, so that it presents only one of its faces, and only allows it to revolve enough to present the other face before again being stopped.

The sign shall be fixed to the stand or pole in such a way that the fixing does not alter or obscure the layout or colouring on either side of the sign.

Any visible supporting substrate to which the sign is applied shall be coloured grey.

*NOTE 1 The signs to appear on each side of the substrate are specified in diagrams 7023, 7024 and 7031 in the TSRGD [1]. The substrate and any surrounding frame should be circular.*

*NOTE 2 The method of fixing the sign to the stand should be such that the sign cannot be dislodged or rotated from its position.*

## 8.2 Visual performance

The visual performance shall conform to **A.3**.

## 8.3 Physical performance

The physical performance shall conform to **A.4**.

# 9 Portable school crossing patrol signs

## 9.1 General

The pole on which the sign is mounted shall be 1.4 m to 1.5 m in length. The sign shall be fixed to the pole in such a way that the fixing does not alter or obscure the layout or colouring on either side of the sign.

*NOTE The legend to appear on each side of the sign plate is specified in the schedule to the School Crossing Patrol Sign Regulations [2], [3]. These regulations also govern any protective strip applied to the perimeter of the sign plate. The same regulations further specify that the pole on which the sign is mounted has to be marked with alternate black and yellow bands (300 ±20) mm high, commencing with a 300 mm black band at the top.*

## 9.2 Visual performance

The visual performance shall conform to **A.3**.

# 10 Portable flat traffic delineators (FTDs)

## 10.1 General

The blade and its attachment to the base or fixing shall be so constructed that the face of the blade presents a plane to the approaching traffic no more than 12.5° from the vertical.

The white portions shall be retroreflective; the red portions may also be retroreflective.

*NOTE The general design and dimensions of FTDs are prescribed in diagram 7102 and other provisions of the TSRGD [1].*

## 10.2 Visual performance

The visual performance shall conform to **A.3**.

### 10.3 Physical performance

#### 10.3.1 Impact resistance at low temperature

When tested in accordance with Annex G, there shall be no cracking or delamination of any retroreflective surface from the substrate outside a circle of radius 6 mm with the point of impact as its centre. The blade shall not become detached from its base. The FTD shall recover its original form after the impact.

#### 10.3.2 Resistance to bending

When tested in accordance with Annex H, the residual deflection of the top of the blade measured from the reference surface shall not exceed 5% of the height of the blade. The blade shall be neither damaged nor detached from its base.

#### 10.3.3 Fatigue resistance

When tested in accordance with Annex I, the blade shall be neither damaged nor detached from its base.

## 11 Fixed, permanent, manually operated flap signs

### 11.1 General

A flap sign shall consist of a sign plate which is constructed in such a way that the whole or part of the message can be concealed when not required or an alternative message displayed.

The sign shall be so constructed that not more than 5% of its surface is obscured by fittings used to effect the changes. Any hinge plates or other fittings shall be fitted to the back of the sign.

To avoid staining of the sign face, the fittings shall conform to BS EN 12899-1:2007, 7.1.7, Table 15 for either SP1 or SP2.

*NOTE* When the message is concealed, the TSRGD [1] require the parts of the sign visible to drivers to be grey or black.

Means shall be provided for the assembly to be locked in the displayed and the concealed positions in such a manner that the sign face is not damaged.

### 11.2 Visual performance

The visual performance of the sign face material of flap signs shall conform to A.3.

### 11.3 Physical performance

The flap sign shall conform to BS EN 12899-1.

## 12 Fixed, permanent pedestrian crossing and refuge beacons and twin amber flashing lights

### 12.1 Electrical requirements

Electrical components, including associated ballasts, flashing units and controllers, shall have radio interference field strengths within the limits set by BS EN 55014-1, and shall conform to BS EN 50293 for electromagnetic compatibility.

Means shall be provided to correct the power factor to not less than 0.85.

Protection against electric shock shall be either Class 1 or Class 2 in accordance with BS EN 60598-1:2000, 2.2, as specified by the purchaser [see 4.1b)].

Any base compartment housing electrical components shall be fitted with a secure lock.

*NOTE Attention is drawn to the Low Voltage Directive (LVD) 2006/95/EC [4] for further information on beacon globes, transilluminated posts, and twin amber flashing lights.*

## 12.2 Beacon globes

### 12.2.1 General

*NOTE Beacon globes are regulated by The Zebra, Pelican and Puffin Pedestrian Crossings Regulations [5], as amended, and the TSRGD [1].*

Unless otherwise specified by the purchaser [see 4.1c)], the level of ingress protection afforded by a beacon globe shall be IP 54, and shall conform to BS EN 60529.

The globe shall be suitable for securely fixing to a post of nominal diameter 76 mm or 114 mm. Removal of the globe shall be possible only with the use of a tool.

The external surface of the globe shall be such that it does not retain dirt or moisture and is free from rough edges.

The light of a pedestrian crossing globe shall flash with the following characteristics:

- a flashing rate of  $(40 \pm 4)$  flashes per min, as perceived by the human eye;
- a light-on period of between 50% and 60% of total cycle time; and
- a light-off period not exceeding 0.75 s.

### 12.2.2 Visual performance

#### 12.2.2.1 Chromaticity and luminance factor

##### 12.2.2.1.1 Performance

When measured in accordance with 12.2.2.1.2, the chromaticity and luminance factor of the globe shall conform to Table 3.

Table 3 Chromaticity coordinates and luminance factors of globes

Colour	Day/ night	Chromaticity coordinates								Luminance factor, $\beta$	
		1		2		3		4		Min	Max
		x	y	x	y	x	y	x	y		
White	Night	0.440	0.382	0.285	0.264	0.285	0.332	0.440	0.440	—	—
White	Day	0.350	0.360	0.300	0.310	0.290	0.320	0.340	0.370	0.75	—
Yellow	Day and night	0.522	0.477	0.470	0.440	0.427	0.483	0.465	0.534	0.45	—

##### 12.2.2.1.2 Measurement of globe chromaticity and luminance factor

The chromaticity of light emitted from the globe shall be measured using a colorimetric measuring system in accordance with CIE 15, with its light detector aligned in the same direction as used for intensity or luminance measurements specified in 12.2.2.3.

The light detector shall be at such a distance as to detect light from the whole of the light-emitting surface. The emitted light shall be integrated to eliminate localized colour variation before the light is measured.

#### 12.2.2.2 Mean luminance and uniformity of luminance

When measured in accordance with 12.2.2.4, the mean luminance of the globe shall be not less than  $300 \text{ cd}\cdot\text{m}^{-2}$ . The uniformity of luminance, in terms of the ratio of the minimum to the maximum measured luminance of the globe, shall be not less than 0.66.

#### 12.2.2.3 Measurement of mean luminance and uniformity of luminance

Measurements shall be made in accordance with BS EN 13032-1.

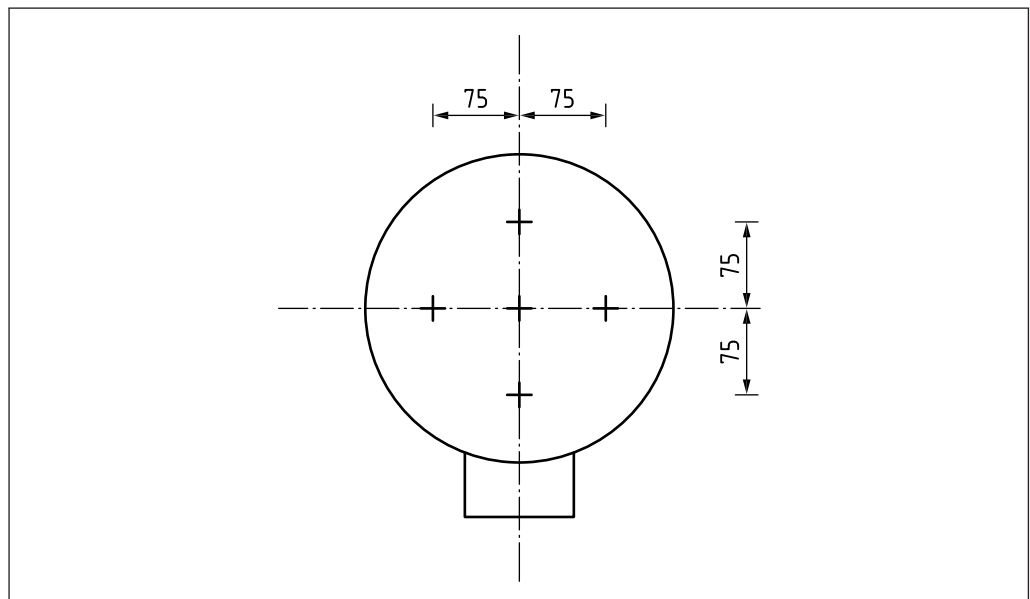
The beacon globe shall be illuminated using the light source with which the globe is to be used, mounted in the position in which it is to be when the globe is in use.

Measurements shall be taken in a direction normal to the tangent to the surface of the globe at the points shown in Figure 2 on an area of the globe of  $(25 \pm 0.5) \text{ mm}$  projected diameter.

The measurements shall be repeated at angles of  $120^\circ$  and  $240^\circ$  in plan to the original direction.

The mean luminance and uniformity of luminance shall be calculated in accordance with BS EN 13032-1.

Figure 2 Luminance measurement



#### 12.2.2.4 Visibility of light source

When the globe is illuminated, the light source shall be not visible through the globe material.

### 12.3 Posts

#### 12.3.1 General

A post shall consist of a base section with door opening and an upper part.

*NOTE The shape may be cylindrical with not more than one change of diameter, or conical.*



The upper part shall terminate in a spigot of  $(76_{-0}^{+3})$  mm diameter and not less than 100 mm in length, for connection to the globe. The door opening and base compartment shall conform to BS EN 40-2:2004, 4.3 and 4.4, respectively. The length of the base section below ground shall conform to the purchaser's specifications, depending on the installation and cable entry method to be used, and shall incorporate a cable entry slot conforming to BS EN 40-2:2004, 4.3, unless cable entry is through the base of the post.

Unless otherwise specified by the purchaser [see 4.1c)], the level of ingress protection afforded by the post base compartment shall be not less than IP 23, in accordance with BS EN 60529.

### 12.3.2 Non-illuminated posts

#### 12.3.2.1 Zebra crossing posts

The post shall conform to 10.3.1, except that it shall be cylindrical with not more than one change of diameter, and any larger diameter base section shall not extend more than 1 150 mm above ground level.

*NOTE* Attention is drawn to *The Zebra, Pelican and Puffin Pedestrian Crossings Regulations [5]* which permit the purchaser to specify the length of the post above ground [see 4.1d)], but require that the bottom of the globe is not less than 2.1 m and not more than 3.1 m above ground level. The same regulations require that posts are marked with alternate black and white bands.

#### 12.3.2.2 Refuge beacon posts

The length of the post above ground shall conform to the purchaser's specifications.

*NOTE 1* Attention is drawn to the *TSRGD [1]* regarding the length of the post above ground [see 4.1d)].

*NOTE 2* Attention is drawn to the *TSRGD [1]* which requires the centre of the globe to be not less than 3.8 m and not more than 5 m above the adjacent carriageway level. The same regulations require that the posts are coloured grey or black, with two white bands, each being not less than 275 mm or more than 335 mm deep and placed in accordance with direction 45 of the *TSRGD [1]*.

### 12.3.3 Internally illuminated posts

#### 12.3.3.1 Zebra crossing posts

The post shall conform to 12.3.1 and 12.3.2.1, except that it shall be cylindrical with not more than one change of diameter and the finished outside upper shaft diameter above the base section shall be  $(114_{-3}^{+0})$  mm. If there is a change of diameter, the larger diameter base section shall not extend more than 1 150 mm above ground level.

The post shall be provided with a means to internally illuminate its white bands. When this is done by means of openings in the shaft, these shall be diametrically opposite to each other and not less than 90° of arc when viewed in plan.

*NOTE* The design of the post should allow any shadows cast by components within the post to be arranged at an angle of approximately 90° to the edge of the carriageway being served.

#### 12.3.3.2 Refuge beacon posts

The refuge beacon post shall conform to 12.3.3.1.

*NOTE* Internally illuminated refuge beacon posts are governed by the *TSRGD [1]*.

### 12.3.4 Visual performance

#### 12.3.4.1 Non-illuminated posts

Retroreflective white bands shall be provided for non-illuminated posts.

*NOTE Attention is drawn to the TSRGD [1] regarding retroreflective white bands.*

#### 12.3.4.2 Internally illuminated posts

##### 12.3.4.2.1 Chromaticity and luminance factor for internally illuminated posts

The chromaticity and luminance factor of the illuminated white portions shall conform to Table 3 when measured in accordance with CIE 15.

##### 12.3.4.2.2 Mean luminance and uniformity of luminance of internally illuminated posts

When measured in accordance with Annex J, the luminance of the post shall conform to Table 4. The uniformity of luminance, in terms of the ratio of the minimum to the maximum measured luminance of the illuminated parts of the post, shall be not less than 0.66.

Table 4 Luminance of posts

Luminance category	Luminance, cd·m <sup>-2</sup>	
	Min	Max
LP1	200	400
LP2	600	800

*NOTE Posts of luminance category LP2 are suitable for areas with a high background luminance. This is most likely to be experienced in major shopping areas, characterized by well-lit window displays and large bright fascia signs. The choice of category should be made in relation to the background against which posts are viewed. Posts of luminance category LP1 are suitable for all other locations.*

### 12.3.5 Physical performance

The post and any attached signs, fittings and luminaires shall conform to the structural requirements of BS EN 12899-1.

*NOTE See National Annex to BS EN 12899-1:2007 for recommended classes for the location concerned.*

There shall be no splitting, cracking or separation of the opaque and translucent sections of internally illuminated posts as a result of applying the load.

## 12.4 Twin flashing amber light units

### 12.4.1 General

*NOTE 1 The design, colours and dimensions of a twin flashing amber light unit and its housing and associated post are prescribed in diagrams 4004 and 4005 of the TSRGD [1], as appropriate. These regulations also require that each light unit, when operated, shows an intermittent amber light at a rate of flashing of not less than 60 or more than 90 flashes per min and in such a manner that one light is always shown when the other light is not shown.*

Unless otherwise specified by the purchaser [see 4.1c)], the level of ingress protection afforded by twin flashing amber light units shall be IP 54 in accordance with BS EN 60529.

Where two light sources and their control equipment are to be contained in the same housing, this shall be so constructed that stray light from one cannot reach the other.

The units shall be so designed that the failure of one light source does not affect the operation of the other light source.

The control unit shall be mounted so that it can be removed easily as a complete unit for servicing.

The light unit shall be operated by a key or by a push on/off switch accessed through a hole in the base of the housing, or by a remote control or programmable controller mounted within the unit which is type-approved.

*NOTE 2 Attention is drawn to the TSRGD [1] regarding type-approved remote controls and programmable controllers.*

In the latter two cases, an indicator shall be provided at the switching point to indicate when the equipment is switched on. The indicator shall be not visible to passing traffic.

Access to the interior of the light unit shall require the use of a special tool. All screws or fastenings that need to be loosened shall be captive. Self-tapping screws shall be not used.

The panel or other components giving access to the interior of the light unit shall, in the closed position, be firmly attached to the fixed portion of the light unit. In the open position, it shall be attached in such a way that there is no likelihood of it becoming accidentally detached or causing damage likely to impair safety of any part of the light unit or its clamps.

Any access hole to the switch shall be not greater than 3 mm in diameter and shall not afford access to any live parts.

The unit shall incorporate a secure method of fixing to the post specified by the purchaser [see 4.1e)].

## 12.4.2 Visual performance of flashing amber light units

### 12.4.2.1 Chromaticity

When measured in accordance with 12.4.2.2, the chromaticity of the flashing amber light units shall conform to Table 5.

Table 5 Chromaticity of amber light units

Chromaticity coordinates							
1		2		3		4	
x	y	x	y	x	y	x	y
0.546	0.426	0.560	0.440	0.617	0.382	0.612	0.382

### 12.4.2.2 Measurement of chromaticity

The chromaticity of light emitted from amber flashing light units shall be measured using a colorimetric measuring system in accordance with CIE 15 with its light detector aligned in the same direction as specified for intensity or luminance measurements in 12.2.2.3.

The light detector shall be at such a distance as to detect light from the whole of the light-emitting surface. The emitted light shall be integrated to eliminate localized colour variation before the light is measured.

### 12.4.2.3 Luminous intensity and distribution

When measured in accordance with 12.4.2.4, the light unit shall conform to the following performance requirements for operation in daylight:

- a) at the normal to the lens or cover, on the photometric axis of the light unit, the intensity shall be not less than 50 cd and not greater than 75 cd;

- b) within an angular cone of  $7^\circ$  to the normal, the intensity shall be not less than 0.5; and
- c) at  $90^\circ$  to the normal, the intensity shall be zero.

*NOTE* These figures are based on test results and consideration of the angular relationship between the driver of a car 3 m from the kerb and a light unit offset 2 m behind the kerb with the normal parallel to the kerb and with the driver at various distances from the unit (300 m, 150 m, 75 m and 50 m).

#### 12.4.2.4 Method for the determination of the luminous intensity and distribution

The luminous intensity of a single light unit shall be measured in accordance with BS EN 13032-1.

The light unit shall be operated at the voltage at which it is to be used, as specified by the manufacturer.

The angle subtended at the geometric centre of the warning light by the diameter of the detector aperture shall be not greater than 10 min of arc.

The measured values for angles shall be within the following tolerances:

- a)  $\pm 0.1^\circ$  for angles  $>2^\circ$  and  $<4^\circ$ ;
- b)  $\pm 0.2^\circ$  for angles  $\geq 4^\circ$  and  $<8^\circ$ ; or
- c)  $\pm 0.4^\circ$  for angles of  $8^\circ$  and above.

Sufficient readings shall be taken within the angular limits specified in 12.4.2.3 to find and record the points of both maximum and minimum intensity.

#### 12.4.3 Physical performance of flashing amber light units

When tested in accordance with BS EN 12899-1:2007, 7.1.7, flashing amber light units shall show no change in appearance, using an untreated sample for comparison.

### 12.5 Non-retroreflective road studs

Studs shall be designed so that, when correctly installed, they do not present sharp edges to traffic.

*NOTE 1* Non-retroreflective and non-light-emitting road studs can be used to mark crossing places (diagrams 1055.1 and 1055.2 in the TSRGD [1]).

*NOTE 2* TSRGD [1] require studs which are not retroreflective and do not contain a light source to have a diameter between 95 mm and 110 mm, or if square to be between 95 mm and 110 mm.

The edges of the stud shall not project more than 6 mm above the surface of the adjacent carriageway, and at its highest point it shall not project more than 20 mm above that surface.

## 13 Retroreflective self-righting bollards (RSRBs)

### 13.1 General

#### 13.1.1 Types

The RSRB shall be one of the following:

- a) type A: retroreflective fluorescent yellow conspicuity panels and retroreflective sign, see 13.2 and 13.3;
- b) type B: retroreflective fluorescent yellow conspicuity panels and lit retroreflective sign, see 13.2, 13.3 and 13.4;

- c) type C: lit retroreflective fluorescent yellow conspicuity panels and lit retroreflective sign, see 13.2, 13.3 and 13.5; or
- d) type D: lit body (or body and base mounting), lit retroreflective fluorescent yellow conspicuity panels and lit retroreflective sign, see 13.2, 13.3 and 13.6.

### 13.1.2 Design: common characteristics for all RSRB types

The RSRB shall incorporate one or more traffic signs or alternatively a plain white borderless roundel conforming to 13.2.

*NOTE Attention is drawn to the TSRGD [1].*

### 13.1.3 Height

The minimum height of an RSRB which displays a sign or roundel with a diameter of less than 350 mm shall be 900 mm above the ground line.

The minimum height of an RSRB which displays a sign or roundel with a diameter equal to or greater than 350 mm in diameter shall be 1 100 mm above the ground line.

The distance between the upper extremity of the RSRB and the top of any roundel shall be not more than 70 mm.

### 13.1.4 Body

The body shall contain no sharp edges. Any curvature of a roundel shall be limited to one plane and shall have a radius of not less than 2 000 mm.

### 13.1.5 Conspicuity panels

Conspicuity panels shall be applied to the front and sides of all RSRB types; rear conspicuity panels are optional. Conspicuity panels shall be retroreflective, fluorescent and yellow in colour.

*NOTE RSRBs rely on the brightness of retroreflective panels to be conspicuous at night. Daytime conspicuity of these devices is enhanced by the use of fluorescent yellow material.*

The minimum projected area of the front or side conspicuity panels shall conform to Table 6. Where both faces display a traffic sign both shall display a conspicuity panel. The lower edge of the front conspicuity panel shall be a minimum of 100 mm and a maximum of 200 mm above the ground line.

Table 6 Projected area of the conspicuity panels

Projected area, mm <sup>2</sup>	
Front view	Side view
150 000	20 000

## 13.2 Visual performance: common characteristics for all RSRB types

### 13.2.1 Chromaticity

When tested in accordance with the relevant procedure specified in CIE 15, using CIE standard daylight illuminant D65 and the standard CIE 45/0 viewing conditions, the chromaticity and the luminance factor  $\beta$  of the yellow fluorescent conspicuity panels and the traffic signs or plain white roundel shall conform to Table 7.

Table 7 Daytime chromaticity and luminance factor

Colour	Chromaticity co-ordinates								Minimum luminance factor, $\beta$
	1		2		3		4		
	x	y	x	y	x	y	x	y	
White	0.355	0.355	0.305	0.305	0.285	0.325	0.335	0.375	$\beta \geq 0.27$
Red	0.735	0.265	0.674	0.236	0.569	0.341	0.655	0.345	$\beta \geq 0.03$
Blue	0.078	0.171	0.150	0.220	0.210	0.160	0.137	0.038	$\beta \geq 0.015$
Fluorescent yellow	0.479	0.520	0.446	0.483	0.512	0.421	0.557	0.443	$\beta \geq 0.40$

### 13.2.2 Photometric performance of conspicuity panels, traffic signs and plain white circles incorporated in all RSRB

Retroreflective material shall conform to BS EN 12899-1:2007, Table NA.1B, an extract from which is reproduced in A.3.2.2, Table A.1.

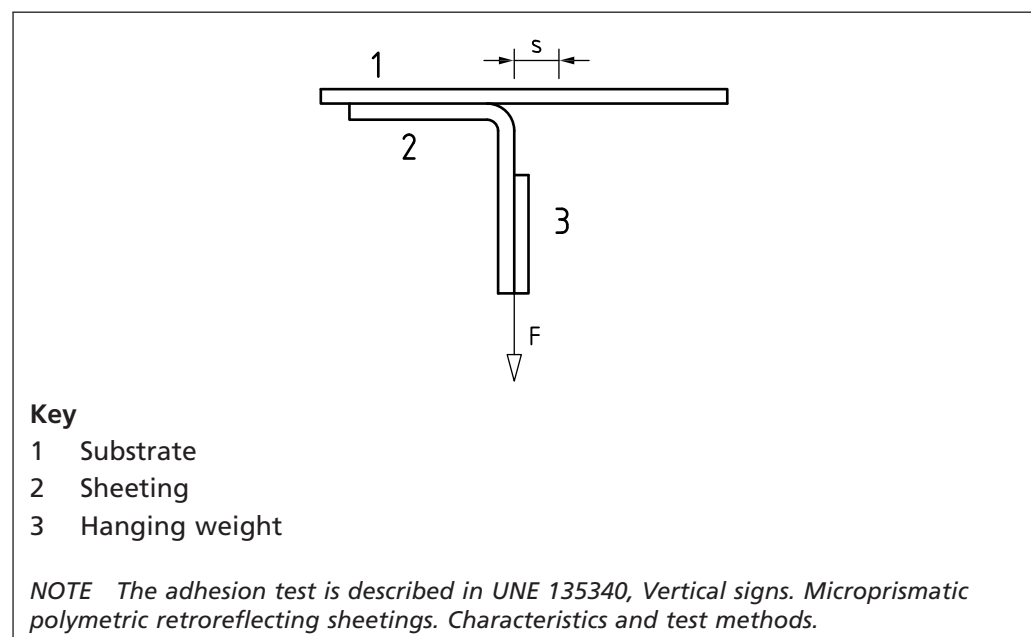
### 13.3 Physical performance: common characteristics for all RSRB types

#### 13.3.1 Adhesion to substrate

Approximately 2/3 of the length of a (25 × 150) mm strip of the retroreflective sheeting is mounted following the sheeting manufacturer's instructions onto a sample of the intended substrate at least (200 × 70) mm in size, as shown in Figure 3. After conditioning the samples for 72 h at a temperature of (23 ± 3) °C and a relative humidity of (50 ± 5)% a hanging weight with a mass of  $F = 0.8$  kg is applied to the free end of the sheeting strip. The extent to which the sheeting strip peels away from the substrate five min after application of the weight is measured. The amount of peeling shall not exceed 50 mm in five min.

The test is valid only for a particular substrate material and a family of retroreflective sign face materials with identical adhesive. This test shall be repeated for other substrate materials or adhesives.

Figure 3 Adhesion test



### 13.3.2 Corrosion resistance

Metallic parts shall be protected against corrosion, including electrolytic corrosion, in accordance with Table 8 and shall meet class SP1 or SP2.

Table 8 Surface protection

Class	Requirements
SP1	Protective coatings provided
SP2	Inherent surface protection provided

Hot dip galvanizing shall conform to BS EN ISO 1461 or BS EN 10240 as appropriate.

Any part of an aluminium support which is to be placed underground shall have a protective coating applied in accordance with the instructions and recommendations of the manufacturer of the surface coating.

The manufacturer shall apply surface coating in accordance with the instructions and recommendations of the manufacturer of the surface coating.

### 13.3.3 High impact resistance

When tested in accordance with BS EN 12767, the RSRB shall remain in position and no portion of the RSRB greater than 25 g shall become detached. The RSRB shall return to its original position, or have a residual deflection of no more than 10% of its height, measured horizontally at the upper extremity, not more than 15 min after the time of impact.

After impact, its mountings shall remain in place for not more than 15 min after the time of impact and the residual rotation about the vertical axis shall not exceed 5°.

When tested in accordance with BS EN 12767, the RSRB shall meet one of the following performance classes: 100,NE,4; 70,NE,4; or 50,NE,4.

After testing in accordance with BS EN 12767, lit parts shall continue to operate.

## 13.4 Type B bollards: additional requirements

### 13.4.1 Mean luminance

When measured in accordance with Annex K, the lit traffic sign or any plain white roundel shall conform to Table 9.

*NOTE* See BS EN 12899-1:2007, National Annex, for recommended classes for visual performance most suitable for UK practice.

Table 9 Mean luminance,  $L$ ,  $\text{cd}\cdot\text{m}^{-2}$

Colour	Class L1	Class L2
White	$40 \leq L \leq 150$	$150 \leq L \leq 300$
Yellow	$30 \leq L \leq 100$	$100 \leq L \leq 300$
Red	$6 \leq L \leq 20$	$20 \leq L \leq 50$
Blue	$4 \leq L \leq 10$	$10 \leq L \leq 40$

### 13.4.2 Luminance contrast

When measured in accordance with Annex K, the luminance contrast of the lit traffic sign shall conform to Table 10.

Table 10 Luminance contrast,  $K$ , lit traffic sign

Colour	Blue	Red
Contrast colour	White	White
Luminance contrast	$5 \leq K \leq 15$	$5 \leq K \leq 15$

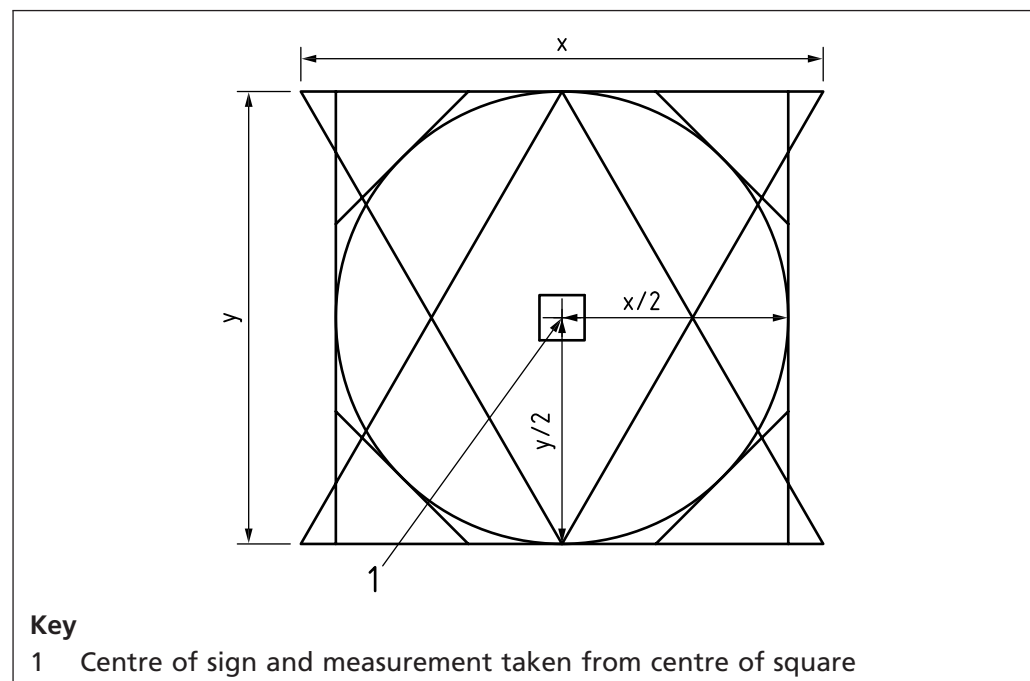
### 13.4.3 Uniformity of luminance

When measured in accordance with Annex K, the uniformity of luminance, determined by the ratio of the lowest and highest measurements taken shall be not less than 1/3.

*NOTE 1 For the purposes of luminance uniformity testing, a plain white roundel is used. This roundel is of the same retroreflective material as is used for the sign face on the finished product.*

*NOTE 2 Figure 4 shows the location of the central test square on a sign face from which the location of all other test squares is based.*

Figure 4 Location of the central sign centre



### 13.4.4 Colour rendering of light sources

Light sources shall be of types with a general colour rendering index  $R_{A,r}$ , as defined in BS EN 12665, of a minimum value of 80.

### 13.4.5 Protection from foreign objects and water

The minimum levels of protection against penetration by solid particles and water, specified in BS EN 60529, shall be in accordance with Table 11.

Table 11 Protection from foreign objects and water

Component	Solid particles	Water
Head and body	Level 5	Level 6
Electrical components housed wholly or partly below ground line	Level 6	Level 7



### 13.4.6 Electrical

Electrical components, circuitry and installation shall conform to BS EN 12899-1:2007, 7.1.13.

Electrical supply cables shall enter the base below the ground line.

Access shall be possible only by the use of a special tool or key.

### 13.5 Type C bollards: additional requirements

Type C bollards shall conform to 13.4 and shall have night-time performance as follows.

- a) Conspicuity panels shall be translucent and lit.
- b) The luminance shall be in accordance with Table 11.
- c) The uniformity of luminance shall be not less than 1/6.

### 13.6 Type D bollards: additional requirements

Type D bollards shall conform to 13.4 and shall have night-time performance as follows.

- a) The RSRB body shall be fully lit and conspicuity panels shall be translucent.
- b) The luminance shall be in accordance with Table 9.
- c) The uniformity of luminance shall be not less than 1/10.

## 14 Marking and information

### 14.1 Marking

Single-sided sign plates shall be marked as described.

*NOTE 1 Attention is drawn to the TSRGD [1] for the colour and size of the lettering of the label.*

No coloured or reflective background shall be permitted; lettering shall be applied directly to the sign back or by means of a transparent adhesive label or one which has the same background as the sign back.

Signs and other devices shall, where practicable, be clearly and durably marked on the back with the following:

- a) the number and date of this British Standard, i.e. BS 8442:2015<sup>2)</sup>;
- b) the name, trade mark or other means of identification of the manufacturer or vendor;
- c) the month and year of manufacture;
- d) the classification of any retroreflective material used, where applicable; and
- e) the level of wind resistance afforded by the notified ballast (see Annex B), where applicable.

*NOTE 2 Attention is drawn to the TSRGD [1].*

Where it is not practicable to mark this information on the product, it shall be included in the accompanying commercial documentation.

2) Marking BS 8442:2015 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

## 14.2 Durability of marking

When tested using the procedure given in BS EN 60598-1:2000, 3.4, the marking on any sign or other device shall remain legible and adhesive labels, where used, shall not become detached or curled at the edges.

## 15 Information to be supplied by the manufacturer

The manufacturer shall provide the following information with each product:

- a) instructions on assembly, erection, usage and operation (see Note 1);

*NOTE 1 The purchaser should be made fully aware of the conditions under which the product performs adequately.*

- b) details of any limitations on location or usage (see Note 1);
- c) instructions on the maintenance of the product;
- d) when applicable, the type, wattage and lumen output of the light source for which the unit is designed (see Note 2); and

*NOTE 2 This should enable the purchaser to replace spent lamps with the correct type.*

- e) where applicable, the voltage, with tolerances, of the electrical supply on which the unit is designed to operate.

## Annex A (normative)

### A.1 Retroreflective sheeting materials

#### A.1 General

The specifier shall choose from the following performance requirements for retroreflective material and/or signfaces and classes of retroreflective performance.

*NOTE* Many of the devices described in this standard require retroreflective material and/or signfaces. Retroreflective materials return some light from a vehicle's headlamp to its driver to enable visibility of that device at night.

#### A.2 Sampling and preparation of retroreflective test samples

##### A.2.1 Test samples

Samples for performance testing shall be representative of the normal production of the retroreflective sheeting materials used for the devices described in this standard.

##### A.2.2 Preparation of samples

The tests listed require reflective sheeting samples to be mounted on a flat substrate for testing; where this is required the retroreflective sheeting shall be applied in accordance with the material manufacturer's application instructions to 3 mm aluminium sheet conforming to BS EN 485-1 or other agreed substrate [4.1b)]. Any protective coatings required by the material manufacturer shall be applied in accordance with the manufacturer's instructions.

#### A.3 Visual performance

##### A.3.1 Daylight chromaticity and luminance factor

###### A.3.1.1 Non-retroreflective sign face material

When tested in accordance with BS EN 12899-1:2007, 7.2.2.1.3, the chromaticity and the luminance factor shall conform to BS EN 12899-1:2007, Table 16.

###### A.3.1.2 Retroreflective sign face materials

###### A.3.1.2.1 Glass bead

When tested in accordance with BS EN 12899-1:2007, 4.1.1.3, the chromaticity and the luminance factor of class RA1 or RA2 sheetings shall conform to BS EN 12899-1:2007, Table 1.

###### A.3.1.2.2 Microprismatic

When tested in accordance with the relevant procedure specified in CIE 15, using CIE standard daylight illuminant D65 and the standard CIE 45/0 viewing conditions, the chromaticity and the luminance factor of microprismatic retroreflective materials shall conform to Table 7.

##### A.3.2 Coefficient of retroreflection

###### A.3.2.1 Glass bead sign face materials

When tested in accordance with BS EN 12899-1:2007, 4.1.1.4 the coefficient of retroreflection ( $R_{\lambda}$ ) of retroreflective glass bead material shall conform to BS EN 12899-1:2007, Table 3, for RA1 or Table 4 for RA2.

### A.3.2.2 Microprismatic sign face materials

When measured in accordance with the procedure specified in CIE 54.2, using CIE standard illuminant A, the minimum initial coefficients of retroreflection  $R_A$  ( $\text{cd} \cdot \text{lx}^{-1} \cdot \text{m}^{-2}$ ) of microprismatic retroreflective materials shall be as follows:

- Class RA1 microprismatic materials shall meet the requirements of BS EN 12899-1:2007, Table 3.
- Class R2 microprismatic materials shall meet the requirements of BS EN 12899-1:2007, Table 4.
- Class R3B UK microprismatic materials shall meet the requirements in BS EN 12899-1:2007, Table NA.1B, an extract from which is reproduced in Table A.1.

Table A.1 Minimum coefficient of retroreflection (Class R3B-UK) (unit  $\text{cd} \cdot \text{lx}^{-1} \cdot \text{m}^{-2}$ )

Geometry of measurement		Colour				
$\alpha$	$\beta$	White	Yellow	Fluorescent yellow	Red	Blue
20'	+5°	300	195	180	60	19
	+20°	240	155	144	48	16
	+30°	165	110	99	33	11
	+40°	30	20	18	6	2
1°	+5°	35	23	21	7	2.5
	+20°	30	20	18	6	2
	+30°	20	13	12	4	1.5
	+40°	3.5	2	2	1	#
1.5°	+5°	15	10	9	3	1
	+20°	13	8	8	2.5	#
	+30°	9	6	5.5	2	#
	+40°	1.5	1	1	#	#

NOTE 1 # Indicates: value greater than zero, but not significant or applicable.

NOTE 2 Coloured areas created by digital or screen printing should meet 70% of the values in Table A.1.

### A.3.3 Resistance to weathering of retroreflective sheeting materials

A.3.3.1 After weathering in accordance with A.3.4 the following requirements shall apply.

#### A.3.3.1.1 Glass beaded sheetings

The chromaticity and luminance factor of materials shall conform to BS EN 12899-1:2007, Table 1, class CR1.

#### A.3.3.1.2 Microprismatic sheetings

The chromaticity and luminance factor of materials shall conform to Table 7.

#### A.3.3.1.3 All sheetings

When tested at an observation angle ( $\alpha$ ) of 20' and entrance angles ( $\beta 1 = 5^\circ$  and  $30^\circ$ , with  $\beta 2 = 0^\circ$ ) the coefficient of retroreflection shall be not less than 80% of the values required at those test angles for the declared material class (RA1, RA2, R2, R3B, etc.).

Retroreflective sheetings used on traffic devices intended for temporary use shall have the same visual performance as those used on permanent devices.

*NOTE Retroreflective sheetings used on traffic devices intended for temporary use might have a shorter service life.*

#### A.3.4 Accelerated natural weathering

Samples of material shall be exposed, inclined at an angle of 45° to the horizontal and facing the equator, in accordance with BS EN ISO 877-1:2010 and BS EN ISO 877-2:2010, Method A for the exposure period selected from Table A.2.

Two periods of accelerated natural weathering exposure are available. Manufacturers of retroreflective sheeting shall select an exposure class from Table A.2 and shall declare a product's results after T1 or T2 accelerated natural weathering exposure.

Table A.2 Exposure period for accelerated natural weathering

Class	Period
	Years
T1	2
T2	3

#### A.3.5 Accelerated artificial weathering

Samples prepared in accordance with BS EN 12899-1:2007, 4.1.1.5.3, for 2 000 h shall meet the after weathering requirements in A.3.3.1.1, A.3.3.1.2 and A.3.3.1.3.

### A.4 Physical performance

#### A.4.1 Resistance to impact

When tested in accordance with BS EN 12899-1:2007, 4.1.2 non-reflective and retroreflective materials shall conform to the requirements of BS EN 12899-1:2007, 4.1.2.

#### A.4.2 After-weathering test reports

Tests reports shall be provided on request. These reports shall include performance before and after accelerated natural weathering.

Preliminary test reports based only on performance after accelerated artificial weathering may be produced as an interim while accelerated natural weathering is being conducted; these reports shall be labelled as preliminary test reports.


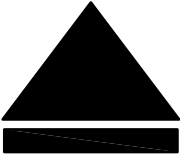


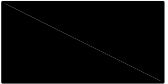
Annex B  
(normative)

## Ballast for self-supporting rigid and flexible portable signs, and classification and labelling of barrier units

### B.1 Temporary signs

Using the sample form shown in Table B.1, the manufacturer shall indicate the mass of the ballast to be added to each sign assembly to resist a specified class of wind speed (calculated in accordance with Annex C), depending upon the sign shape, size and the level of wind resistance chosen.


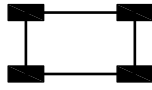
Table B.1 Ballast required for wind resistance of temporary signs

Sign shape	Sign size	Ballast required for wind resistance		
		kg		
		A	B	C
	600			
	750			
	900			
	1 200			
	1 500			
	600			
	750			
	900			
	1 200			
	1 500			
	600			
	750			
	900			
	1 200			
	1 500			
	600			
	750			
	900			
	1 200			
	1 500			
	1 050 × 750			
	600 × 450			

## B.2 Barrier units

Using the sample form shown in Table B.2, the manufacturer shall indicate the mass ballast to be added to each barrier assembly to resist a specified class of wind speed (calculated in accordance with Annex C), depending upon the barrier configuration and the level of wind resistance chosen.

Table B.2 Ballast required for wind resistance of barrier assembly

Configuration	Barrier board length m	Ballast requirement for class of wind speed		
		kg		
		A	B	C
	1.25			
	2			
	2.5			
	3			
	1.25			
	2			
	2.5			
	3			

Annex C  
(normative)

## Calculation of minimum recommended ballast required to resist overturning and sliding of self-supporting rigid portable signs

### C.1 Calculation of the force on a sign face due to wind pressure

The force,  $F$  on a flat plate (a road sign) perpendicular to its surface, due to wind pressure, shall be expressed as a function of the plate area,  $A$  and the wind speed,  $V$  as given in equation C.1.

$$F = C_w A \left( \frac{1}{2} \rho V_e^2 \right) \quad (\text{C.1})$$

This reduces to:

$$F = SA(V_e)^2 \quad (\text{C.2})$$

where:

- $F$  is the force on the sign plate perpendicular to its surface, due to wind pressure, in Newtons (N);
- $C_w$  is the coefficient based on the characteristics of the sign plate and frame, the values of which are given in Table C.1;
- $A$  is the area of the sign plate in metres squared ( $\text{m}^2$ );
- $\rho$  is the density of air in kilograms per cubic metre ( $1.23 \text{ kg}\cdot\text{m}^{-3}$ );
- $V_e$  is the effective wind speed in metres per second ( $\text{ms}^{-1}$ ), as given in Table 1 (see 5.1); and
- $S$  is the function of  $C_w$  and  $\rho$  values of which are given in Table C.2.

Table C.1 Values of  $C_w$

Size of sign plate	Unframed	Framed
<1 500 mm	1.2	1.45
$\geq$ 1 500 mm	1.4	1.65

Table C.2 Values of  $S$

$C_w$	$S$
1.2	0.74
1.4	0.86
1.45	0.89
1.65	1.01

### C.2 Mass and positioning of ballast

Equations C.3 and C.4 shall be used to calculate the minimum recommended ballast required to resist overturning and sliding of a self-supporting rigid portable sign. These calculations assume that the sign assembly is designed so that the ballast is placed symmetrically about the longitudinal and transverse centrelines; if this is not so then the calculations shall be amended to take account of the actual position of the ballast.

### C.3 Overturning

The mass of the ballast plus sign support,  $W$ , in kilograms (kg), required to resist overturning shall be calculated using one of the following formulae:

- a) where the wind acts on the front of the sign plate:

$$W = \frac{Fy \cos \alpha - Fx \sin \alpha}{gb} - \frac{wx}{b} \quad (\text{C.3})$$

- b) where the wind acts on the rear of the sign plate:

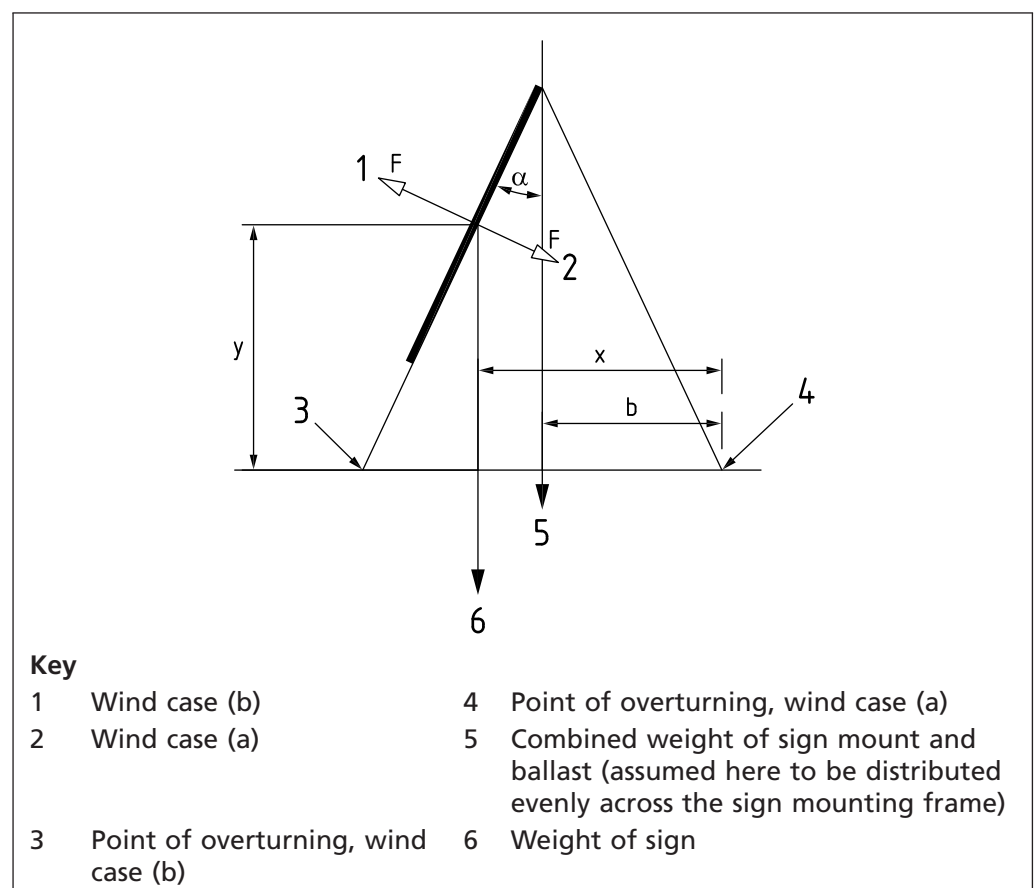
$$W = \frac{Fy \cos \alpha + Fx \sin \alpha}{gb} - \frac{wx}{b} \quad (\text{C.4})$$

where:

- $w$  is the mass of the sign plate in kilograms (kg);
- $F$  is the force on the sign plate due to wind pressure in Newtons (N);
- $W$  is the mass of the sign support and ballast in kilograms (kg);
- $\alpha$  is the angle of inclination of the sign plate in degrees ( $^{\circ}$ ), as shown in Figure C.1; and
- $g$  is the acceleration due to gravity ( $9.81 \text{ ms}^{-2}$ ).

*NOTE* Where wind acts on the rear of the sign plate, the values of  $x$ ,  $y$  and  $b$  for case (b) can be different because of the change in the point of overturning (see Figure C.1).

Figure C.1 Overturning moment diagram



#### C.4 Sliding

The mass of the ballast plus sign support,  $W$ , in kilograms (kg), required to resist sliding shall be calculated using one of the following formulae:

- a) where the wind acts on the front of the sign plate:



$$W = \frac{F \cos \alpha - F \sin \alpha}{\mu g} - \frac{w}{g} \quad (\text{C.5})$$

b) where the wind acts on the rear of the sign plate:

$$W = \frac{F \cos \alpha + F \sin \alpha}{\mu g} - \frac{w}{g} \quad (\text{C.6})$$

where:

$\mu$  is the coefficient of friction between the sign assembly supports and the surface on which they rest;  $\mu$  shall be taken as 0.6;

$g$  is the acceleration due to gravity ( $9.81 \text{ ms}^{-2}$ ).

*NOTE* Symbols are as indicated in Figure C.1 and in C.3.

## Annex D (informative)

### Classes of wind speed

The following notes on wind speed classes should be used as a guide for the sign manufacturer and the purchaser:

- a) Class A – This is the maximum wind speed likely to be experienced on any one day in any year in urban and rural locations in England and Wales. This does not include extremes such as estuarial or very high and exposed sites. A sign designed to resist Class A wind speed might be appropriate for longer term or more exposed works.
- b) Class B – This is the maximum wind speed likely to be experienced on any one day in the months of May, June and July in any year in urban and rural locations in England and Wales. A sign designed to resist Class B wind speed might be appropriate for works which are not always attended or which occur at less windy times of the year.
- c) Class C – This represents a maximum wind speed approximately half of that for Class B. A street sign designed to resist Class C wind speed might be appropriate for routine short term works, attended works and unplanned incidents which would not need Class A or B.

Urban locations in Scotland and Northern Ireland can be expected to experience similar wind speeds to those indicated in Table 1 (see 5.1), but rural locations should be expected to experience wind speeds as much as 40% greater.

## Annex E (normative)

### Test for overturning and sliding performance of self-supporting rigid portable signs

#### E.1 Principle

This test is used to determine that when ballasted for a wind class as recommended by its manufacturer, the rigid portable sign resists sliding and overturning. In this test, a pulley system is used to apply a load equal to that wind class and the sliding or overturning behaviour is noted.

#### E.2 Apparatus

**E.2.1 Test surface**, comprising wet-pressed or semi-dry concrete flags manufactured in accordance with BS 7263-1. The edges of the concrete flags shall be so placed as to not interfere with the potential sliding of the sign assembly.

**E.2.2 Pull cord**

**E.2.3 Pulley**

E.2.4 *Weight pan*, containing the weight to produce the required load

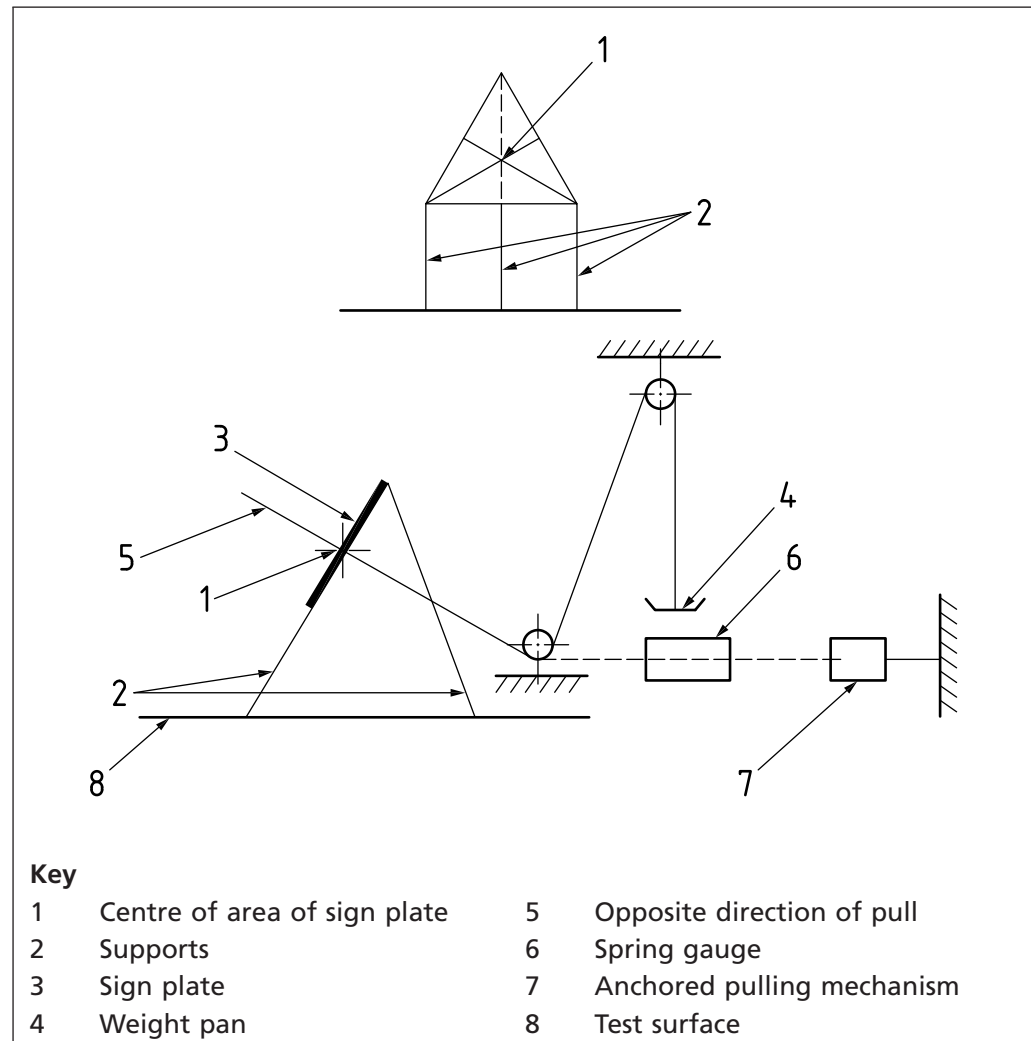
E.2.5 *Weight*

E.2.6 *Spring gauge*

E.2.7 *Pulling mechanism*

*NOTE* The pulling mechanism may be a block and tackle anchored to a wall. See Figure E.1.

Figure E.1 Test apparatus for stability and sliding performance



### E.3 Procedure

E.3.1 Erect the sign assembly in accordance with the manufacturer's instructions on the flat test surface as shown in Figure E.1.

E.3.2 Add the ballast specified by the manufacturer for the wind speed classification being tested.

E.3.3 Attach the pull cord directly to the centre of the sign plate area so that a force equivalent to one of the wind speeds in Table 1 (see 5.1) is applied perpendicular to the sign plate.

E.3.4 Either pass the cord over a pulley and connect it to a weight pan, or attach it via a spring gauge to a pulling mechanism, such as a block and tackle anchored to a wall, as shown in Figure E.1.

E.3.5 Apply the load until the design force derived from equation C.2 is reached or until the sign assembly overturns or slides.

E.3.6 Repeat the test procedure with the force applied to the reverse of the sign face.

#### E.4 Test report

The test report shall declare whether the ballasted product overturned or slid when (or before) the target wind force was applied to the face and the back of the sign.

Annex F  
(informative)

## Calculation of minimum recommended ballast required to resist overturning and sliding of barrier units

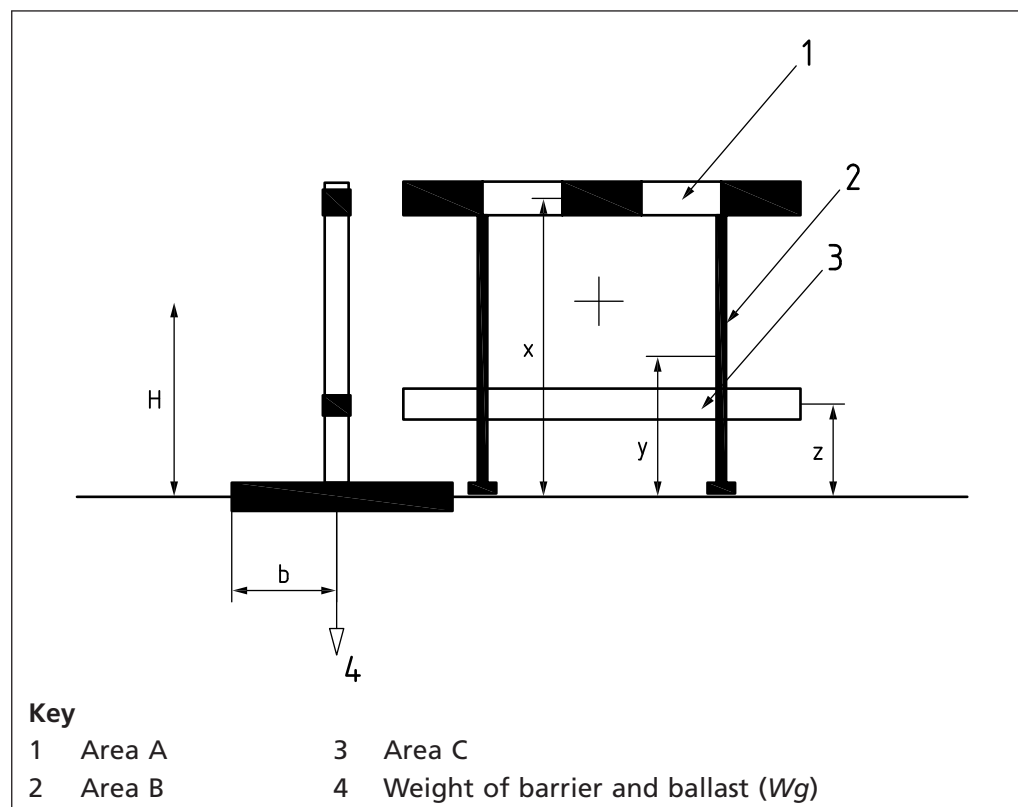
### F.1 Positioning of ballast

The calculations in equations F.2 and F.3 can be used to calculate the minimum recommended ballast to resist any overturning and sliding of barrier units.

### F.2 Overturning

*NOTE* Figure F.1 shows the physical attributes of barriers to use in equations F.1, F.2, F.3, F.5, F.6 and F.7.

Figure F.1 Resistance to overturning diagram



Both  $W$  (the mass of the barrier assembly and ballast) and  $P$  (the pull-over force) should be determined.

Taking moments about the point of overturning:

$$Wgb = PH = [F(Ax + 2By + Cz)] \quad (F.1)$$

$H$ ,  $W$  and  $P$  can be calculated from:

$$H = \frac{Ax + 2By + Cz}{(A + 2B + C)} \quad (F.2)$$

$$W = \frac{F(Ax + 2By + Cz)}{gb} \quad (F.3)$$

$$P = \frac{Wgb}{H} \quad (F.4)$$

where:

- $F$  is the force on the barrier assembly due to wind pressure, perpendicular to its surface in Newtons (N) (see equation C.2);
- $A, B$  and  $C$  is the area of the barrier assembly components in metres squared (m<sup>2</sup>);
- $x, y$  and  $z$  is the height of the centres of area of the barrier assembly components in metres (m);
- $H$  is the height of the pull-over weight application (the centre of pressure of the overall wind force) in metres (m);
- $P$  is the pull-over force in Newtons (N);
- $g$  is the acceleration due to gravity (9.81 ms<sup>-2</sup>);
- $W$  is the mass of the sign support and ballast in kilograms (kg).

This assumes, as in most cases, that the supports present a significant surface area.

The supports and joints should be strong enough to resist the forces imposed.

### F.3 Sliding

For sliding the sideways force,  $P$  is given by:

$$P = Wg\mu = F(A + 2B + C) \quad (F.5)$$

where:

- $\mu$  is the coefficient of friction between the sign assembly supports and the surface on which they rest;  $\mu$  should be taken as 0.6.

$W$  and  $P$  can be calculated from:

$$P = F(A + 2B + C) \quad (F.6)$$

$$W = \frac{F(A + 2B + C)}{\mu g} \quad (F.7)$$

## Annex G (normative)

### Test for impact resistance of flat traffic delineators (FTDs) at low temperature

#### G.1 Principle

This test is used to determine the effect of impact on an FTD at cold temperature. The FTD at the required temperature is held and struck by a weight. The effect, if any, on the FTD and the retroreflective material on it are noted.

#### G.1.1 Test sample

**G.1.1.1** Flat traffic delineator, complete with its retroreflective component.

## G.2 Apparatus

### G.2.1 Reference surface

G.2.2 *Steel ball*, of mass of  $(0.9 \pm 0.045)$  kg, suspended from one or two steel pendulum wires of not more than 1 mm diameter so that the pendulum radius is  $(1\ 750 \pm 10)$  mm

## G.3 Conditioning

G.3.1 Fix the base of the FTD to the reference surface.

G.3.2 Condition the sample for a period of not less than 2 h at a temperature of  $(-16 \pm 2)$  °C.

## G.4 Procedure

G.4.1 With the base of the FTD fixed to the reference surface, conduct impact testing less than 60 s after conditioning, using the steel ball swung on its pendulum.

G.4.2 The point of impact shall be vertically beneath the centre of radius of the pendulum and at a height on the specimen of  $(H/2 \pm 10)$  mm (where  $H$  is the height of the FTD) above the reference surface.

G.4.3 Examine the sample for:

- a) any damage to the retroreflective surface; and
- b) detachment of the blade from its base.

## G.5 Test report

A test report shall declare if the retroreflective sheeting has been damaged and the extent of that damage, as well as whether the blade of the FTD detached from its base.

Annex H  
(normative)

## Test for bending resistance of flat traffic delineators (FTDs)

### H.1 Principle

This test is used to determine the effect of bending on an FTD at cold and hot temperatures. The FTD at each required temperature is bent and any residual horizontal deflection measured and other effects noted.

#### H.1.1 Test sample

H.1.1.1 Flat traffic delineator, complete with its retroreflective component (not the same specimen tested in Annex G).

### H.2 Apparatus

#### H.2.1 Reference surface

### H.3 Conditioning

H.3.1 Fix the base of the FTD to the reference surface in accordance with the manufacturer's instructions for installation.

H.3.2 Cold condition the blade and its base for a period of not less than 2 h at a temperature of  $(-16 \pm 2)$  °C.

## H.4 Procedure

H.4.1 The bend testing is to take place at a temperature not greater than 25 °C. Cold conditioned samples shall be tested within 60 s of being taken from the cold environment.

H.4.2 With the base of the FTD fixed to the reference surface, bend the blade over its base line by applying a force to the face of the blade at a point on its vertical centre line ( $H/2 \pm 10$ ) mm from the top, so that the top edge touches the reference surface or the base (where  $H$  is the height of the FTD).

H.4.3 When the top edge of the blade touches the reference surface or base, remove the bending force immediately.

H.4.4 Between 30 s to 60 s after bending, measure the maximum residual horizontal deflection of the top of the blade from the vertical axis passing through the centre of the base of the blade and keep perpendicular to the reference surface.

H.4.5 Repeat the test in the opposite direction.

H.4.6 Repeat the procedure at a temperature of  $(32 \pm 2)$  °C.

H.4.7 Examine the sample for deflections, damage, detachment of the blade from its base, and any movement of the base.

## H.5 Test report

H.5.1 A test report shall include the extent of residual deflection in each direction at both test temperatures.

H.5.2 A test report shall also report whether the blade became detached from the base during testing and whether the base moved or separated from the reference surface.

Annex I  
(normative)

## Test for fatigue resistance of flat traffic delineators (FTDs)

### I.1 Principle

This test assesses the effect of fatigue on the FTD. In this test a sample is repeatedly oscillated at a set frequency after cold conditioning and then at an elevated temperature to determine whether fatigue damages the FTD or causes its blade to become detached from its base.

#### I.1.1 Test sample

I.1.1.1 Flat traffic delineator, complete with its retroreflective component (not the same specimen tested in Annex G or in Annex H).

### I.2 Apparatus

I.2.1 *Reference surface*

### I.3 Conditioning

I.3.1 Fix the blade to the base in accordance with the manufacturer's instructions for installation.

I.3.2 Condition the blade and its base for a period of not less than 2 h at a temperature of  $(-16 \pm 2)$  °C.

## I.4 Procedure

After conditioning, and with the blade fixed to the base in accordance with the manufacturer's instructions, oscillate the blade, at a frequency of between 60 and 90 oscillations per min, for 10 min by applying a force to the face of the blade at a point on its vertical centre line ( $H/2 \pm 10$ ) mm from the top.

The amplitude of the oscillation shall be at  $H/4$ , measured at the top with the reference surface held in a horizontal position, where  $H$  is the height of the FTD. One oscillation is the movement from the upright position to the maximum amplitude in one direction, then to the maximum amplitude in the opposite direction and then the return to the upright position.

I.4.1 Repeat the procedure at a temperature of  $(32 \pm 2)$  °C.

I.4.2 Examine the sample for damage and any detachment of the blade from its base.

## I.5 Test report

I.5.1 A test report shall report any damage to the FTD and at what stage it occurred.

I.5.2 A test report shall also report whether the blade detached from the base and the conditions at which this happened.

Annex J  
(normative)

## Measurement of the luminance of internally illuminated posts

### J.1 Principle

This test determines the mean and uniformity of luminance of internally illuminated posts.

#### J.1.1 Sample

J.1.1.1 Internally illuminated post

### J.2 Apparatus

J.2.1 *Luminance meter*

### J.3 Procedure

J.3.1 Illuminate the post using the light source and in the position specified by the manufacturer.

J.3.2 Take luminance measurements in a direction normal to the tangent to the surface of the illuminated part of the post, on an area of  $(25 \pm 0.5)$  mm projected diameter.

J.3.3 If the illuminated section of the post consists of completely illuminated bands, take four measurements at 90° intervals around the centre of each band.

J.3.4 If the illuminated section of the post consists of translucent openings in the shaft, take measurements in the centre of each opening.

J.3.5 Calculate the mean luminance and uniformity of luminance.

### J.4 Test report

Test reports shall report the measured luminance values, the mean luminance and the uniformity of luminance.

Annex K  
(normative)

## Determination of mean luminance and uniformity of luminance

### K.1 Principle

This test measures the luminance across the surface of the transilluminated retroreflective signs mounted on RSRBs (see Clause 13) and from this data calculate the mean luminance and the uniformity of luminance for each colour and determine the luminance contrast between colour combinations used on the signs. Single colour transilluminated retroreflective roundels of the same material as is used for the sign face on the finished RSRB product are used as proxies for the traffic sign roundel. This is done so that the maximum number of test squares containing a single colour can be tested. This test method is based on BS EN 12899-1:2007, 7.3.1.7, but differs from it in the size of the test squares used and in the use of full colour roundels as proxies for the traffic sign.

### K.2 Apparatus

K.2.1 *Luminance meter* conforming to BS EN 13032-1

### K.3 Calibration

K.3.1 Calibrate the luminance meter across the full range of measurements.

### K.4 Procedure

K.4.1 Each colour retroreflective roundel shall be mounted onto an RSRB using the same sheeting orientation that shall be used for the sign face on the finished product.

K.4.2 The supply voltage shall be stabilized at the value declared by the manufacturer.

K.4.3 The roundel shall be divided into test squares beginning at the centre of the sign face (see Figure 4).

K.4.4 The sides of the test squares shall be 50 mm.

K.4.5 The luminance shall be measured in a direction normal to the test square so that the circular area of the measuring spot falls on the centre of the test square.

K.4.6 Measurements for those test squares where the area of the circular measuring spot falls partly outside the retroreflective roundel shall be omitted.

K.4.7 After the application of any photometric correction factors, the mean luminance for each colour shall be calculated using simple averaging and the luminance uniformity for each colour shall be calculated as the ratio of the lowest measured luminance to the highest measured luminance for that sample.

K.4.8 Luminance contrast,  $K$  for two colours that occur on signs shall be calculated as the ratio of the larger mean luminance to the smaller mean luminance.

### K.5 Test report

The test report shall declare the luminance of each of the squares tested, the mean luminance for each applicable colour, the luminance uniformity for each colour and the luminance contrast for colour combinations to be used on traffic signs mounted on the final product.



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For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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