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Stalna vertikalna cestna signalizacija - 6. del: Vizualne zahteve za retroreflektivni premazne materiale

Fixed vertical road traffic signs - Part 6: Visual performance of retroreflective sheeting materials

Ortsfeste, vertikale Straßenverkehrszeichen - Teil 6: Visuelle Anforderungen an retroreflektierendes Beschichtungsmaterial

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Fixed vertical road traffic signs - Part 6: Visual performance of retroreflective sheeting materials

Ortsfeste, vertikale Straßenverkehrszeichen - Teil 6: Visuelle Anforderungen an retroreflektierendes Beschichtungsmaterial

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 226.

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Contents

Foreword

This document (prEN 12899-6:2008) has been prepared by Technical Committee CEN/TC 226 “Road equipment”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This European Standard consists of the following Parts under the general title:

Fixed, vertical road traffic signs —

Part 1: *Fixed signs*

Part 2: *Transilluminated traffic bollards (TTB)*

Part 3: *Delineator posts and retroreflectors*

Part 4: *Factory production control*

Part 5: *Initial type testing*

Part 6: **(This part)** *Visual performance of retroreflective sheeting materials*

Annexes A and B are normative.

The visual performance of retroreflective sheeting materials is is dependent on the properties of retroreflection, luminance factor and chromaticity. Retroreflection is the relevant characteristic for the legibility of road signs during night time driving, while luminance factor and chromaticity are relevant characteristics for the legibility of signs during the daytime (and for illuminated signs at night).

Test methods for retroreflection are provided in Annex A and for luminance factor and chromaticity in Annex B. These Annexes are of a complex technical nature, as they deal with retroreflective sheeting materials of both known technologies - glass beaded and microprismatic - and because the fluorescence of fluorescent sheeting materials has been taken into account in Annex B. These Annexes are primarily intended to be studied by experts working at test laboratories.

The requirements for retroreflection are provided in clause 4. A distinction is made between the situations in which a road sign has to be read and the level of luminance to be expected from a sign with a particular sheeting material in those situations. The situations are grouped into a number of application classes while the level of luminance is described by means of an R_A index. A number of classes of convenience called performance classes are defined by means of the R_A index.

This system of classes is intended as a tool for trading in the sense that the manufacturer of a retroreflective sheeting material can supply adequate documentation of the performance of his product, which is to be used by the purchaser of sheeting materials to select products that are suitable for particular purposes. The system of classes is complex - and has to be complex - in order to make good use of retroreflection. A single material cannot supply optimum or even adequate sign legibility in all applications, but some materials can do so in some applications and other materials in other applications.

However, it is assumed that the purchaser has some guidance through national regulations or tender specifications that define the application and performance classes for individual road signs or types or uses of road signs. Clause 4 is therefore intended primarily for the manufacturers of retroreflective sheeting materials and for national legislators perhaps assisted by specialists.

National regulations or tender specifications will reflect a national policy that may take several matters into account. Annex C is intended to provide guidance for formulating such a policy.

The requirements for the luminance factor and the chromaticity of retroreflective materials are provided in clause 5. These are formulated in a simple manner by means permissible values for the luminance factor and permissible chromaticity boxes for the chromaticity.

Introduction

A legend or a symbol on a sign face is presented in one colour against the background of another colour. One of these colours is generally brighter than the other and is called the signal colour, while the darker colour is called the contrast colour; refer to 3.1 and 3.2.

Some bright colours serve generally as signal colours, while some dark colours generally serve as contrast colours. A few colours may sometimes serve as signal and sometimes as contrast colours. The supplier of a sheeting material may decide which colours he wants to offer as signal and/or contrast colours.

The signal colour is considered to be the more important in terms of retroreflective performance. This has implications for the methods for deriving the coefficient of retroreflection R_A and for the requirements for retroreflection.

The methods for deriving the coefficient of retroreflection R_A are provided in Annex A. These methods are to be used for all sheeting materials regardless of their technology and the results may differ from those obtained with other test methods (for instance the simplified test method conventionally used for glass beaded sheeting materials).

The requirements for retroreflection are provided in clause 4. For signal colours, the requirements are expressed by technical classes for application and performance. For contrast colours, the requirements are expressed by the contrast to signal colours.

Some guidelines for the selection of application and performance classes are offered in the informative Annex C.

It is a particular feature of retroreflection that it has limitations. Consequently, application and performance classes cannot in practice be selected independently of each other. Additionally, the application class which is the most suitable for drivers of small vehicles may be less suitable for drivers of large vehicles.

Annex C is therefore intended as the basis for forming a policy for retroreflective road signs, in which conflicting interests are weighed against each other in a suitable manner.

The daytime performance is described in a conventional manner by means of requirements for the luminance factor and the chromaticity. The requirements are provided in clause 5 and the test methods in Annex B.

1 Scope

This standard specifies the visual performance for road users of retroreflective sheeting materials, as expressed by their retroreflection in vehicle headlamp illumination and their reflection and chromaticity in daylight.

2 Normative references

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

IEC 60050-845, *International Electrotechnical Vocabulary.Lighting*

CIE 15:2004, *Colorimetry*

CIE 54.2, *Retroreflection: definition and measurement*

3 Terms, definitions, symbols and abbreviations

For the purpose of this standard the following terms, definitions, symbols and abbreviations given in IEC 60050-845 and CIE 54.2 and the following apply:

3.1
signal colour
brightest colour of the sign face of a retroreflective sign

NOTE: The signal colour is white for most signs, but may be yellow, orange, fluorescent yellow or fluorescent yellow/green for some.

3.2
contrast colour
any colour of the sign face of a retroreflective sign that is not the signal colour

3.3
coefficient of retroreflection (of a plane retroreflecting surface), symbol R_A, unit $cd \cdot lx^{-1} \cdot m^{-2}$
ratio of the luminous intensity of a plane retroreflecting surface in the direction of observation to the illuminance at the retroreflecting surface measured on a plane perpendicular to the direction of the incident light in proportion to the area of the retroreflecting surface.

NOTE The value of the coefficient of retroreflection depends in principle on four angles, this being the number of angles needed to describe the directions of observation and incident light relative to the retroreflecting surface. Refer to CIE 54.2 for the definition of such angles and their combination into angular systems.

3.4
$R_{A,C}(\alpha,\beta)$ value
calculated value of the coefficient of retroreflection R_A for a combination of the observation angle α and the entrance angle β

NOTE 1 Definitions of the observation angle α and the entrance angle β are provided in CIE 54.2. A value of the observation angle α relates to the distance to a road sign and a value of the entrance angle β relates to the obliqueness at which the sign is illuminated.

NOTE 2 The $R_{A,C}(\alpha,\beta)$ value is calculated from various R_A measurements in which two additional angles have been varied. The calculation is such that the $R_{A,C}(\alpha,\beta)$ value is a reasonable representation of the coefficient of retroreflection R_A taking account of variation in vehicle geometries and location of signs.

3.5
application class
class defining the geometrical circumstances in which a road sign is to be read by drivers of passenger cars, comprising a number of values of the observation angle α and the entrance angle β

3.6
R_A index
index providing a single measure of the general level of retroreflective performance of a sheeting material for the geometrical circumstances of an application class

NOTE The R_A index value of a particular sheeting material will in general depend on the application class.

3.7
performance class
classification based on the R_A index value of a signal colour for a given application class

3.8
datum axis
direction relative to a retroreflective material indicating the orientation with which the material is to be mounted on a road sign so that the datum axis is pointed upwards

NOTE 1 A datum axis can be indicated by a datum mark on the material or can be the direction of the roll of the material or can be indicated in other ways and shall be declared by the manufacturer of the sheeting material.

NOTE 2 If the manufacturer declares more than one datum axis, one datum axis is distinguished as the primary datum axis while the others are secondary datum axes.

4 Retroreflection of retroreflective sheeting materials

4.1 Introduction

The retroreflection of a retroreflective sheeting material is in principle determined by R_A values. The R_A values shall be measured in accordance with 4.2, and shall be used to derive $R_{A,C}(\alpha,\beta)$ values by calculation as also accounted for in 4.2 by reference to Annex A.

Refer to 3.3 for a definition of R_A and to 3.4 for a definition of $R_{A,C}(\alpha,\beta)$. Further explanation of the purpose of reduction of a set of measured R_A values to a smaller set of calculated $R_{A,C}(\alpha,\beta)$ values can be found in 4.2 and Annex C.

The performance of a retroreflective sheeting material is judged by comparison of $R_{A,C}(\alpha,\beta)$ values to reference $R_{A,R}(\alpha,\beta)$ values. The reference $R_{A,R}(\alpha,\beta)$ values are introduced in 4.3 which also provides some explanation. Further explanation can be found in Annex C.

This comparison is carried out for signal colours of a sheeting material, while contrast colours are considered in a different manner to be explained later. Signal and contrast colours are defined in 3.1 and 3.2 respectively.

The comparison includes a selection of (α,β) cases that corresponds to a certain application of the sheeting material in terms of a distance range and an entrance angularity. Such a selection defines an application class and several of these are introduced in 4.3.

The method of comparison is accounted for in 4.4. The result of a comparison is an R_A index, which is used to determine a performance class by comparison with a scale of values as also accounted for in 4.4. Both the R_A index and the performance class is specific for a particular signal colour of the sheeting material and a particular application class.

An R_A index for a particular signal colour is in principle valid for a particular datum axis and has relevance only if the sheeting material is finally employed with this datum axis pointed upwards. Refer to 3.8 for a definition of datum axis.

The manufacturer of a sheeting material shall declare the datum axis. The manufacturer can declare more than one datum axis. If so, one datum axis is distinguished as the primary datum axis while the others are secondary datum axes. Secondary datum axes are defined by clockwise rotations relative to the primary datum axis.

A specific way to declare more than one datum axis is to declare datum axis reversal symmetry or datum axis rotation symmetry, meaning respectively that the material can be applied with a 180° rotation, or with any rotation.

The derivation of R_A index for secondary datum axes is accounted for in 4.5.

A contrast colour is judged by means of the ratio between the $R_{A,C}(\alpha,\beta)$ value of the contrast colour and $R_{A,C}(\alpha,\beta)$ value for the signal colour white. This ratio is requested to be in a permissible range that is specific to the contrast colour in question, refer to 4.6.

4.2 Derivation of the coefficient of retroreflection for signal and contrast colours

A sign face is assumed to combine a signal colour and a contrast colour, refer to 3.1 and 3.2. The retroreflectivity of these different colours is represented by different values of $R_{A,C}(\alpha,\beta)$.

The expression $R_{A,C}(\alpha,\beta)$ means the R_A value for a particular combination of the observation angle α and the entrance angle β, refer to 3.4. $R_{A,C}(\alpha,\beta)$ values shall be obtained by the methods provided in Annex A, measuring R_A for one or more geometrical situations.

4.3 Application classes for signal colours

The classifications are based on comparison of $R_{A,C}(\alpha,\beta)$ values of the signal colour with the $R_{A,R}(\alpha,\beta)$ reference values provided in Table 1 for particular cases of α and β.

Table 1 - $R_{A,R}(\alpha,\beta)$ reference values for white parts of road signs

Observation angle α	Entrance angle β			
	5°	15°	30°	40°
0,20°	66,4	64,4	57,7	51,0
0,33°	32,9	31,9	28,6	25,3
0,50°	18,4	17,8	16,0	14,2
0,70°	11,5	11,1	9,99	8,84
1,00°	6,97	6,76	6,06	5,36
1,50°	3,95	3,83	3,44	3,04
2,00°	2,64	2,56	2,30	2,03

NOTE 1 The observation angle α relates to the distance between a sign and a vehicle (small α corresponds to a large distance), while the entrance angle β relates to the obliqueness with which the headlight of the vehicle illuminates the sign.

NOTE 2 The $R_{A,R}(\alpha,\beta)$ reference values correspond to a constant sign luminance of 1 cd/m². These values are provided in Table 1 and come from the function $R_A = 6{,}99 \times \alpha^{-1{,}4} \times \cos\beta$.

The comparison between $R_{A,C}(\alpha,\beta)$ values of the signal colour and $R_{A,R}(\alpha,\beta)$ reference values is limited to one or more selections of cases of α and β as indicated in Table 2. These selections correspond to the following application classes:

- A11 : long distance, narrow entrance angularity (up to 5° entrance angularity)
- A12 : long distance, medium entrance angularity (up to 15° entrance angularity)
- A21 : medium distance, narrow entrance angularity (up to 5° entrance angularity)
- A22 : medium distance, medium entrance angularity (up to 15° entrance angularity)
- A23 : medium distance, wide entrance angularity (up to 30° entrance angularity)
- A31 : short distance, narrow entrance angularity (up to 5° entrance angularity)
- A32 : short distance, medium entrance angularity (up to 15° entrance angularity)
- A33 : short distance, wide entrance angularity (up to 30° entrance angularity)
- A34 : short distance, extra wide entrance angularity (up to 40° entrance angularity)

Long, medium and short distances relate to ranges of distances that are relevant for signs on different types of roads depending on driving speeds and other matters. Narrow, medium, wide and extra wide entrance angularity refers to the need to ensure performance in situations with oblique light incident on the signs.

Two or more classes of entrance angularity can be applied simultaneously.

For example: in recognition that the majority of signs are positioned at small entrance angles, the 5° entrance angularity class can be applied with a high performance class. Simultaneously a lower performance class can be applied for the 15° and 30° entrance angularity class, as there are likely to be some signs viewed at larger entrance angles. This would emphasise the performance requirement for the majority of signs that are positioned at small entrance angles and still require a level of performance for those signs viewed at wider entrance angles.

The classes A11, A21 and A31 shall only be applied in combination with other application classes with wider entrance angularity, as the narrow entrance angularity is not sufficient in itself. Refer to C.7 for further information.

Table 2 - Selections of cases for application classes A11, A12, A21, A22, A23, A,31, A32, A33 and A34

Class A11

α	β
	5°
0,20°	66,4
0,33°	32,9
0,50°	18,4
0,70°	11,5
1,00°	6,97
1,50°	-
2,00°	-

Class A12

β	
5°	15°
66,4	64,4
32,9	31,9
18,4	17,8
11,5	11,1
6,97	6,76
-	-
-	-

Class A21

α	β
	5°
0,20°	-
0,33°	32,9
0,50°	18,4
0,70°	11,5
1,00°	6,97
1,50°	3,95
2,00°	-

Class A22

β	
5°	15°
-	-
32,9	31,9
18,4	17,8
11,5	11,1
6,97	6,76
3,95	3,83
-	-

Class A23

β		
5°	15°	30°
-	-	-
32,9	31,9	28,6
18,4	17,8	16,0
11,5	11,1	9,99
6,97	6,76	6,06
3,95	3,83	3,44
-	-	-

Class A31

α	β
	5°
0,20°	-
0,33°	-
0,50°	18,4
0,70°	11,5
1,00°	6,97
1,50°	3,95
2,00°	2,64

Class A32

β	
5°	15°
-	-
-	-
18,4	17,8
11,5	11,1
6,97	6,76
3,95	3,83
2,64	2,56

Class A33

β		
5°	15°	30°
-	-	-
-	-	-
18,4	17,8	16,0
11,5	11,1	9,99
6,97	6,76	6,06
3,95	3,83	3,44
2,64	2,56	2,03

Class A34

β			
5°	15°	30°	40°
-	-	-	-
-	-	-	-
18,4	17,8	16,0	14,2
11,5	11,1	9,99	8,84
6,97	6,76	6,06	5,36
3,95	3,83	3,44	3,04
2,64	2,56	2,30	2,03

4.4 Performance classes for signal colours

For a particular signal colour and application class, an R_A index is derived in three steps:

I: the ratios are formed between $R_{A,C}(\alpha,\beta)$ values of the signal colour and $R_{A,R}(\alpha,\beta)$ reference values for each of the cases in the selection corresponding to the class

II: for each column of β cases within the selection, the harmonic mean of the ratios formed in step I is formed

III: the R_A index value is selected as the smallest of the harmonic means formed in step II.

The harmonic means to be determined in step II include five ratios R_1, R_2, R_3, R_4 and R_5. The harmonic mean is determined as $5/(1/R_1+1/R_2+1/R_3+1/R_4+1/R_5)$.

NOTE The R_A index is a single measure of the general level of retroreflection of a sheeting material as compared to the $R_{A,R}(\alpha,\beta)$ reference values. An R_A index applies for a particular application class; the value will in general depend on the application class.

EXAMPLE 1 (applies to application class A23): The R_A index is determined in three steps. In step I the ratios between the $R_{A,R}(\alpha,\beta)$ reference values and the $R_{A,C}(\alpha,\beta)$ values of the signal colour are formed, in step II the harmonic means of the ratios are formed for each relevant case of the entrance angle β and in step III the smallest of these harmonic means is selected.

$R_{A,R}(\alpha,\beta)$ reference values

Observation angle α	Entrance angle β		
	5°	15°	30°
0,20°	-	-	-
0,33°	32,9	31,9	28,6
0,50°	18,4	17,8	16,0
0,70°	11,5	11,1	9,99
1,00°	6,97	6,76	6,06
1,50°	3,95	3,83	3,44
2,00°	-	-	-

step II:	
step III:	

$R_{A,C}(\alpha,\beta)$ values of the signal colour

Entrance angle β		
5°	15°	30°
-	-	-
432	370	183
340	306	151
230	198	97,4
103	89,1	44,0
28,2	25,2	11,3
-	-	-

harmonic means	
minimum	

step I: Ratios

Entrance angle β		
5°	15°	30°
-	-	-
13,1	11,6	6,40
18,5	17,2	9,44
20,0	17,8	9,75
14,8	13,2	7,26
7,14	6,58	3,28
-	-	-

12,9	11,7	6,19
6,19		

For a particular application class, the R_A index is used to decide the performance class in accordance with the minimum requirements of Table 3.

Table 3 - Minimum requirements for performance classes

performance class	signal colour		
	white	yellow	orange
P0	NPD *)	NPD *)	NPD *)
P1	R_A index ≥ 1,4	R_A index ≥ 1,0	R_A index ≥ 0,7
P2	R_A index ≥ 2,0	R_A index ≥ 1,4	R_A index ≥ 1,0
P3	R_A index ≥ 2,8	R_A index ≥ 2,0	R_A index ≥ 1,4
P4	R_A index ≥ 4,0	R_A index ≥ 2,8	R_A index ≥ 2,0
P5	R_A index ≥ 5,6	R_A index ≥ 4,0	R_A index ≥ 2,8
P6	R_A index ≥ 8,0	R_A index ≥ 5,6	R_A index ≥ 4,0
P7	R_A index ≥ 11,3	R_A index ≥ 8,0	R_A index ≥ 5,6
P8	R_A index ≥ 16,0	R_A index ≥ 11,3	R_A index ≥ 8,0
*) no performance determined			

EXAMPLE 2: An R_A index of 6,19 for the signal colour white leads to performance class P5.