EUROPEAN STANDARD **EN 12966-1**

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English version

Vertical road signs—Part 1: Variable message signs

Signaux de signalisation routière verticale—Partie 1: Panneaux à messages variables

Ortsfeste, vertikale Verkehrszeichen—Teil 1: Wechselverkehrszeichen

This European Standard was approved by CEN on DD MM YYYY

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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Foreword

This document EN 12966-1:2008 has been prepared by Technical Committee CEN/TC 226 “”, the secretariat of which is held by AFNOR.

This document is currently submitted to UAP.

This document has to be implemented at national level, either by publication of an identical text or by endorsement, by month year, and conflicting national standards have to be withdrawn by month year.

No existing European Standard is superseded.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s). For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

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

Vertical road traffic signs

- **Part 1 : (this part) *Variable message signs (VMS)***

- Part 2 : *Variable message signs - Initial type testing*

- Part 3 : *Variable message signs - Factory production control*

It derives from performance requirements and test methods published in CEN, CENELEC, CIE and ISO documents together with standards of the CEN member organisations.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard is designed for use by Road Authorities and private developers who wish to use variable message signs. It provides performance requirements and the means of evaluation of conformity to those requirements.

This European Standard is a product standard covering the requirements for Variable Message Signs (VMS). A VMS is a sign where the information shown can be changed. The information can be text and/or symbols.

This European Standard does not describe the detailed form and configuration of a VMS. Therefore test modules are used to demonstrate conformance with the requirements of this standard because of the impracticality of testing some complete signs.

Because of the major demands on a sign for good legibility and visibility throughout the required viewing range, the main properties of the sign are described. These properties can vary depending on the situation. For example, it will be not necessary to ask for a minimum temperature requirement of -40 °C in Greece, but this must be considered in Lapland. For visual performance there will be a difference between installation on highways - with good distance visibility and a narrow beam width - and installation in cities, where there is only short distance legibility and when a wide beam may be required.

This European Standard uses performance requirements, which are not dependent on technology. The visual and environmental performance is demonstrated on a test module. This European Standard contains a number of defined requirements, some of which have to be demonstrated on the test module, others that are to be verified by the manufacturer. It is the manufacturer’s responsibility to ensure that the final product is fully representative of the test module.

The main properties of VMS are divided into classes, which are designed to be selected by choosing a combination of classes dependent on the situation and purchaser requirements. This combination covers not only the regulatory requirements of the territory of destination but also issues of lifetime, quality, maintenance and construction, all of which affect the ability of a sign in its particular application, to meet safety and fitness for purpose. The details in the informative annexes are provided as useful guidance on the additional aspects relating to VMS for those setting up purchasing contracts for signs or signing systems.

The working environment for VMS can be relatively harsh and equipment that is deemed "fit for purpose" is expected to last in an exposed, corrosive environment for a minimum of 10 years. It is essential that all materials and manufacturing processes take this into account. The manufacturer should detail all steps taken to comply with this.

1 Scope

This part of EN 12966 specifies requirements and test methods for new Variable Message Signs (VMS).

VMS comprise two types, Continuous and Discontinuous signs :

- continuous signs are those that are similar to fixed signs, the only difference being that by some electro-mechanical means they can show various messages.

NOTE: for example rotating prism signs, roller blinds, ….

- discontinuous signs create messages using individual elements that can be in one of two states (or more) and can thereby create various messages on the same sign face.

NOTE: for example fibre optic signs, LED signs, …..

This European Standard covers the performance requirements for Variable Message Signs used for the instruction and guidance of road users on public and private land, including tunnels. In the standard a number of different performance requirements (visual performance, EMC, environmental performance, etc) are covered, as well as durability.

The EMC, safety and environmental requirements for both types of VMS are included in this standard together with the Visual performance for the Discontinuous types VMS.

The visual performance for continuous signs and externally illuminated discontinuous signs is covered by EN 12899-1.

This European Standard defines performance limits and a range of performance classes for both sign assemblies without vertical support and assemblies complete with vertical support.

The control of the luminance of luminous signs with respect to the ambient light is not covered by this document

Not covered by this standard:

a) Sign gantries, cantilevers and foundations;

b) Signal heads;

c) Sizes and shapes of VMS messages;

d) Control units and monitoring units unless inside the test module ;

e) Sign luminance control; the control of the luminance of luminous signs with respect to the ambient light is not covered by this document

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 12767, *Passive safety of support structures for road equipment — Requirements and test methods*

EN 12899-1, *Fixed, vertical road traffic signs — Part1: Fixed signs*

EN 50293, *Electromagnetic compatibility — Road traffic signal systems — Product standard*

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

EN 60598-1, *Luminaries — Part 1: general requirements and tests*

ISO 7000, *Graphical symbols for use on equipment — Index and synopsis*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray test*

IEC 60068-2-1, *Environmental testing — Part 2: Tests — Tests A: cold*

IEC 60068-2-2, *Basic environmental testing procedures — Part 2: Tests B: dry heat*

IEC 60068-2-5, *Environmental testing — Part 2: Tests — Test Sa: simulated solar radiation at ground level*

IEC 60068-2-14, *Environmental testing — Part 2: Tests — Test N: change of temperature*

IEC 60068-2-30, *Environmental testing — Part 2: Tests — Test Db and guidance: damp heat, cyclic (12 plus 12 hour cycle)*

IEC 60068-2–64, *Environmental testing — Part 2: Tests — Vibration test*

IEC 60417-1, *Graphical symbols for use on equipment*

IEC 60664-1, *Insulation co-ordination for equipment within Low-voltage systems — Part 1: Principles, requirements and tests*

CIE Publication No. 15.2, *Colorimetry*

CIE Publication No. 17.4, *International lighting vocabulary*

CIE Standard No. S 004/E, *Colours of light signals*

HD 384-4, *Electrical installation of buildings — Part 4 : Protection for safety*

HD 638, *Road Traffic Signal Systems*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions given in CIE Publication Nos. 15.2 and 17.4 and the following apply.

When reading this document for the first time, particular attention should be paid to Annex B.

3.1 backing-board
the surround to the VMS, used depending on local circumstances, providing improved visibility of the VMS by means of broadening its size and by providing suitable visible contrast with the VMS background

3.2 cantilever support
support system with a single post and a cantilever arm supporting VMS(s) mounted over the traffic lane(s)

3.3 control device
equipment used to execute a change of message other than by purely manual means

3.4 display surface
the visible part of a VMS that contains the elements that may be activated to display the message

3.5 element
the basic visual light emitting and/or reflecting object or cluster of objects in the display surface of a VMS, activated in conjunction with other elements to form the desired message

3.6 equivalent area
see Annex A (normative): Equivalent area

3.7 front panel
the visible part of a sign comprising the display surface; and the backing-board when this is integrated in the front of the VMS

3.8 front screen
A screen protecting the display surface or the parts of it against dust, water, etc…

3.9 gantry
support system spanning a carriageway with one or more posts on each side of the carriageway supporting VMS mounted over the traffic lanes

3.10 horizontal reference plane
the horizontal plane containing the reference axis, when the VMS is positioned in such a way that the reference axis is horizontal

3.11 lay-out
the physical arrangement of characters (text) and symbols, on the display surface

3.12 luminance ratio (LR)
the ratio of luminance emitted from the sign in the ON state compared to the luminance in the OFF state. Luminance ratio shall be calculated as follows:

$$LR = \frac{L_a - L_b}{L_b}$$

where

L_a is the measured luminance of the sign in the ON-state when under external illumination

L_b is the measured luminance of the sign in the OFF-state when under external illumination

3.13 matrix
a grid whose intersections hold the centre of the elements used in a VMS. A matrix may cover the whole display surface or part of it. Axes X and Y of the grid may or may not be orthogonal

3.13.1 irregular matrix
the spacing of intersections on either X or Y or both axes is not constant

3.13.2 regular matrix
the spacing of intersections on the X and Y axes is constant but may be different

3.14 message
a configuration consisting of symbols and/or text

3.15 reference axis
the axis originating on the reference centre of the test module being perpendicular to the front of it, unless otherwise defined by the manufacturer

3.16 reference centre
a point on or near the test module which is designated to be the centre of the device for specifying its performance and which shall be defined by the manufacturer

3.17 test angles
the horizontal test angle is the angle between the test axis and the vertical reference plane; and the vertical test angle is the angle between the test axis and the horizontal reference plane

NOTE 1: When the test axis is lower than the horizontal reference plane the vertical component of the test angle is designated as negative.

NOTE 2: When the test axis is to the left of the vertical reference plane as seen from the reference centre the horizontal component is designated as negative.

3.18 test axis
the line from the reference centre of the test module to the luminance meter head

3.19 variable Message Sign (VMS)
a sign for the purpose of displaying one of a number of messages that may be changed or switched on or off as required

3.20 vertical reference plane
the vertical plane containing the reference axis

3.21 VMS background
the part of environmental scenery, which, to the viewer, immediately surrounds the VMS

4 Dimensions and tolerances

The limits related to performance requirements and tests specified and defined in this standard are minimum or maximum values as stated. Dimensions, shape and other physical parameters, character sizes, tolerances and character spacing shall be as required by the purchaser. The dimensions of the characters and symbols shall be defined using equivalent area as detailed in Annex A.

5 General design requirements

The manufacturer shall provide a maintenance manual. This shall include details of routine maintenance recommendations of spare parts and details of estimated lifetime of components. The design shall ensure that all maintenance activities can be easily carried out. The manufacturer shall also offer a maintenance service if required.

All parts of the sign shall be securely connected to the VMS housing.

NOTE: See Annex E (informative): “Specific design issues” gives guidelines.

6 Materials

Materials used for housings and front panels shall be resistant to corrosion in accordance with clause 5.3.5 of EN 12899-1 and shall conform to the European Standard for the appropriate material where it exists. Manufacturers using materials not covered by European Standards shall demonstrate the durability of the material by reference to an appropriate European technical assessment.

NOTE: This is the only occasion where tests may be carried out on material and not the whole test module.

7 Visual performance

The visual performance for continuous signs and externally illuminated discontinuous signs is covered by EN 12899-1.

7.1 Classification

The manufacturer shall declare the relevant class designations for his products. This shall be in accordance with those photometric parameter classes listed in Table 1.

Table 1 — Class designation of the photometric parameters of the VMS

Photometric parameter	Class designation	Remarks
Colour	C1, C2	C2 is the more restrictive
Luminance (L_a)	L1, L2, L3, L3(*)	L3 has the highest luminance (*) for specific situations
	L1(T), L2(T), L3(T)	These classes are for tunnel use
Luminance ratio (LR)	R1, R2, R3	R3 has the highest luminance ratio
Beam width	B1, B2, B3, B4, B5, B6, B7	B7 has the widest beam

NOTE 1: The purchaser should select the appropriate parameter classes relevant to the application. Care is needed because some class-combinations are not possible and/or not effective.

NOTE 2: Specific design issues are covered in Annex D.3, where guidelines are given on class combinations

7.2 Colour

The colour coordinates shall be measured in accordance with 9.3.5. The chromaticity of the colours is defined in accordance with the CIE 1931 Standard Colorimetric Observer as referenced in CIE publication 15.2.

The chromaticity for the colours of the colour class C1 shall conform to Table 2. The chromaticity for the colours of the colour class C2 shall conform to Table 3. In Figure 1 these chromaticity areas are plotted in a CIE 1931 chromaticity diagram.

The colour white/yellow shall not be used when there is a need to differentiate between white and yellow. When there is a need to differentiate between white and yellow the colours shall conform to the specified chromaticities in Table 2 or Table 3 for white and yellow respectively.

The chromaticity limits in Table 2 and Table 3, with the exception of white/yellow, are recommended in CIE Standard S 004/E as colours for signal lights.

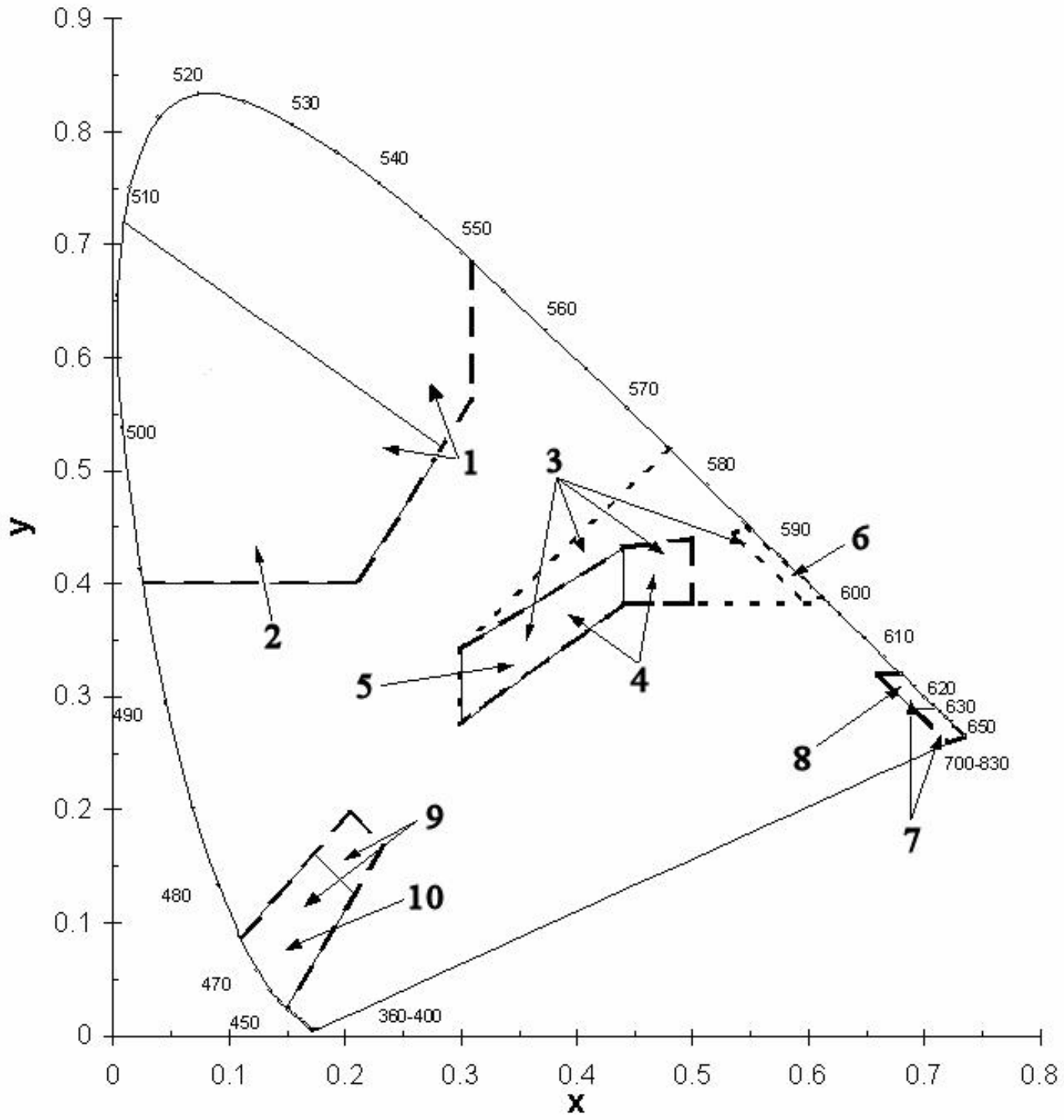
NOTE: The chromaticity limits in Table 3 are recommended to be used when there is a clear need to distinguish between colours.

Table 2 — Corner points (CIE 1931 chromaticity co-ordinates x, y) of the chromaticity areas for the colours of class C1

Colour	Colour co-ordinates						
	corner point =>	1	2	3	4	5	6
Red	x	0.660	0.680	0.735	0.721	-	-
	y	0.320	0.320	0.265	0.259	-	-
Yellow	x	0.536	0.547	0.613	0.593	-	-
	y	0.444	0.452	0.387	0.387	-	-
White	x	0.300	0.440	0.500	0.500	0.440	0.300
	y	0.342	0.432	0.440	0.382	0.382	0.276
White/yellow	x	0.479	0.300	0.300	0.440	0.618	
	y	0.520	0.342	0.276	0.382	0.382	
Green	x	0.310	0.310	0.209	0.028	-	-
	y	0.684	0.562	0.400	0.400	-	-
Blue	x	0.109	0.204	0.233	0.149	-	-
	y	0.087	0.196	0.167	0.025	-	-

Table 3 — Corner points (CIE 1931 chromaticity co-ordinates x, y) of the chromaticity areas for the colours of class C2

Colour	Colour co-ordinates					
	corner point = >	1	2	3	4	5
Red	x	0.660	0.680	0.710	0.690	-
	Y	0.320	0.320	0.290	0.290	-
Yellow	x	0.536	0.547	0.613	0.593	-
	Y	0.444	0.452	0.387	0.387	-
White	x	0.300	0.440	0.440	0.300	-
	Y	0.342	0.432	0.382	0.276	-
White/yellow	x	0.479	0.300	0.300	0.440	0.618
	Y	0.520	0.342	0.276	0.382	0.382
Green	x	0.009	0.284	0.209	0.028	-
	Y	0.720	0.520	0.400	0.400	-
Blue	x	0.109	0.173	0.208	0.149	-
	Y	0.087	0.160	0.125	0.025	-



Key

- - - Class C1 and C2
– – Class C1
— Class C2

1 green C1
2 green C2
3 white/yellow C1, C2
4 white C1
5 white C2
6 yellow C1, C2
7 red C1
8 red C2
9 blue C1
10 blue C2

Figure 1 — Allowed chromaticity areas for the colour classes C1 and C2 plotted in the CIE 1931 chromaticity diagram

7.3 Luminance

The luminance shall be measured in accordance with 9.3.2, under external illumination from a solar simulator and with the test module switched on. The Luminance values measured shall comply with Table 4a to Table 4f as applicable.

For use in tunnels, only sign luminances corresponding to sign illuminances of 400 lx or less are required. These are designated (T) in Table 1.

For specific situations (e.g. with the sun low in the sky) the purchaser can require that additional luminance and luminance ratios be measured with the external illumination set to 10 000 lx at 5°. This is denoted by an (*) in Tables 4a-4f.

NOTE 1: The maximum luminance values of the classes L1, L2, and L3, are a factor 5 higher than the minimum luminances of class L3.

NOTE 2: Specific design issues are covered in Annex D.3, where guidelines are given on class combinations

Table 4a — Luminance (La) limits for white, on reference axis, for the luminance classes L1, L2, L3 and L3(*)

Sign illuminance (lx)	Luminance (cd/m^2)			
	Minimum			Maximum
	L3	L2	L1	L1, L2, L3
40 000	12 400	6 200	3 100	62 000
10 000	12 400 (*)	-	-	-
4 000	2 200	1 100	550	11 000
400	600	300	150	3 000
40	250	200	100	1 250
≤ 4	75	60	30	375

Table 4b — Luminance (La) limits for white/yellow, on reference axis, for the luminance classes L1, L2, L3 and L3(*)

Sign illuminance (lx)	Luminance (cd/m^2)			
	Minimum			Maximum
	L3	L2	L1	L1, L2, L3
40 000	10 540	5 270	2 635	52 700
10 000	10 540 (*)	-	-	-
4 000	1 870	935	468	9 350
400	510	255	128	2 550
40	213	170	85	1 065
≤ 4	64	51	26	320

Table 4c — Luminance (La) limits for yellow, on reference axis, for the luminance classes L1, L2, L3 and L3(*)

Sign illuminance (lx)	Luminance (cd/m^2)			
	Minimum			Maximum
	L3	L2	L1	L1, L2, L3
40 000	7 440	3 720	1 860	37 200
10 000	7 440 (*)	-	-	-
4 000	1 320	660	330	6 600
400	360	180	90	1 800
40	150	120	60	750
≤ 4	45	36	18	225

Table 4d — Luminance (La) limits for green, on reference axis, for the luminance classes L1, L2, L3 and L3(*)

Sign illuminance (lx)	Luminance (cd/m^2)			
	Minimum			Maximum
	L3	L2	L1	L1, L2, L3
40 000	3 720	1 860	930	18 600
10 000	3 720 (*)	-	-	-
4 000	660	330	165	3 300
400	180	90	45	900
40	75	60	30	375
≤ 4	23	18	9.0	115

Table 4e — Luminance (La) limits for red, on reference axis, for the luminance classes L1, L2, L3 and L3(*)

Sign illuminance (lx)	Luminance (cd/m^2)			
	Minimum			Maximum
	L3	L2	L1	L1, L2, L3
40 000	3 100	1 550	775	15 500
10 000	3 100 (*)	-	-	-
4 000	550	275	138	2 750
400	150	75	38	750
40	63	50	25	315
≤ 4	19	15	7.5	95

Table 4f — Luminance (La) limits for blue, on reference axis, for the luminance classes L1, L2, L3 and L3(*)

Sign illuminance (lx)	Luminance (cd/m^2)			
	Minimum			Maximum
	L3	L2	L1	L1, L2, L3
40 000	1 240	620	310	6 200
10 000	1 240 (*)	-	-	-
4 000	220	110	55	1 100
400	60	30	15	300
40	25	20	10	125
≤ 4	7.5	6.0	3.0	37.5

Additionally, for classes L3, L3(*) and L2, the sign shall achieve the relevant luminance values without the external illumination (solar simulator OFF) when the sign is set for the 40 000 lx test.

When the tunnel sign is set for the 400 lx test, the sign shall achieve the relevant luminance values without the external illumination (solar simulator OFF).

7.4 Luminance ratio

The minimum luminance ratios for the various colours shall be in accordance with Table 5. The luminance ratio values shall be maintained for all illuminances between 400 lx and 40 000 lx. The test angles are dependent on the beam width class, see 7.5 and 9.3.2.3.

Table 5 — Minimum luminance ratios (LR) for various colours and classes R1, R2 and R3, at test angles on the reference axis and off the reference axis

Colour	Minimum luminance ratio					
	R3		R2		R1	
	on reference axis	off reference axis	on reference axis	off reference axis	on reference axis	off reference axis
White	16.7	8.35	10	5	5	3
white/yellow	14.2	7.1	8.5	4.25	4.25	2.55
Yellow	10	5	6	3	3	1.8
Green	5	2.5	3	1.5	1.5	0.9
Red	4.2	2.1	2.5	1.25	1.25	0.75
Blue	1.7	0.85	1	0.5	0.5	0.3

NOTE 1: For illuminances below 400 lx (e.g. tunnels) there is no luminance ratio requirement.

NOTE 2: Specific design issues are covered in Annex D.3, where guidelines are given on class combinations.

7.5 Beam width

Beam width shall be measured in accordance with 9.3.3.

Within the beam width angles, the measured luminance shall not be lower than 50% of the measured luminance on the reference axis.

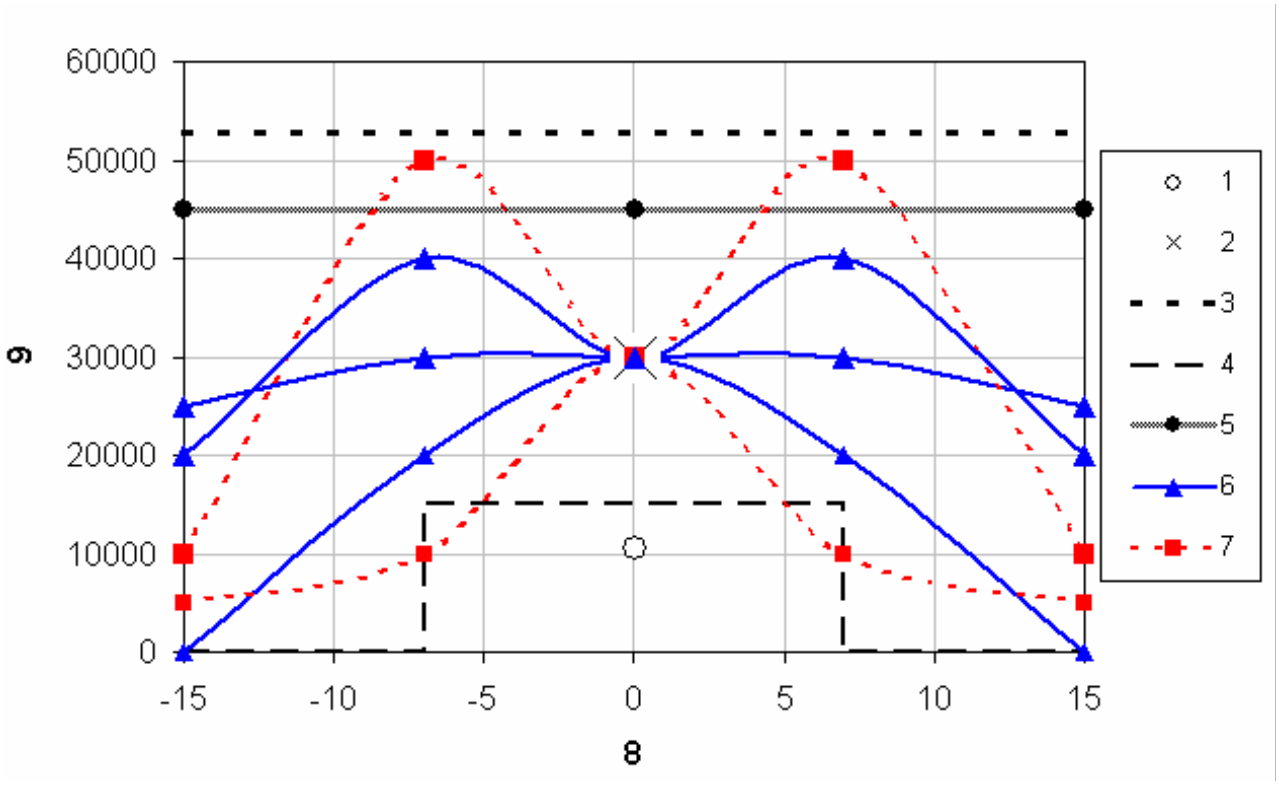
Table 6 shows the seven beam width classes.

At all angles the luminance shall not be more than 150% of the measured luminance on the reference axis.

Any measured luminance at any angle shall not exceed the maximum luminance in accordance with Tables 4a to 4f.

NOTE 1: Figure 2 shows examples of passed and not passed luminance distributions for the white/yellow colour, class luminance L3, and beam width class B2 at a sign illuminance of 40 000 lx.

NOTE 2: Specific design issues are covered in Annex D.3, where guidelines are given on class combinations.



Key

1 = minimum luminance at reference axis
2 = actual measured luminance (L_{mes}) at reference axis
3 = maximum luminance at all angles
4 = lower limit (50% of L_{mes})
5 = upper limit (150% of L_{mes})
6 = passed distributions
7 = not passed distributions
8 = horizontal angle (degrees)
9= luminance ($cd.m^{-2}$)

Figure 2 — Examples of passed and not passed luminance distributions for class luminance L3, colour white/yellow, and beam width class B2 at a sign illuminance of 40000 lx.

The luminance for this colour at the reference axis should be in the range 10 540 to 52 700 cd/m^2. Suppose the actual measured luminance at the reference axis obeys this requirement and is 30 000 cd/m^2. Then the maximum luminance at all other angles is 1.5 * 30 000 = 45 000 cd/m^2. The minimum luminance at within the beam width angles shall not be lower than 0.5 * 30 000 = 15 000 cd/m^2. Outside the beam width angles the luminance is allowed to be zero, but never larger than 57 200 cd/m^2.

Table 6 — Test angles for the various beam width classes

Beam width class	Test angles (degrees)	
	Horizontal	Vertical
B1	-5	0
	+5	0
	0	-5
B2	-7	0
	+7	0
	0	-5
B3	-10	0
	+10	0
	0	-5
B4	-10	0
	+10	0
	0	-10
B5	-15	0
	+15	0
	0	-5
B6	-15	0
	+15	0
	0	-10
B7	-30	0
	+30	0
	0	-20

Class B7 is only recommended for specific applications.

7.6 Uniformity

Uniformity measurements shall be done in accordance with 9.3.4. For the luminous intensities of any individual element of the test module the ratio of the average output from the highest 12 % of the elements, to the lowest 12 %, shall be less then 3:1.

The ratio of the average output from the highest 4 % of the elements, to the lowest 4 %, shall be less then 5:1.

The number of elements in consideration shall be rounded to the next highest whole number.

The luminous intensity uniformity shall apply to each separate colour.

7.7 Visible flicker

When the light sources of a test module are operating in a pulse mode, no light flicker shall be visible. In the case of doubt, the frequency of the light emitted shall be measured. This frequency shall not be less than 90 Hz.

8 Physical performance

8.1 Classification

The environmental parameter classes for test modules are listed in Table 7.

Table 7 — Class designation of environmental parameters

Environmental parameters	Class designation	Remarks
Temperature	T1, T2, T3	
Protection	P1, P2, P3	P3 is the most restrictive

8.2 Environmental requirements

8.2.1 Temperature

One of the following temperature classes shall be selected:

Table 8 — Temperature range classes

Class	ambient temperature (°C)	
	Minimum	Maximum
T1	-15	+60
T2	-25	+55
T3	-40	+40

Temperature performance of the test module shall be tested in accordance with 9.2.3 as relevant to the specific class.

8.2.2 Resistance of electrical / electronic components to the effects of pollution

The manufacturer shall declare the degree of resistance to pollution in accordance with IEC 60664-1.

8.2.3 Resistance to corrosion

Test modules with a pollution degree level of 2, 3 or 4 shall be tested in accordance with 9.2.3, Table 15.

8.2.4 Degrees of protection provided by enclosures (IP-level)

Test modules containing exposed electrical equipment shall be protected according to Table 9 (IP code as required by EN 60529 category 2) and test modules with a pollution degree level of 2, 3 or 4 shall be tested in accordance with 9.2.3, Table 16 and Table 17.

Table 9 — Ingress protection level classes

Class	Ingress Protection Level
P1	IP44
P2	IP54
P3	IP56

8.3 Structural performance

8.3.1 General

VMS shall be designed to ensure reliable transfer of all static and dynamic forces to the fixing and mounting structures. The walls of the housing shall be designed to satisfy the static requirements.

The structural performance of VMS including their supports and fixings – excluding cantilevers and gantries – shall be in accordance with EN 12899-1.

8.3.2 Resistance to horizontal Loads

8.3.2.1 Loads

The loads shall be in accordance with EN 12899-1.

8.3.2.2 Deflections

Deflections shall be in accordance with EN 12899-1.

8.3.3 Passive safety for VMS support

If the manufacturer is declaring passive safety, the VMS supports shall comply with one of the classes of EN 12767. If passive safety is not declared, the VMS supports shall be considered as Class 0 of EN 12767.

8.3.4 Impact resistance

The test modules shall be capable of withstanding impact, and shall be tested in accordance with 9.2.3, Table 13. After the test the test module front panel or parts of it shall show no damage other then small indentations in the front surface; it shall exhibit no cracking. The test module shall continue to meet all the requirements of the standard

8.3.5 Vibration resistance

The test modules shall be capable of withstanding vibration, and shall be tested in accordance with 9.2.3, Table 14.

8.4 Electrical requirements

8.4.1 Electrical supply and limits

8.4.1.1 Maximum power consumption

The manufacturer shall state the maximum power consumption of the VMS.

8.4.1.2 Nominal voltages

The standard nominal voltage for connection to the public supply shall be taken to be 230 VAC rms single phase or 400 VAC rms three phases.

NOTE: Where low voltages are used, these shall be as detailed by the manufacturer.

8.4.1.3 Operating voltage range

Variations in the nominal supply voltage of –13 % to +10 % shall have no effect.

This shall be tested in accordance with 9.2.2 Table 11 and Table 12.

8.4.1.4 Mains frequency

Variations within the frequency range (50 ±1) Hz shall have no effect.

This shall be tested in accordance with 9.2.2 Table 12.

8.4.1.5 Power up activation

The VMS shall become available for activation when the supply voltage reaches a value within its operating voltage range. At no time during power up activation shall partial, incomplete or false messages be displayed.

This shall be tested in accordance with 9.2.2 Table 11 and Table 12.

8.4.1.6 Low voltage

8.4.1.6.1 Switch off voltage response

A drop in the nominal voltage of more than 13 % shall not cause partial, incomplete or false messages to be displayed or cause damage to the VMS.

This shall be tested in accordance with 9.2.2 Table 11.

8.4.1.6.2 Voltage interruption

In the event of short voltage interruptions in the supply of specific duration (see Table 10) the VMS shall operate as follows.

Table 10 — Effect of voltage interruption

Duration (ms)	**Effect**
Less than 50	No effect
50 to less than 100	The VMS shall continue displaying the current message. The VMS may be affected by a variation of luminance during the voltage interruption.
Greater than or equal to 100	Shut down is allowed unless specified differently by the purchaser This shall not cause partial, incomplete or false messages to be displayed or cause damage to the VMS. When the power supply is restored the VMS shall behave as described in 8.4.1.5 Power up activation

This shall be tested in accordance with 9.2.4.

8.4.1.7 Temporary over voltage

When protection for temporary (not transient) over voltage is incorporated, the operating voltage range of the protective device shall be stated.

This shall be tested in accordance with 9.2.2 Table 11.

8.4.2 Electrical safety

The test module shall conform to electrical safety requirements of HD 384-4 and HD 638 as applicable.

8.5 Electromagnetic compatibility

8.5.1 Electromagnetic emission

For all types of environment the test module shall conform to EN 50293.

8.5.2 Electromagnetic immunity

For all types of environment the test module shall conform to EN 50293.

9 Test methods

9.1 Test modules

9.1.1 General

NOTE: In order to allow for future developments in technology and sign design, the standard uses performance requirements which are not dependent on technology and which can be demonstrated on a test module. This European Standard contains a number of defined requirements, some of which have to be demonstrated on the test module, others that are to be certified by the manufacturer. This combination covers not only confirmation of compliance with the standard, which is required to meet the regulatory requirements but also issues of lifetime, quality, maintenance and construction, all of which affect the ability of a sign in its particular application, to meet safety and fitness for purpose. The details in the informative annexes are provided as useful guidance on the additional aspects relating to VMS for those setting up purchasing contracts for signs or signing systems.
The test module ensures that the manufacturer can demonstrate to the purchaser that his requirements have been fulfilled. The tests on the test module also cover the Initial Type Testing (ITT) and the relevant requirements of the Factory Production Control (FPC) also detailed in this standard.
It is not possible to define one uniform test module for all Variable Message Signs, bearing in mind the wide range of applications and technologies, the range of sizes, and various requirements for characters and symbols. Type testing, which cannot be carried out on the total VMS size for practical reasons but uses a test module to demonstrate that all the requirements of this standard are achieved, is a realistic approach to the situation; and the successful type testing of a representative test module shall ensure that the minimum performance requirements are fulfilled. It affords maximum freedom to supply a variety of sign sizes without the need to submit every part of every sign for testing.

Test modules manufactured to comply with the following requirements shall:

a) be complete with all components or devices that are fitted in a production unit and necessary to meet the performance requirements ;

b) be complete with all facilities necessary for function test during the environmental and optical performance tests;

c) provide the necessary control system to enable performance testing, the “all ON/ all OFF” and “individual ON” modes with the respective illuminance requirements necessary for the visual performance measurements;

d) include electrical test points to allow for the monitoring of the parameter(s) used for each of the visual performance test settings;

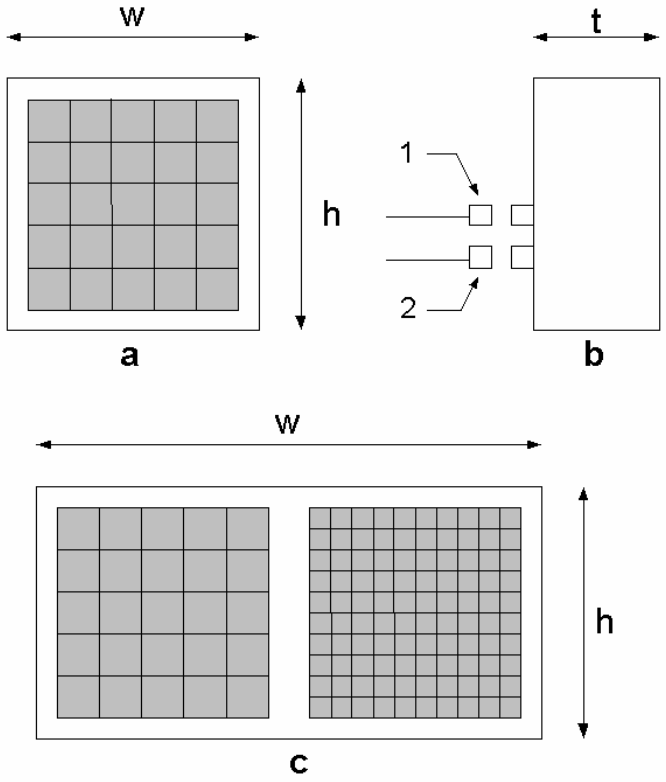
e) be of sufficient elements to demonstrate the compliance of the VMS placed on the market with the requirements of this European Standard.

The manufacturer shall provide documentary and safety instructions detailing all necessary installation and operational procedures. The manufacturer shall state in detail each of the settings for all parameters relevant for the various tests.

9.1.2 Dimensions of test modules

The maximum size (w x h x t) of the test module shall be (1 350 x 1 350 x 500) mm (Figure 3a, Figure 3b). If the dimensions of the production sign are within these limits, the test module can be identical to the production sign.

Each optical test area in a test module shall have minimum dimensions in accordance with 9.3.2.1. A test module might have two or more optical test areas with a different number of elements (Figure 3c). Where a production sign is used for testing, the manufacturer shall identify the test area which shall be as defined in 9.3.2.1.



Key

1 Power input

2 Control input

Figure 3 — Examples of variable message sign test modules in front view (a and c) and side view (b) with indications for the dimensions, width (w), height (h) and thickness (t). The shaded squares are equivalent element areas and form the optical test area;

The spacing between the centres of the elements shall be measured for the test modules, which meet the test requirements and shall be reported as the “element spacing”. The element spacing of the actual VMS shall be within ±10 % of the element spacing measured on the test module.

9.1.3 Function Test

9.1.3.1 General

The function test is based on alternate activation/deactivation of all the elements, which is the cyclic change of all elements from one state to another.

The test shall be carried out at the level used for the maximum applicable performance level.

Each cycle “ON/OFF” shall comprise at least 1s ON followed by at least 1s OFF. The test shall comprise a minimum of 10 cycles.

9.1.3.2 Test Conditions

The function test shall be executed in the environmental tests conditions specified in 9.2.

9.1.3.3 Test Sequence

The test procedures are grouped and shall be conducted in following sequence:

1) electrical Tests;

2) impact;

3) vibration;

4) corrosion test;

5) degrees of protection provided by enclosures (IP-class);

6) temperature (thermostatically controlled temperature regulation devices, if provided, shall be allowed to operate normally):

   a) cold;

   b) dry heat or solar radiation (solar radiation test can be conducted instead of the dry heat test Class T1);

   c) damp heat-cyclic;

   d) change of temperature (can be substituted for the above tests a) and b));

7) EMC test;

8) optical performance.

9.2 Environmental, mechanical and electrical test methods

9.2.1 General

A function test shall be carried out during the execution of test procedure, at the moment and with the frequency indicated in the following.

9.2.2 Electrical tests

Prior to the commencement of the environmental test the following tests shall be undertaken.

Table 11 — Operating voltage range, Power up activation and Temporarily overvoltage tests

Test sequence	Voltage value	Measurements
1	No power	No power supply
2	Nominal	Switch ON the test module and check that there is no partial, incomplete or false display
3	Nominal	Function test
4	Drop to the minimum voltage	Check that there is no partial, incomplete or false display
5	Drop to 50% of the nominal voltage	Check that there is no partial, incomplete or false display
6	Nominal	Check that there is no partial, incomplete or false display
7	Nominal	Function test
8	Raise to the maximum voltage	Check that there is no partial, incomplete or false display
9	Nominal	Check that there is no partial, incomplete or false display
10	Nominal	Function test
This test is done only if a protection device is incorporated.		
11	Maximum voltage stated by the protection device	Check that there is no partial, incomplete or false display No visual damage of the test module
12	Nominal	Check that there is no partial, incomplete or false display
13	Nominal	Function test

The function test shall be repeated for different combinations of voltage and frequency as follows:

Table 12 — Frequency and voltage tests table

Test sequence	Frequency value	Voltage value
1	lower	lower
2	Nominal	nominal
3	upper	upper

9.2.3 Environmental and mechanical tests

The environmental and mechanical test methods are detailed in the following tables.

Table 13 — Impact Test

Impact **EN 60598-1**	Impact tests shall be conducted on horizontally mounted test module front panel using a steel ball of 50 mm diameter with a mass of 0.51 kg dropped from a height h (1.3 m) to produce an impact energy of 6.5 Nm.
	The test module shall be conditioned at a temperature of 20 °C (± 2 °C) and then be subject to three single impacts, at the weakest point on the front panel of the test module, this shall be determined by the Test-House in consultation with the manufacturer.
	The test module shall be cooled to a temperature of -5 °C (±2 °C), which shall be maintained for three hours. Whilst the test module is at this temperature it shall be subjected to three single impacts at the weakest point on the front panel of the test module, this shall be determined by the Test-House in consultation with the manufacturer.
	After the test the test module front panel or parts of it shall show no damage other then small indentations in the front surface; it shall exhibit no cracking. The test module shall continue to meet all the requirements of the standard.

Table 14 — Vibration Test

Vibration **IEC 60068-2–64**	Mounting :	The test module shall be securely fixed to the vibrating table.
	Reference and check-points:	The reference point shall be chosen on the vibrating table; in the case of large test module it shall be a virtual point, where the reference signal spectrum will be defined as the arithmetic mean of ASD (Acceleration Spectrum Density) values of signals measured at the check points.
	Frequency range:	10 Hz to 200 Hz.
	ASD levels:	0.013 g^2/Hz (10 Hz to 50 Hz). 0.013 g^2/Hz (50 Hz to 200 Hz with a negative slope 3 dB/octave). Overall RMS acceleration 1.2 g.
	Duration of conditioning:	90 min in each of 3 axes.
	Reproducibility:	Low.
	Initial measurements:	Visual inspection and Function test.
	Functioning during conditioning:	No.
	Final measurements:	Visual inspection and Function test.

Table 15— Corrosion test

Salt test **ISO 9227**	Initial measurements:	Visual inspection and Function test.
	State of the test module during the test:	Unpacked, locked and switched off.
	Duration of test:	240 hours.
	Operating conditions:	35°C ± 2°, Neutral salt spray
	Treatment after test:	In accordance to clause 10
	Final measurements:	Visual inspection and Function test.

Table 16— Water Penetration Test

TEST		**Class P1**	**Class P2**	**Class P3**
Water Penetration **EN 60529**	Severity:	IP x4	IP x4	IP x6
		According to EN 60529.		
	Pre-conditioning:	None		
	Initial measurements:	Visual inspection and Function test shall be conducted before commencing the conditioning period.		
	Conditioning:	The equipment shall be hosed on all faces and at all angles from vertically down to horizontal concentrating on points to be “most likely” to result in water ingress.		
	Intermediate measurements:	The equipment shall be switched on and function test shall be continuously repeated throughout the test.		
	Final measurements:	Visual inspection and Function Test. Acceptance according to EN 60529.		

Table 17 — Dust Penetration Test

TEST		Class P1	Class P2	Class P3
Dust Penetration EN 60529	Severity:	IP 4x	IP 5x	IP 5x
		According to EN 60529 category 2.		
	Pre-conditioning:	None.		
	Initial measurements:	None	Visual inspection and Function test shall be conducted before commencing the conditioning period.	
	Conditioning:	None	The equipment shall be switched OFF.	
	Intermediate measurements:	None.		
	Final measurements:	Visual inspection and Function Test. Acceptance according to EN 60529 category 2.		

Table 18 — Temperature Test

TEST		Class T1	Class T2	Class T3
	General: During normal operation the majority of VMS generate heat, this results in increased temperatures within the equipment. Operation in high ambient air temperatures can further increase the internal temperature. When equipment is used in a situation where it can be in direct sunlight, the effects of Solar Radiation can result in the surface temperature of the equipment being significantly higher than the air temperature. These effects shall be tested by either conducting the dry heat test or the solar radiation test for Class T1 only. The tests for dry heat and cold can be replaced by the “change of temperature” test.			
COLD IEC 60068-2-1 Test Ab	Pre-conditioning:	None		
	Initial measurements:	Visual inspection and Function test.		
	State of test module during conditioning:	Equipment switched off until the final hour.		
	Conditioning temperature:	-15 °C	-25 °C	-40 °C
	Conditioning time:	16 h		
	Measurement and/or loading during conditioning:	During the final hour at test temperature; switch on and function test shall be continuously repeated. During the warm up period function test shall be continuously repeated.		
	Recovery if non-standard:	Recovery at laboratory ambient.		
	Final measurements:	Visual inspection and Function test.		
	Any deviation in procedure:	None		
DRY HEAT IEC 60068-2-2 Test Bb	Pre-conditioning:	None		
	Initial measurements:	Visual inspection and Function test.		
	State of test module during conditioning:	The equipment shall be switched on and function test shall be continuously repeated.		
	Conditioning temperature:	60 °C	55 °C	40 °C
	Conditioning time:	16 h		
	Measurement and/or loading during conditioning:	Function test shall be continuously repeated during the cooling period.		
	Recovery if non-standard:	Recovery at laboratory ambient.		
	Final measurements:	Visual inspection and Function test.		

“to be continued”

Table 18 (*Continued*)

TEST		Class T1	Class T2	Class T3
Damp Heat Cycling **IEC 60068-2-30** **Method Db**	Any deviation in procedure:	None.		
	Air temperature:	40 °C		
	Number of cycles:	2		
	Initial measurements:	Visual Inspection and Function test		
	State of test module during conditioning:	Unpacked, switched on and ready to use		
	Details of mounting and supports:	None		
	Variant:	1		
	Intermediate measurements:	Function test continuously repeated during first 3 h of each cycle; during the last hour of each cycle at 40 °C; and during the final cool down period of the last cycle		
	Recovery conditions:	Recovery at laboratory ambient		
	Special precautions to be taken regarding removal of surface moisture:	Not applicable		
	Final measurements:	Visual inspection and Function test		
Solar radiation **IEC 60068-2-5** **Test Sa**	Pre-conditioning:	None		
	Initial measurements:	Visual Inspection and Function test		
	Attitude of test module as installed:	Equipment in its normal operational attitude. Radiation is orthogonal to the front face of the sample		
	Test procedure	B		
	Object of the test:	This test can be carried out as an alternative to the dry heat test Bb for Class T1		
	Air temperature within the test chamber during irradiation:	40 °C		
	Maximum permissible air velocity within the test chamber:	Normal air circulation required to achieve temperature stability		
	Humidity conditions:	No requirement		
	Test duration:	1 cycle		
	Measurement and/or loading during conditioning:	The test module shall be switched on and the function test will be continuously repeated during the first three hours of test, the last hour of radiation and during the cool down period		
	Recovery conditions:	Recovery at laboratory ambient		
	Final measurements:	Visual inspection and Function test		

"to be continued"

Table 18 (*Continued*)

TEST		Class T1	Class T2	Class T3
Change of temperature **IEC 60068-2-14** **Test Nb**	Mounting or supporting of the test module, if other than prescribed:	As prescribed		
	Lower temperature TA:	-15 °C	-25 °C	-40 °C
	Upper temperature TB:	60 °C	55 °C	40 °C
	Rate of change of temperature:	1 °C / min		
	Number of cycles:	1		
	Initial measurements:	Visual inspection and Function test		
	State of test module when introduced into the chamber:	Ready for use but switched off		
	Exposure time t1:	16 h		
	Measurements during conditioning and the period after which they shall be carried out:	Switch on and function test continuously repeated during the warm up from laboratory ambient temperature Switch on and function test continuously repeated during the last hour at TB and during the cool down to laboratory ambient temperature		
	Recovery:	Minimum of 1h at laboratory ambient		
	Final measurements:	Visual inspection and Function test		

9.2.4 Electromagnetic compatibility (EMC)

The test module shall be tested according to the requirements of the standards EN 50293.

9.3 Optical performance test methods

9.3.1 General

All optical tests shall be repeated for each individual colour of the colour class the sign is required to display.

The tests shall be performed at an ambient temperature of 20 °C +/- 3 °C.

NOTE: The optical performance can be dependent on ambient temperature.

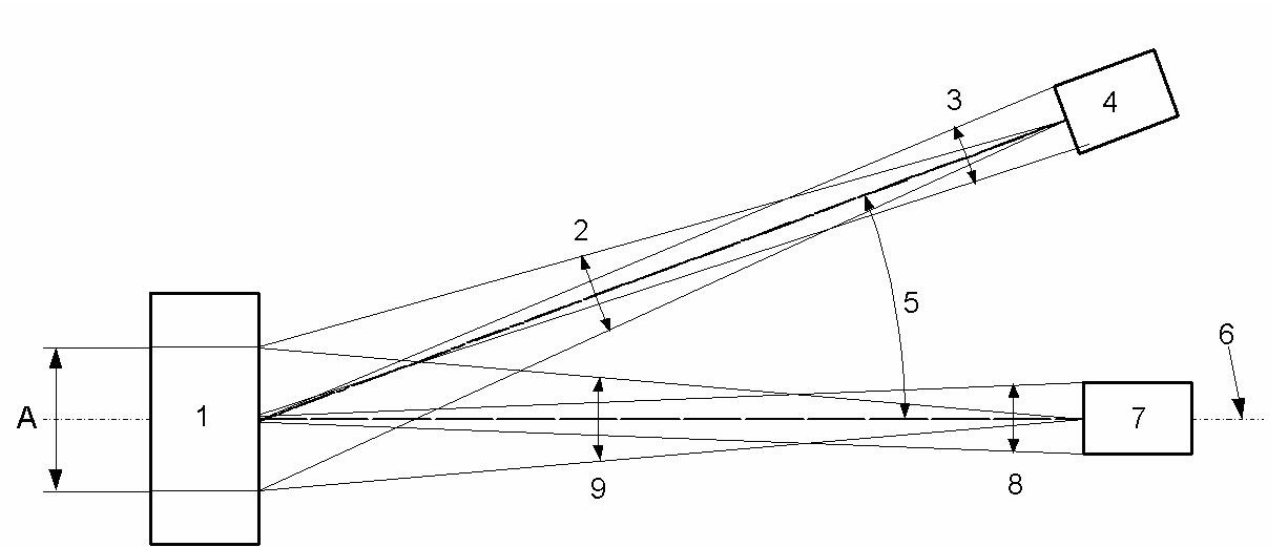
The luminous sources shall have been in operation for sufficient time to be stabilised before making measurements. Supplied sources must be suitably aged so that their electrical and optical characteristics are as stable as possible. A light source is considered to be stable when its light output does not change more than +/- 2 % over a time period of 15 min.

Modules may be operated on any side with the agreement of the manufacturer, in order to facilitate testing. Care shall be taken to ensure the correct optical orientation of components and surfaces of the test and measurement equipment to assure a representative assessment. Any deviation from normal mounting position shall be recorded.

Measurement shall be made with a photo-detector and measuring unit that is stable in operation and not subject to fatigue when exposed to maximum level of luminance. The combination of detector and measuring unit in all ranges shall have linear response to light up to the maximum level of luminance. The spectral sensitivity of the detector shall closely follow the CIE spectral luminous efficiency curve V_λ.

For all photometric measurements it is important to eliminate stray light.

The measurement configuration of the sign, solar simulator and the luminance meter shall be arranged according to Figure 4. In order to limit measuring errors some angles are limited. The measuring aperture of the luminance meter shall not be larger than 3°. The beam divergence of the solar simulator at the area of interest shall not be larger than 3°. The aperture of the solar simulator and the luminance meter, as seen from the test module, shall not be larger than 2° and 0.5°, respectively.



Key

A Diameter of the measurement area
1 test module
2 ≤ 3°
3 ≤ 2°
4 Solar simulator
5 (10 ± 0.1)° and (5 ± 0.1)° for L3 (*)
6 Reference axis
7 Luminance meter
8 ≤ 0.5°
9 ≤ 3°

Figure 4 — Side elevation of the set-up for the measurement of luminance and luminance ratio

The solar simulator shall have a spectral content close to that of natural daylight and a correlated colour temperature within the range of 5 000 K to 6 500 K.

The solar simulator, in conjunction with an optical attenuation device, shall be capable of achieving the required illuminance range, which shall be uniform (+/- 10%) over the area of measurement.

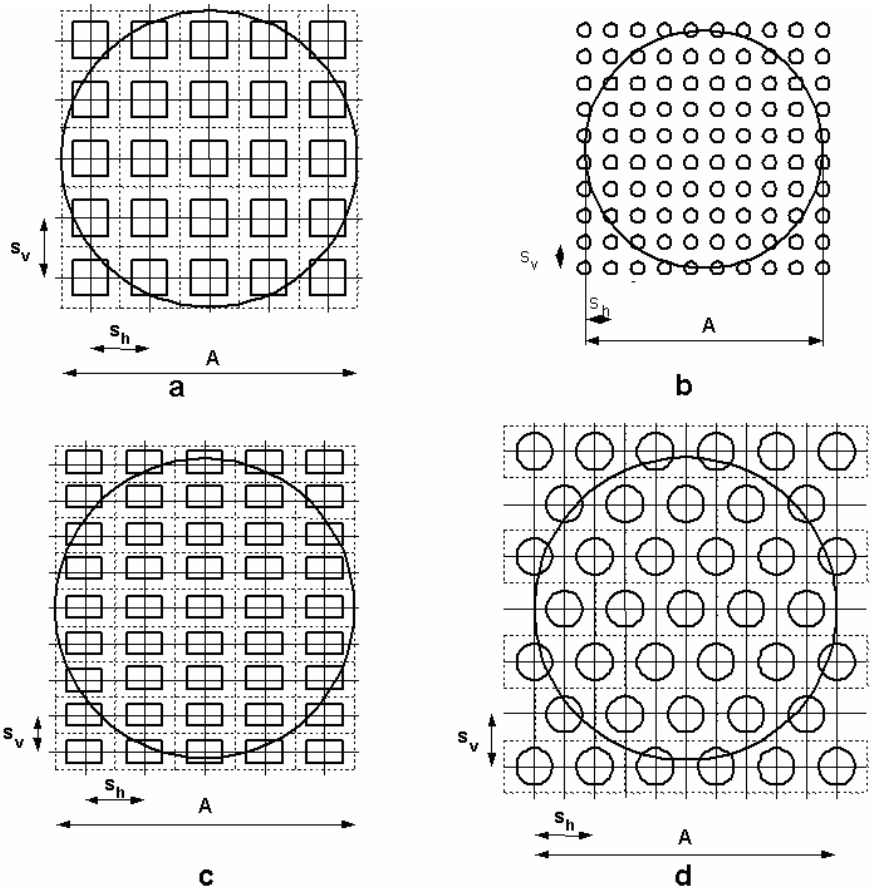
The illumination shall be measured in the reference centre, perpendicular to the reference axis.

9.3.2 Luminance and luminance ratio

9.3.2.1 Test area for luminance ratio measurement

The test area shall meet the following criteria:

- shall contain elements in the form of a regular matrix;
- the whole of the optical test area must be fully populated with elements;
- the minimum size is (100 x 100) mm, including the outer dimensions of the equivalent areas of the elements;
- it must contain at least 5 x 5 = 25 elements;
- the spacing of the elements must be constant in each of the directions of the matrix system, but these spacings need not be the same (Figure 5c and Figure 5d);
- separations of the elements have to be representative for the separations on the real sign.



Key

s_v vertical separation
s_h horizontal separation
A diameter of the measurement area

Figure 5 — Layout examples for a test module and the positioning of the measuring area (circle) of the luminance meter. The equivalent areas of the elements are indicated by dotted lines.

NOTE: In Figure 5 examples are given, where $A \geq 100$ mm. a = 5 x 5 matrix ($s_v = s_h$) ; b = 10 x 10 matrix ($s_v = s_h$); c = 5 x 9 matrix ($s_v = 0.6 * s_h$); d = hexagonal grid ($s_v = 0.5 * \sqrt{3} * s_h$)

When the test module has (5 x 5) elements the measuring area shall just encompass the extremities of the equivalent areas of the five elements in both the horizontal and vertical direction (Figure 5a).

When the test module has more than (5 x 5) elements the measuring area shall comprise a circle with a diameter of at least 100 mm (Figure 5b).

When the element spacing of the horizontal and vertical direction is not equal, the measuring area shall just encompass the extremities of the equivalent areas of the five elements in direction with the largest element spacing (Figure 5c).

It is also allowed to use a non-rectangular grid when it is possible to modify it to a rectangular grid by moving rows of element along horizontal and vertical lines (Figure 5d).

9.3.2.2 Measurement of luminance and luminance ratio

The luminance of the area under test shall be measured under external illumination of 40 000 lx, 10 000 lx (when required by the purchaser) 4 000 lx, 400 lx, 40 lx, and 4 lx.

The luminance shall also be measured with a randomly selected external illumination between 4 000 lx and 40 000 lx.

For tunnel applications the luminance of the area under test shall be measured under external illumination of 400 lx, 40 lx, and 4 lx

Luminance measurements shall be made with the test sign in the following states:

a) all elements of the sign test area ON;

b) all elements of the sign test area OFF.

Luminance ratio shall be calculated as follows:

$$LR = \frac{L_a - L_b}{L_b} \quad (1)$$

where:

L_a is the measured luminance of the sign in the ON-state when under external illumination

L_b is the measured luminance of the sign in the OFF-state when under external illumination

In addition to the requirements for luminance ratio, for various luminance classes, there is also a requirement for luminance. With the test module set up to achieve the stated luminance ratio requirements for the 400 lx (Tunnel) and 40 000 lx illumination level, a luminance measurement shall be taken with the module element “ON” and the solar simulator “OFF”.

NOTE: This is to establish that the test module is emitting light to an appropriate level without external illumination.

The luminance from the test module shall be measured at the test angles listed in Table 20.

9.3.2.3 Test angles

The test angles for the measurement of beam width, uniformity and colour are listed in Table 19, the test angles for luminance and luminance ratio are listed in Table 20.

NOTE 1: The horizontal test angles of the luminance meter depend on the beam width class.

NOTE 2: The test angles for the solar simulator are the same for all beam width classes.

Table 19 — Test angles (in degrees, with respect to the reference axis), used for the measurement of beam width, uniformity and colour

Beam width class	photometer	
	Horizontal	Vertical
B1	0	0
	-5	0
	+5	0
	0	-5
B2	0	0
	-7	0
	+7	0
	0	-5
B3	0	0
	-10	0
	+10	0
	0	-5
B4	0	0
	-10	0
	+10	0
	0	-10
B5	0	0
	-15	0
	+15	0
	0	-5
B6	0	0
	-15	0
	+15	0
	0	-10
B7	0	0
	-30	0
	+30	0
	0	-20

Table 20 — Test angles (in degrees, with respect to the reference axis), used for the measurement of luminance and luminance ratio

Beam width class	Solar simulator			Luminance meter	
	Horizontal	Vertical L1, L2, L3, L3(*)	Vertical L3(*)	Horizontal	Vertical
B1	0	+10	+5	0	0
	0	+10	+5	-5	0
	0	+10	+5	+5	0
	0	+10	+5	0	-2.5
B2	0	+10	+5	0	0
	0	+10	+5	-7	0
	0	+10	+5	+7	0
	0	+10	+5	0	-2.5
B3	0	+10	+5	0	0
	0	+10	+5	-10	0
	0	+10	+5	+10	0
	0	+10	+5	0	-2.5
B4	0	+10	+5	0	0
	0	+10	+5	-10	0
	0	+10	+5	+10	0
	0	+10	+5	0	-2.5
B5	0	+10	+5	0	0
	0	+10	+5	-15	0
	0	+10	+5	+15	0
	0	+10	+5	0	-2.5
B6	0	+10	+5	0	0
	0	+10	+5	-15	0
	0	+10	+5	+15	0
	0	+10	+5	0	-2.5
B7	0	+10	+5	0	0
	0	+10	+5	-30	0
	0	+10	+5	+30	0
	0	+10	+5	0	-2.5

9.3.3 Beam width

The beam width shall be tested in accordance with the luminance measurements with the solar simulator off. The luminance measurements shall be repeated with steps of 1° or less in the horizontal reference plane to 1 degree beyond the angle requirements (Table 19) in both the positive and negative directions and at steps of 1 degree or less in the vertical reference plane in the negative direction only.

Within the limits of the appropriate beam width class to be measured, the luminance shall not vary by more than ±50% when compared to the value measured in the reference axis.

NOTE: Beam width may be obtained by measuring luminance intensity and calculating the luminance using the equivalent area.

9.3.4 Uniformity

The luminous intensity of each individual element of the test module shall be measured *without* external illumination from the solar simulator. Measurements shall be carried out for the highest and the lowest setting specified by the manufacturer according to 7.3. The uniformity is determined calculating the luminous intensity ratio as defined in 7.6.

A minimum of 25 individual elements shall be measured.

The luminous intensity uniformity shall be measured at the test angles specified in Table 19, appropriate to the beam width class.

9.3.5 Colour

Measurements shall be made in accordance with the procedure specified in CIE publication No 15.2. Results shall be expressed in terms of chromaticity co-ordinates.

All colour measurements shall be made without solar simulator illumination.

The colour of the light emitted shall be carried out for the highest and the lowest setting specified by the manufacturer according to 7.3.

The colour of the light emitted shall be measured at the test angles listed in Table 19, as appropriate to the beam width class.

10 Product classification codes

The VMS classification shall be indicated by performance codes in the following way:

a) for Optical performance per colour by a combination of the codes of the following classes (see 7.1 Table 1), for example:

white/yellow: C2L3R2B3
red: C1L3(*)R2B3

Other combinations are possible,

1) colour C1 or C2 ;

2) luminance L1, L2 or L3, L3(*), L1(T), L2(T) or L3(T);

3) luminance ratio R1, R2 or R3;

4) beam width B1, B2, B3, B4, B5, B6 or B7 ;

b) for Environmental requirements by a combination of the codes of the following classes, for example T2P2 (see 8.1 Table 7) :

1) Temperature T1, T2 or T3

2) Protection P1, P2 or P3.

The VMS classification will result from tests carried out on the Test Module and shall be included in the Marking, Labelling and Product information (see clause 11).

11 Marking, labelling and product information

Marking and labelling to meet regulatory requirements are given in Annex ZA.

11.1 Sign assemblies (with and without supports)

11.1.1 Marking and labelling

Where specific marking is also a regulatory requirement it need not be repeated and is deemed to be compliant with this clause, however all non-regulatory marking shall be placed in such a position as to avoid confusion with regulatory marking. Finished VMS shall be clearly, durably and visibly marked with the following information:

a) The name or identifying mark of the manufacturer

b) Name and registered address of the manufacturer

c) The product name and its relevant characteristics

d) The number and year of this standard (EN 12966: YYYY)

e) Electrical and physical ratings for the connection to the supplies e.g. rated or ranged voltage, current, frequency, wattage, air pressure etc…

f) Year of manufacture

Additional markings shall be permitted, provided that they do not give rise to misunderstanding. Where symbols are used, they shall conform to ISO 7000 or IEC 60417-1 where appropriate symbols exist.

The markings shall be in characters legible at a normal reading distance such that the total area of the marking is at least 100 cm^2 and shall be sufficiently durable to last the expected life of the sign. Marking required by this standard shall not be placed on the front face or any removable parts, which can be replaced in such a way that the marking would become misleading.

In considering the durability of the marking, the effect of normal use shall be taken into account.

11.1.2 Product information

The manufacturer shall make available the following information:

a) instructions for the assembly and erection of the sign;

b) details of any limitations on location or use;

c) instructions for the handling, maintenance and cleaning of the sign, including component replacement;

d) safety and environmental instructions and their eventually derived precaution measures in regards to the operating, installing, servicing, transporting or storing of the product;

e) details of luminance control device (if required).

Product information related to safety shall be in a language, which is acceptable in the country in which the product is to be installed.

NOTE: For CE marking and labelling purposes see ZA.3.

11.2 Components

Full details of the component's specifications shall be supplied. Where a component conforms to a European Standard the marking shall be as specified in the relevant standard. The manufacturer shall make available the following information:

a) where the component is not covered by and/or does not conform to a European Standard, a detailed technical specification of the component, which shall become part of the ITT for the VMS;

b) instructions on the application of the component;

c) details of any limitations on location or use, including potential incompatibility with other materials;

d) instructions on the operation and maintenance of the component;

e) safety and environmental information and their eventually derived protection measures in regards to the operating, installing, servicing, transporting or storing of the product.

12 Evaluation of conformity

12.1 General

NOTE: Test modules are used to demonstrate conformance with the majority of the requirements of this standard because of the impracticality of testing some complete signs.

This European Standard contains a number of defined requirements, some of which can be demonstrated on the test module; others may be declared by the manufacturer and demonstrated by extrapolation of previous test results. In addition the manufacturer shall hold the technical documentation which demonstrates how the performance requirements are met on each sign produced.

The compliance of a VMS with the requirements of this standard and with the stated values (including classes) shall be demonstrated by initial type testing and factory production control.

12.2 Initial type testing (ITT)

Shall be in accordance with EN 12966-2.

12.3 Factory production control (FPC)

Shall be in accordance with EN 12966-3.

13 Dangerous substances

Materials used in products shall not release any dangerous substances in excess of the maximum permitted levels specified in a relevant European Standard for the material or permitted in the national regulations of the member state of destination.

Annex A
(normative)

Equivalent area

A.1 General

This annex defines the concept of equivalent area and the use of this concept in the lay-out of VMS messages. The following photometric calculations and design examples demonstrate this.

Aspects, letters and figures of light emitting matrix signs shall be created by single elements. The design objective is that the light intensity (cd) together with element spacing (m) gives the impression of solid lines and surfaces (see Figure A. 1). When the sign is seen from the appropriate distance the elements appear to merge, this creates the impression that the elements are larger then their actual size. The area that the elements are apparently illuminating is defined as the “equivalent area” (m^2). To achieve this effect the combination of luminance and element spacing shall be balanced. The luminance, measured in cd/m^2, is the light intensity per illuminated area (in this case the equivalent area) of each element.

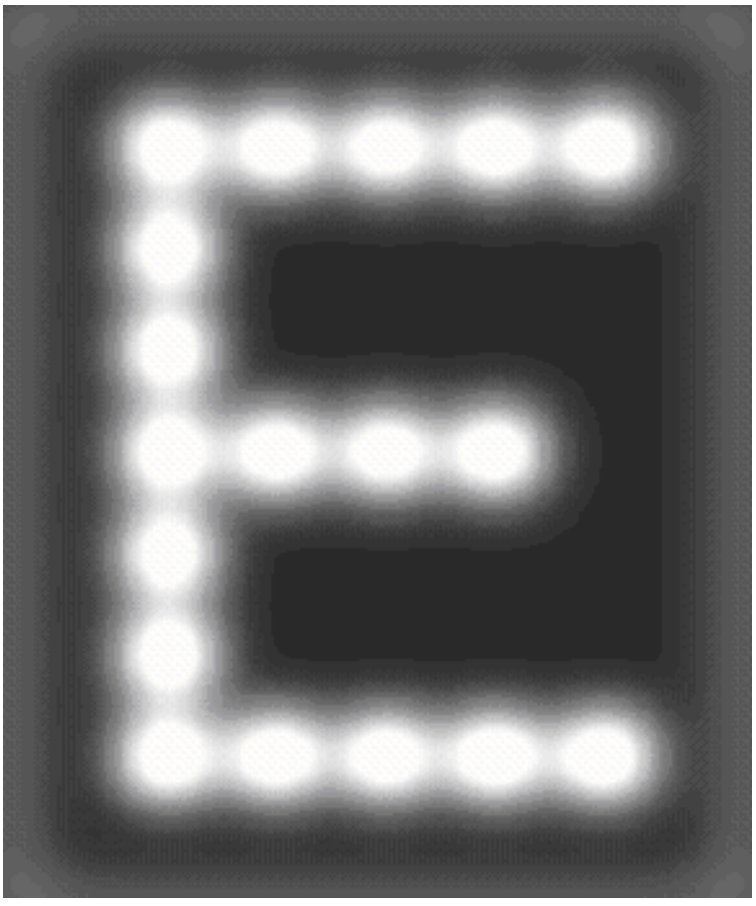


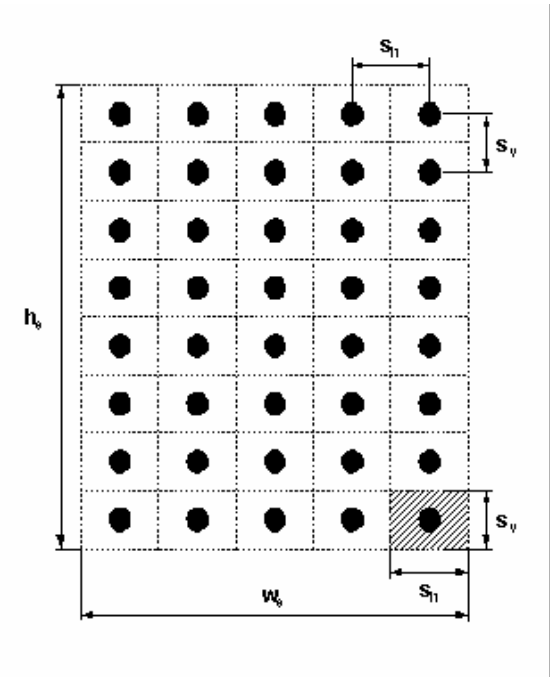
Figure A. 1

In a regular matrix, as in a test module, the equivalent area of an element is the area resulting from the product of the horizontal and the vertical element spacing (see Figure A. 2).

A.2 Calculation of the luminance

Test modules shall be produced by the compilation of a number of elements in a matrix on a surface. The luminous intensity of the elements shall be known. Therefore the desired luminance can be obtained by choosing the appropriate element spacing. The element spacing shall be calculated using the following method.

Consider an example of a test module with a regular orthogonal matrix of (5 x 8) elements (see Figure A. 2). The horizontal element spacing is s_{h} and the vertical element spacing is s_{v}.



Key

s_h = horizontal element spacing (= width of equivalent area of an element)

s_v = vertical element spacing (= height of equivalent area of an element)

h_e and w_e = equivalent height and width of the matrix

Shaded area = equivalent area of an element

Figure A. 2 — Test module with a regular orthogonal matrix of (5 x 8) elements

The average luminance of the test module can be calculated by the formula

$$L = \frac{I}{s_h s_v} \tag{A.1}$$

where

L average luminance (cd/m^2) measured in the direction of reference axis

I average luminous intensity of a single element (cd)

s_h horizontal element spacing (m)

s_v vertical element spacing (m)

When the luminous intensity and the luminance are known the product of the element spacing in horizontal and vertical direction is

$$s_h s_v = \frac{I}{L} \qquad \text{(A.2)}$$

where the product s_h s_v is the size of the *equivalent element area* (shaded area in Figure A. 2) in square meters.

The luminous intensity (cd) of a single element (I) is considered as distributed uniformly over the equivalent area of that element, resulting in an average sign luminance (L) (cd/m^2). This is the luminance that will be seen when viewed from a distance such that the individual elements are indistinguishable. At this distance the elements appear to have the size of the equivalent element area.

NOTE 1: The equivalent area of an element is the reciprocal of the element density (in terms of number of elements per unit of area).

NOTE 2: Calculation example:
Assume that the elements of the test module emit white light and have a luminous intensity of 12 cd. In order to meet the requirements for luminance class L3, a luminance of at least 12 400 cd/m^2 must be made.

According to formula (A.2) the product of horizontal and vertical element spacing (s_h s_v) should not be larger than

$$\frac{12\ \text{cd}}{12\,400\ \text{cd/m}^2} = 0.000968\ \text{m}^2.$$

When the horizontal and vertical element spacing is the same, the spacing must not exceed the square root of this area:

$$\sqrt{0.000968\ \text{m}^2} = 0.0311\ \text{m or } 31.1\ \text{mm}$$

In Figure A. 2 the horizontal element spacing is 50 % larger than the vertical element spacing.

In that case the vertical element spacing is

$$\sqrt{\frac{0.000968 m^2}{1.5}} = 0.0254\ \text{m, or } 25.4\ \text{mm,}$$

and the horizontal element spacing is

$$1.5 * 25.4\ \text{mm} = 38.1\ \text{mm.}$$

As a check on the calculation the luminance can be determined by dividing the total luminous intensity of the test matrix by the equivalent area of the test matrix:

The equivalent width of the test matrix (w_e) is 5 * 38.1 mm = 190.5 mm.

The equivalent height of the test matrix (h_e) is 8 * 25.4 mm = 203.2 mm.

The equivalent area of the test matrix is 0.1905 m * 0.2032 m = 0.0387 m².

The luminous intensity of the test matrix is 5 * 8 * 12 cd = 480 cd.

The luminance of the test matrix is $\frac{480 cd}{0.0387 m^2}$ = 12 400 cd/m².

A.3 Calculation of non-matrix equivalent areas

A.3.1 Equivalent area for a line of elements.

The symbol of the VMS message can be a line of elements not designed in a matrix system as shown in Figure A. 3 and Figure A. 4. The equivalent area A_e will be calculated as following:

$A_e = n * (S_{av})^2$

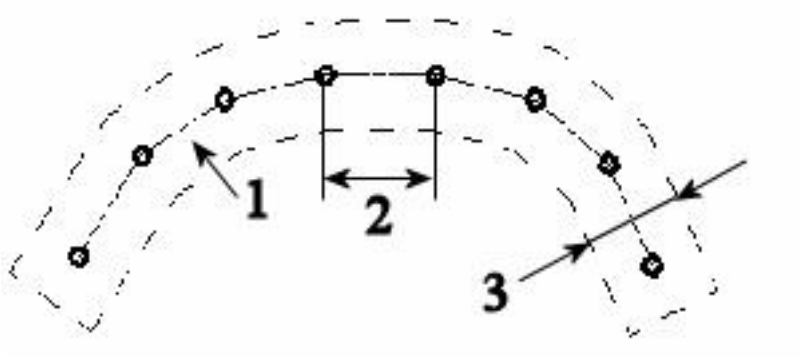
where

n number of elements

S_{av} average spacing between elements

W_s stroke width ($W_s = S_{av}$)

S_i spacing between two elements *i* and *i+1*.



Key

1 A_e

2 S_i

3 W_s

Figure A. 3 — Open line

where:

$$S_{av} = \frac{\sum_{i=1}^{n-1} S_i}{n-1}$$

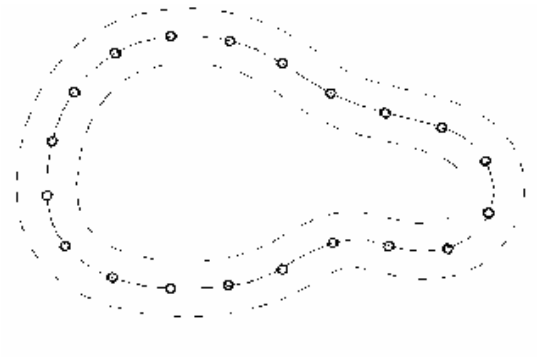


Figure A. 4 — Closed line

For closed line

$$S_{av} = \frac{\sum_{i=1}^{n} S_i}{n}$$

A.3.2 Equivalent area for a symbol fully populated with elements

The symbol of the VMS message can be an area fully populated with elements not designed in a matrix system as shown in Figure A. 5.

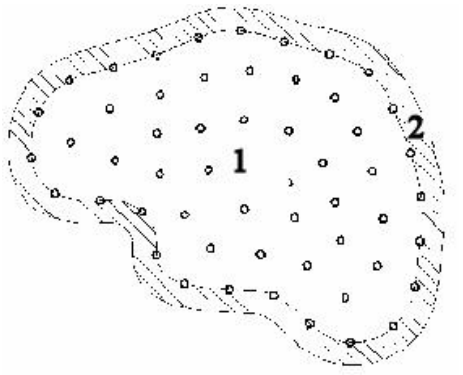
The equivalent area A_e will be calculated as following:

$$A_e = S_1 + S_2$$

where

S_1 Inside area limited by the line of border elements

S_2 Half equivalent area of the border line elements



Key

1 S_1 Inside area fully populated with elements

2 S_2 Half equivalent area of the border line elements

Figure A. 5 — Example of symbol with an area fully populated with elements

A.3.3 Equivalent area for a symbol partially populated with elements

The symbol of the VMS message can be an area partially populated with elements not designed in a matrix system as shown in Figure A. 6.

The equivalent area A_e will be calculated as following:

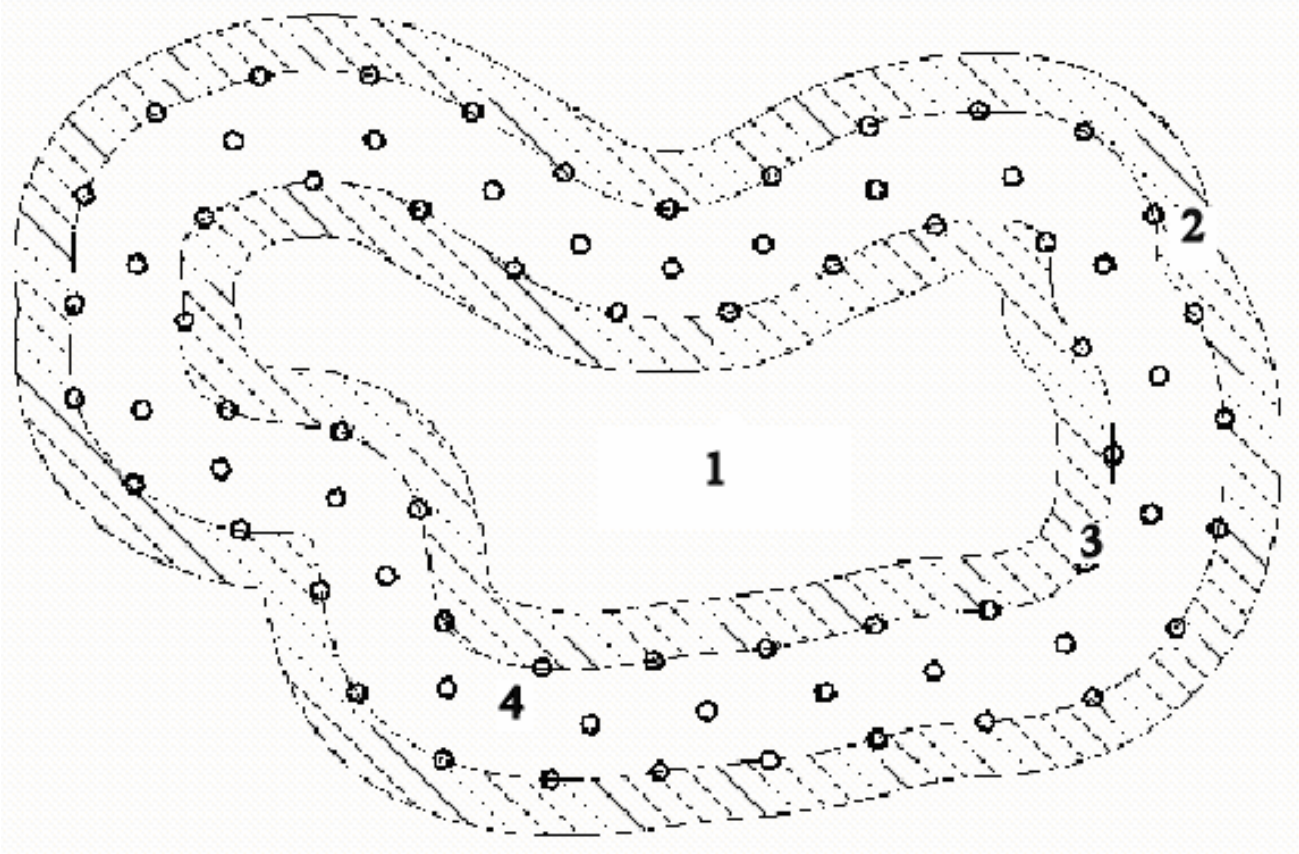
$$A_e = S_1 + S_2 + S_3$$

where

S_1 Inside area limited by the two lines of borders elements

S_2 Half equivalent area of outside border line elements

S_3 Half equivalent area of inside border line elements



Key

1 No element in this area
2 S_2 Half equivalent area of outside border line elements
3 S_3 Half equivalent area of inside border line elements
4 S_1 Inside area fully populated with elements

Figure A. 6 — Example of symbol with an area partially populated with elements

Annex B
(informative)

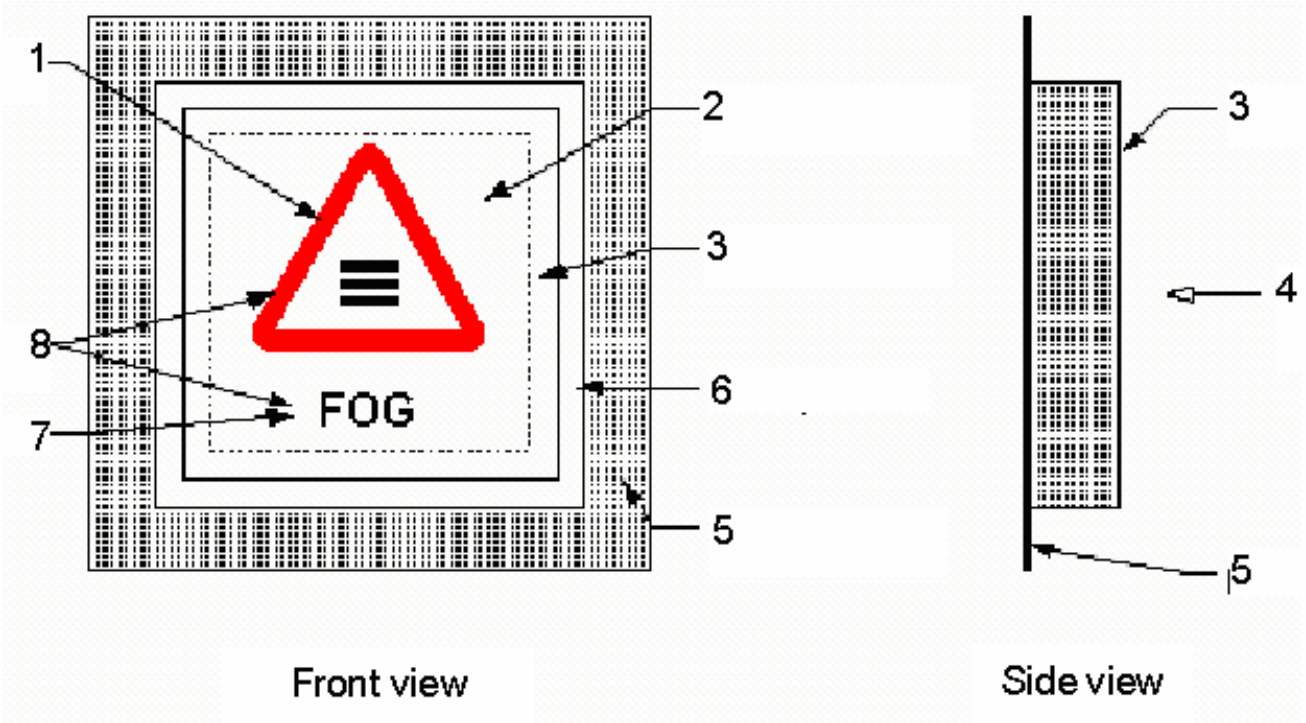
Terminology used in this standard

This appendix is meant for readers new to the standard, who wish to get a quick introduction into the terminology used throughout this standard. Definitions of underlined words can be found in Chapter 3 (Definitions and abbreviations).

VMS are used to display one or more messages, or can be blank. Each message can consist of text and/or symbols. The way these text and/or symbols are arranged is called the message lay-out.

A VMS does not necessarily stand on its own. Sometimes one or more VMS can be fitted into a panel, which can possibly also display fixed text and/or symbols. In that case this standard does not cover the complete panel, but each VMS separately.

The most important area of the front panel of a VMS is the display surface; this is used for the message display. A (transparent) front screen can be used to protect the display surface; front screen and display surface are sometimes integrated. A backing board can be used to improve the contrast between the VMS and its VMS background.



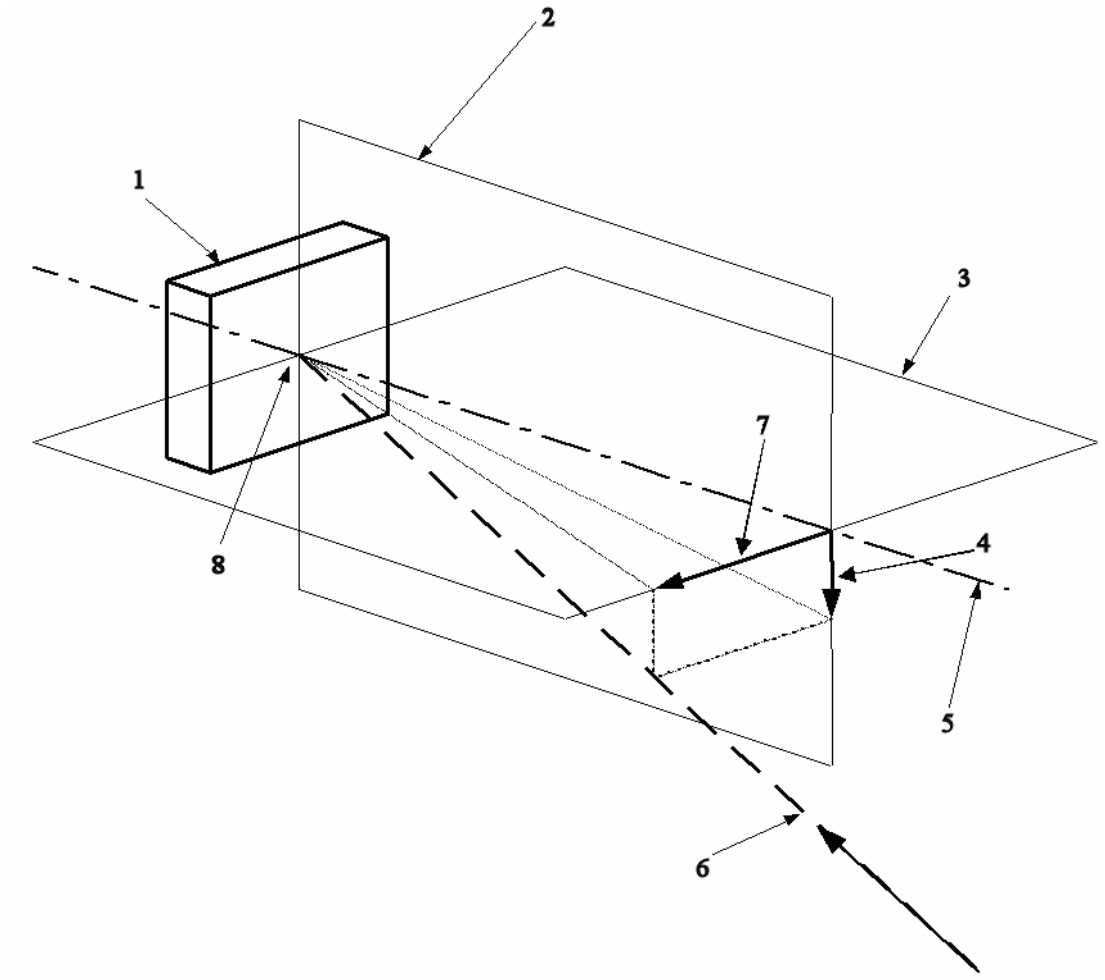
Key

1 Symbol
2 Display surface
3 Front screen
4 Viewing direction
5 Backing board
6 Front panel
7 Text
8 Message

Figure B. 1 — Parts of a VMS

An element is the basic visual light emitting and/or reflective object (or cluster of objects) in the surface of the VMS. The reference grid, with the intersections at the centres of the elements used in a VMS, is called a matrix. Individual elements may have one or more light emitting parts.

For measurements on a test module the reference axis is the basis; this axis originates in the reference centre of the VMS. The vertical reference plane and the horizontal reference plane are vertical and horizontal planes containing the reference centre. Horizontal and vertical test angles describe the angle between the test axis and the vertical and horizontal reference planes respectively.



Key

1 Test module
2 Vertical reference plane
3 Horizontal reference plane
4 Vertical test angle
5 Reference axis
6 Test axis
7 Horizontal test angle
8 Reference centre

Figure B. 2 — Test configuration

VMS can be operated with the help of a control device. When a VMS is in operation and it is displaying a message this is called the ON state; when the VMS is not displaying any message we speak of the OFF state.

Annex C
(informative)

Guidance on graphics for discontinuous light emitting signs

C.1 General

This annex gives informative design examples of variable message signs. Since the layout of the signs is not normative, dependent on local needs, the purchaser can have their own design.

Signs comprise coloured backgrounds with contrasting coloured symbols. For light emitting signs the Vienna Convention on Road Signs and Signals allows colour inversion. Purchasers have different requirements concerning inversion. Some require inversion, some allow inversion, and some do not allow it. Examples of non-inverted and inverted design issues are included in this annex.

The symbol designs also can be based on non-matrix systems, such as circles, arcs and even free forms. Examples of some of these different matrix systems, and the application of the normative design rules, are shown in this annex.

C.2 Variable Message Signs with colour inversion

In order to be clearly distinguished from the coloured border, the symbol to be inscribed within a “symbol area”, requires a minimum clearance between the border and the symbol itself, the size of the symbol area is related to the overall legend size. The following physical parameters are, therefore, utilised for the following examples :

a) CIRCLE (See Figure C. 1 and Figure C. 2)

- circle height (a), measured as the equivalent diameter of the circle;
- stroke width (b), measured as the equivalent width of the red ring;
- stroke width I, measured as the equivalent width of the lines which create the symbol;
- clearance (d), measured as the distance between the inner boundary of the equivalent surface of the red ring and the equivalent surface of the symbol area;
- diameter of maximum equivalent symbol area (e);
- equivalent height (f) of the symbol.

Table C. 1 gives the symbols and formulae for these parameters.

Table C. 1 — Parameters for mandatory signs with a red circle

Parameter	Symbol	Formulae
Average element spacing of circle	s_c	-
Number of pixel-rows of circle	r_c	-
Average element spacing of symbol	s_s	-
Number of pixel-rows of symbol	r_s	-
Height of circle	a	-
Circle stroke width $r_c = 1$ $r_c > 1$	b	$b = s_c$ $b = 0.5 * s_c * r_c * \sqrt{3}$
Legend stroke width $r_s = 1$ $r_s > 1$	c	$c = s_S$ $c = 0.5 * s_S * r_S * \sqrt{3}$
Outer diameter of symbol	e	$e = 0.809 * (a - 2 * b) \pm 8\ \%$
Minimum clearance	d	$d = 0.5 * (a - 2\,b - e)$
Character height within symbol area	f	$f = 0.36 * e$
NOTE 1: The dimensions $a - f$ include equivalent area. NOTE 2: The physical height of the circle (h) can be calculated with : $h = a - 0.5 * s_c * \sqrt{3}$ or $a - s_c$ (for $r_c = 1$) NOTE 3: The number of pixels of the circle (P) can be calculated with: $P = (r_c * h * \pi) / s_c$		

b) TRIANGLE (see Figure C. 3)

- triangle side length (a), measured as the length of one side of the triangle;
- stroke width (b), measured as the equivalent width of the side of the triangle;
- stroke width I, measured as the equivalent width of the lines which create the symbol;
- clearance (d), measured as the distance between the inner boundary of the equivalent surface of the triangle and the equivalent surface of the symbol area;
- height (e) of triangle, which forms the equivalent symbol area;
- equivalent height (f) of the symbol.

Table C. 2 gives the symbol and formulae for these parameters.

Table C. 2 — Parameters for mandatory signs with a red triangle

Parameter	Symbol	Formulae
Average element spacing of triangle	s_t	-
Number of pixel-rows of triangle	r_t	-
Average element spacing of symbol	s_s	-
Number of element-rows of symbol	r_s	-
Side length of triangle	a	-
Triangle stroke width $r_t = 1$ $r_t > 1$	b	$b = s_t$ $b = 0.5 * s_t * r_t * \sqrt{3}$
Legend stroke width $r_s = 1$ $r_s > 1$	c	$c = s_s$ $c = 0.5 * s_S * r_S * \sqrt{3}$
Height of symbol area in triangular shape	e	$e = 0.716 * (0.5 * a * \sqrt{3} - 3 * b) \pm 9\ \%$
Minimum clearance	d	$d = (a * \sqrt{3} - 6 * b - 2 * e) / 6$
Character height within symbol area	f	$f = 0.36 * e$

NOTE 1: The dimensions a-f include equivalent area.

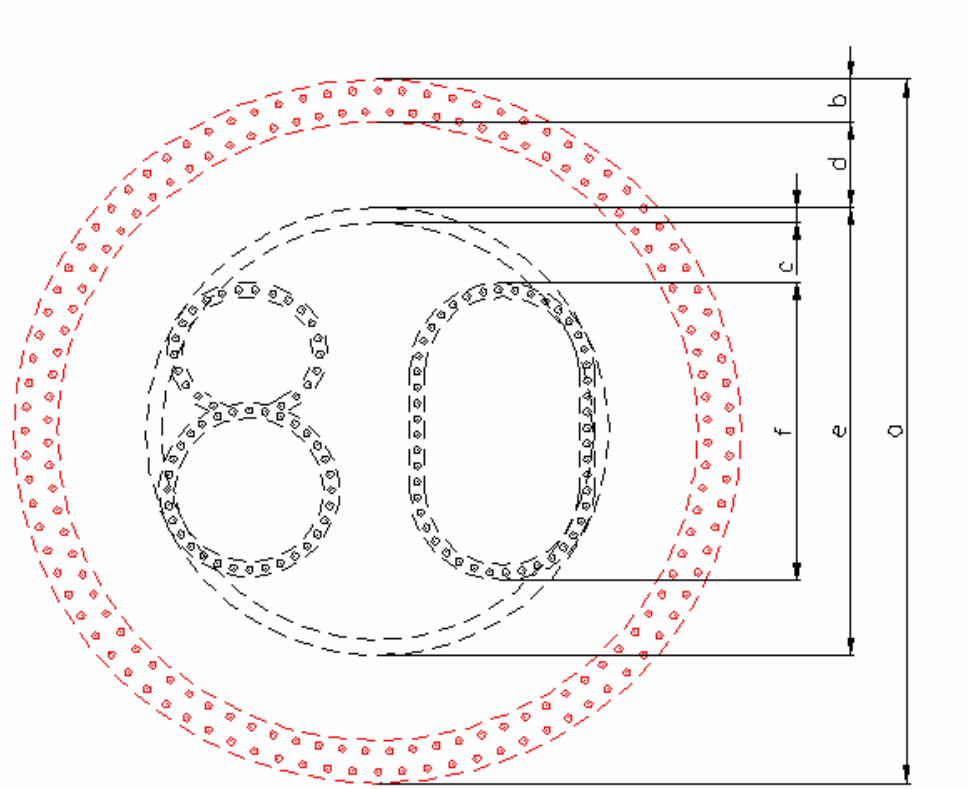
NOTE 2: The physical side length of the triangle (h) can be calculated with :

$$h = a - d_t * \sqrt{3}$$

NOTE 3: The number of pixels of the triangle (P) can be calculated with :

$$P = 3 * (\frac{h}{s_t} * r_t - r_t^2 - 1)$$

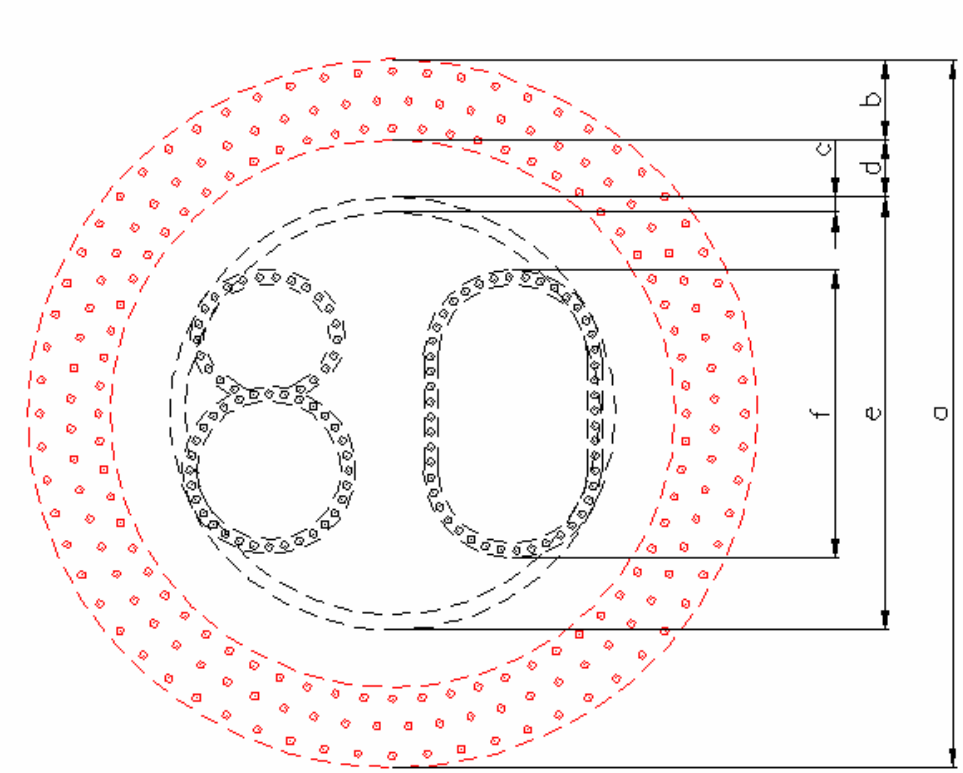
Example 1, circle



S_c	=	33.9 mm	s_S	=	30.9 mm
R_c	=	2	r_S	=	1
			a	=	999.4 mm
B	=	$0.5 * s_c * r_c * \sqrt{3}$	b	=	58.7 mm
C	=	S_S	c	=	30.9 mm
E	=	$0.809 * (a - 2 * b) \pm 8\ \%$	e	=	730.0 mm
D	=	$0.5 * (a - 2 * b - e)$	d	=	75.8 mm
f	>	$0.36 * e$ =262.8	f	=	380.0 mm
H	=	$a - 0.5 * s_c * \sqrt{3}$	h	=	970.0 mm
Pixels : P	=	$(r_c * h * \pi) / s_c$	P	=	176

Figure C. 1 — Example of calculation dimensions of circular mandatory VMS

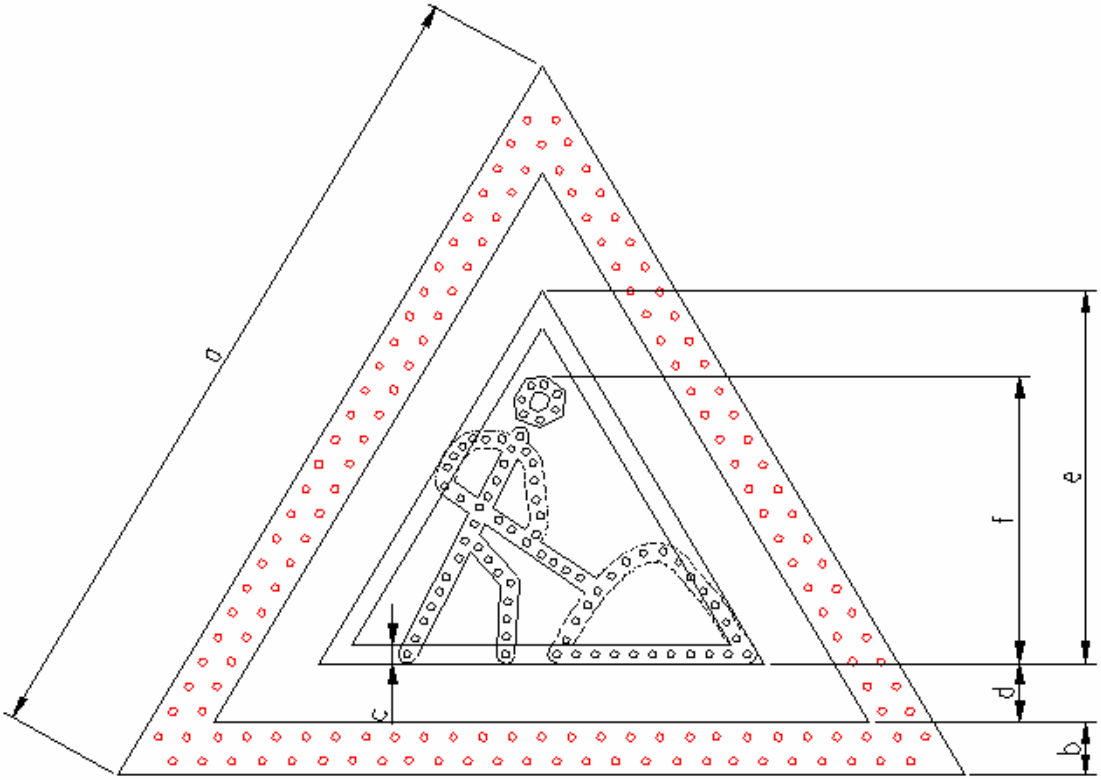
Example 2, circle



S_c	=	40.9 mm	s_S	=	29.5 mm
R_c	=	3	r_S	=	1
			a	=	935.4 mm
B	=	$0.5 * s_c * r_c * \sqrt{3}$	b	=	106.3 mm
C	=	S_S	c	=	29.5 mm
E	=	$0.809 * (a - 2 * b) \pm 8\ \%$	e	=	570.0 mm
D	=	$0.5 * (a - 2 * b - e)$	d	=	76.4 mm
F	>	$0.36 * e$ =205.2	f	=	370.0 mm
H	=	$a - 0.5 * s_c * \sqrt{3}$	h	=	900.0 mm
Pixels : P	=	$(r_c * h * \pi) / s_c$	P	=	192

Figure C. 2 — Example of calculation dimensions of a circular mandatory VMS

Example 3, triangle



s_t = 37.5 mm s_S = 26.1 mm

r_t = 2 r_S = 1

a = 1 115.0 mm

b = $0.5 * s_t * r_t * \sqrt{3}$ b = 65.0 mm

c = $0.5 * S_S * r_s * \sqrt{3}$ c = 22.6 mm

e = $0.716 * (0.5 * a\sqrt{3} - 3 * b) \pm 9\ \%$ e = 552.0 mm

d = $(a * \sqrt{3} - 6 * b - 2 * e) / 6$ d = 72.9 mm

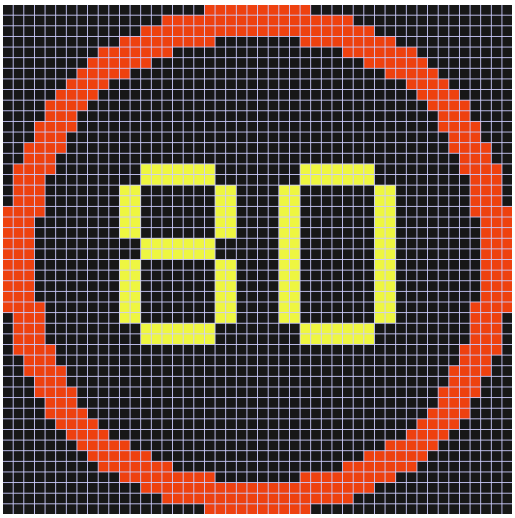
h = $A - \sqrt{3} * S_t$ h = 1 050.0 mm

Pixels : P = $3 * (\frac{h}{s_t} * r_t - r_t^2 - 1)$ P = 153

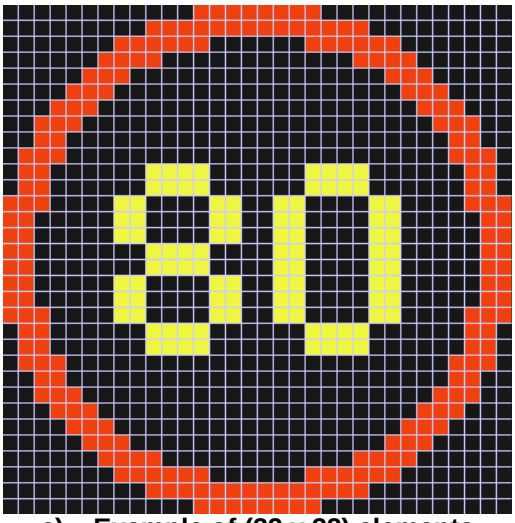
Figure C. 3 — Example of calculation dimensions of a triangular warning VMS

The following examples demonstrate the effect of colour inversion in a regular orthogonal system matrix.

a) Example of (64 x 64) elements



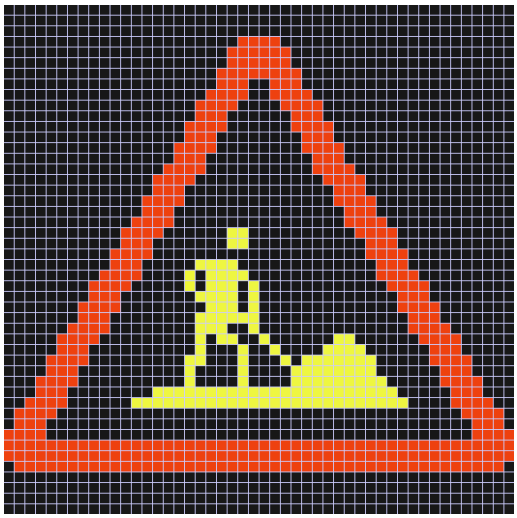
b) Example of (48 x 48) elements



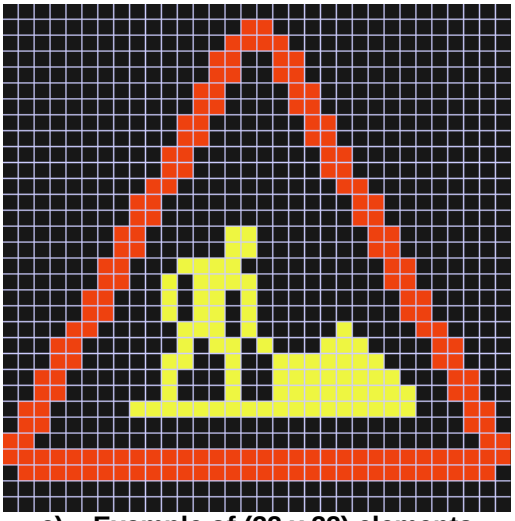
c) Example of (32 x 32) elements

Figure C. 4 — Example of symbol with circle

a) Example of (64 x 64) elements



b) Example of (48 x 48) elements



c) Example of (32 x 32) elements

Figure C. 5 — Example of symbol with triangle

C.3 Variable Message Signs without colour inversion

The following examples apply to VMS, often referred to as “full colour graphic VMS”, consisting of displaying elements disposed in an orthogonal matrix, with equal horizontal and vertical element spacing, each formed by at least 3 light emitters, i.e. red, green and blue. In this way it is possible, by varying the luminosity and the colour of each VMS element, to display on the VMS any pictogram, of any colour.

Important aspects, besides those already regulated by this standard, regarding this type of VMS, are:

- number of elements per unit surface area;

- single pixel luminance control.

The use of regular matrix may not allow the exact reproduction of oblique lines, and circles: in both cases there may be a “staircase effect”. To reduce this and to improve the quality of the displayed pictogram, it is advisable to limit the distance between the elements as well as to use other techniques capable of reducing the staircase effect, and techniques to improve the perception of the equivalent area.

Luminance control of each VMS light-emitting element is another important aspect to be considered, since there are a number of operational conditions where this feature is of the utmost importance.

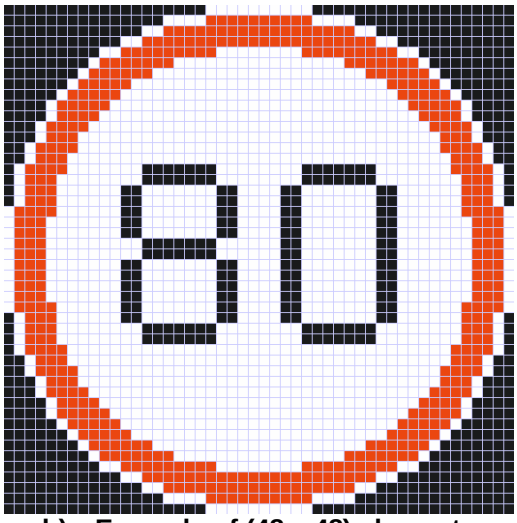
Some pictograms, in fact, comprise thin black lines on white background. When luminous intensity of the white parts of them is very high (as during daytime hours, with sun in front of the display), the thin black line becomes partially reduced in dimension, due to the white component “invading” part of the black area. At night, instead, when low white intensity is required, the black line appears larger in dimension. In order to avoid this effect, it is necessary to control the luminous intensity of each element reducing, in certain situations, the luminance of the white pixels near to black areas, respect to other white elements that are far away.

This example is generally applicable to all borders with different colours and mainly when the two adjacent colours belong to strong emissive colour (as white and yellow) and to background colours (black, blue, red).

NOTE 1: When using a white background, the perceived character size can change depending on the viewing distance. This can be solved with an appropriate control of the luminance of the background.

The following examples demonstrate the effect of non colour inversion in a regular orthogonal system matrix.

a) Example of (64 x 64) elements



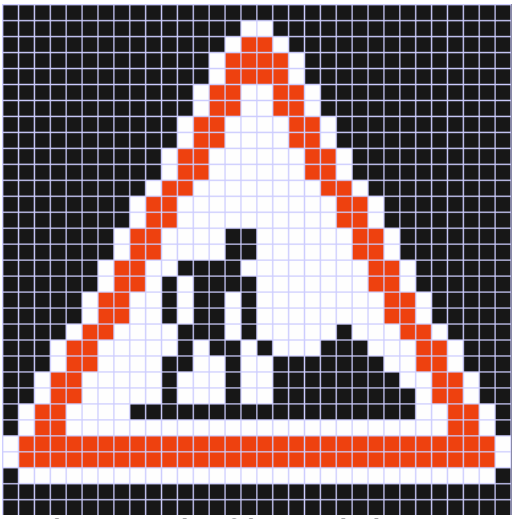
b) Example of (48 x 48) elements

c) Example of (32 x 32) elements

Figure C. 6 — Example of symbol with circle

a) Example of (64 x 64) elements

b) Example of (48 x 48) elements



c) Example of (32 x 32) elements

Figure C. 7 — Example of symbol with triangle

Annex D
(informative)

Guidance on Dimensions and Class Combinations for discontinuous light emitting signs

D.1 General

The aim of this annex is to give to the designer or purchaser some typical values of dimensions and tolerances used on VMS in order to obtain an acceptable legibility.

The choice of the size range is determined by the required legibility distance and approach speed to the sign on site.

The legibility distance can be based on letter height times a factor. This factor is dependent on various environmental and human parameters and is typically given a value in the range 500 – 600.

D.2 Dimensions

D.2.1 Text

The different parameters of Table D. 1 are defined in Annex F (informative).

Table D. 1 — Dimensions of textes

Size range	**Minimum character height:** h (mm)	**Minimum character width:** w (mm)	**Minimum character spacing:** sc (mm)	**Minimum word spacing:** sw (mm)	**Minimum line spacing:** sl (mm)	**Minimum backing board border distance:** (mm)
A	100	71	28	71	57	100
B	160	114	46	114	91	160
C	240	171	68	171	137	240
D	320	228	91	228	182	320
E	400	285	114	285	228	400

NOTE 1: The minimum character width is equal to 5/7 h.

NOTE 2: The minimum character spacing is equal to 2/7 h.

NOTE 3: The minimum word spacing is equal to 5/7 h.

NOTE 4: The minimum line spacing is equal to 4/7 h.

NOTE 5: The minimum backing board border distance is equal to h. This distance is measured from the border of text to the border of backing board.

The minimum number of elements for an alphanumeric character is 7 (7 elements in vertical direction) by 5 (5 elements in horizontal direction).

D.2.2 Circles

The different parameters of Table D. 2 are defined in Annex C (informative) Guidance on graphics for light emitting signs.

Table D. 2 — Dimensions of circles

Size range	Minimum height of circle : a (mm)	Circle stroke width : b (mm)
A	450	35 ± 10 %
B	650	50 ± 10 %
C	850	60 ± 10 %
D	1 050	75 ± 10 %
E	1 250	90 ± 10 %

The minimum number of elements for a matrix containing a circle is 32 x 32 (32 elements in vertical direction, (32 elements in horizontal direction).

D.2.3 Triangles

The different parameters of Table D. 3 are defined in Annex C (informative) Guidance on graphics for light emitting signs.

Table D. 3 — Dimensions of triangles

Size range	Minimum side length of triangle : a (mm)	Triangle stroke width : b (mm)
A	500	30 ± 10 %
B	700	45 ± 10 %
C	1 000	60 ± 10 %
D	1 250	75 ± 10 %
E	1 500	90 ± 10 %

The minimum number of elements for a matrix containing a triangle is 32 (32 elements in vertical direction) by 32 (32 elements in horizontal direction).

D.3 Class Combinations

D.3.1 General

The purpose of this Informative Annex is to provide guidance to those individuals charged with the responsibility for selecting the appropriate Visual and Physical Performance classes from clauses 7 and 8 of this Standard respectively. The Visual and Physical parameters offer a variety of combinations and could be easily misinterpreted leading to an incorrect selection. This could result in a VMS which is not suitable for use.

For effective use the correct selection of combinations of beam width, luminance and luminance ratio is essential.

The first decision to be made is the location of the sign. This is used to select the appropriate Beam Width Class.

Subsequently the selection of the relevant levels of Luminance and Luminance ratio can be made taking into account the legibility criteria.

For example, the selection of the highest (brightest) Luminance class L3 for long viewing distance means, that in practice a narrow beam width is only required; this means, that the available light has a distribution to cover the lane width at a significant distance from the sign.

Wider beam widths distribute the light laterally over a larger angle; and consequently have a shorter viewing distance. Typically to maintain the brightness between Beam Width classes B1 and B7 the luminance required for B7 class would be approximately 24 times the B1 class. Consequently for the shorter viewing distance the luminance required is less, therefore for wider Beam Width classes it is only necessary to select the lower luminance classes.

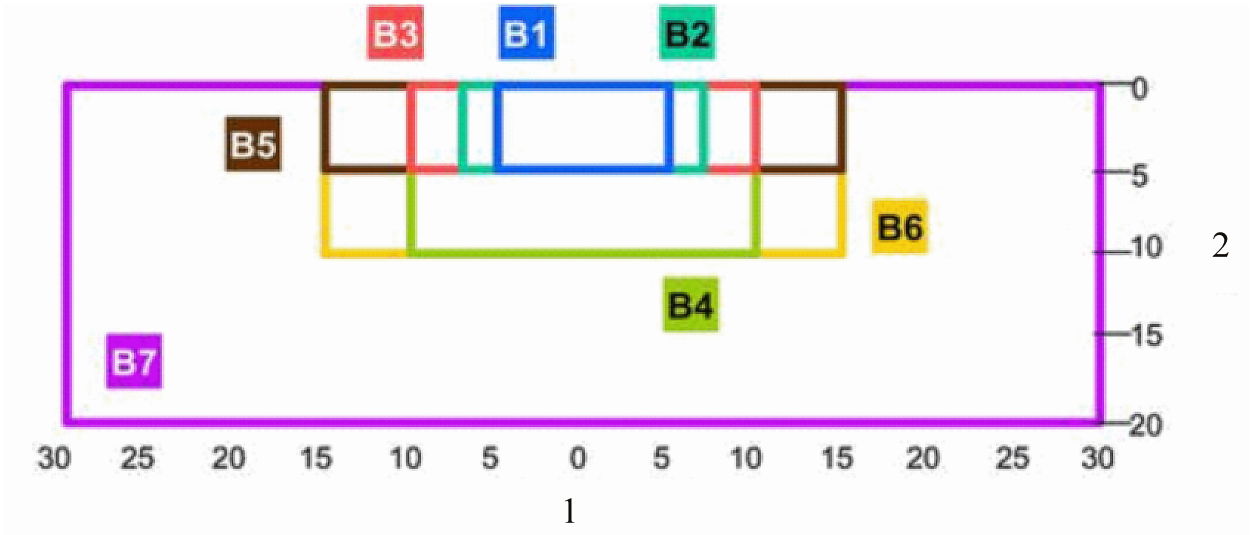
Because the Luminance Ratio is linked to Luminance for any particular sign or colour, the selection of Luminance Ratio class to be used depends on the Luminance and therefore on the Beam Width.

D.3.2 Beam Width

Seven beam width classes B1 to B7 are given in Table 6 of the Standard, a copy is shown below for ease of reference.

Beam width class	**Test angles (degrees)**	
	Horizontal	Vertical
B1	-5	0
	+5	0
	0	-5
B2	-7	0
	+7	0
	0	-5
B3	-10	0
	+10	0
	0	-5
B4	-10	0
	+10	0
	0	-10
B5	-15	0
	+15	0
	0	-5
B6	-15	0
	+15	0
	0	-10
B7	-30	0
	+30	0
	0	-20

To understand this table more graphically the Figure D. 1 the relationship between classes. If the area covered by B1 is considered as one unit then it can be seen that B7 covers 24 times B1.



Key

1 Beam width horizontal

2 Beam width vertical

Figure D. 1 — Relation between classes

The following Table D. 4 gives examples of typical applications to assist in the correct selection of Beam Width Class.

Table D. 4 — Examples for applications of Beam Width Classes

Beam width class	Typical application
B1	High speed road, two running plus one safety lanes, sign mounted at high level above traffic typically size ranges D and E of Table D. 1, Table D. 2 and Table D. 3.
B2	High speed road, three running plus one safety lanes, sign mounted at high level above traffic typically size ranges D and E of Table D. 1, Table D. 2 and Table D. 3.
B3	High speed road, four running plus one safety lanes, sign mounted at high level above traffic or at the side of the road and requiring a wider beam width to cover all the lanes, typically size ranges D and E of Table D. 1, Table D. 2 and Table D. 3.
B4	Medium speed road, sign mounted at high level, typically size ranges B and C of Table D. 1, Table D. 2 and Table D. 3.
B5	Urban areas, shoulder mounted sign, sign mounted at low level, typically size ranges A, B and C of Table D. 1, Table D. 2 and Table D. 3.
B6	As B5 above, sign mounted at high level.
B7	For special applications where very wide horizontal and vertical beam widths are required NOTE 1: In urban areas B7 could be used where the approach speed is slow and legibility distance is short, it could account for the interests of cyclists and pedestrians. NOTE 2: In highway applications B7 could be used where extreme road curvature has to be accommodated e.g. a circular entry slip road onto a high speed highway.

Figure D. 2 shows an example of coverage by Beam Width Class B1

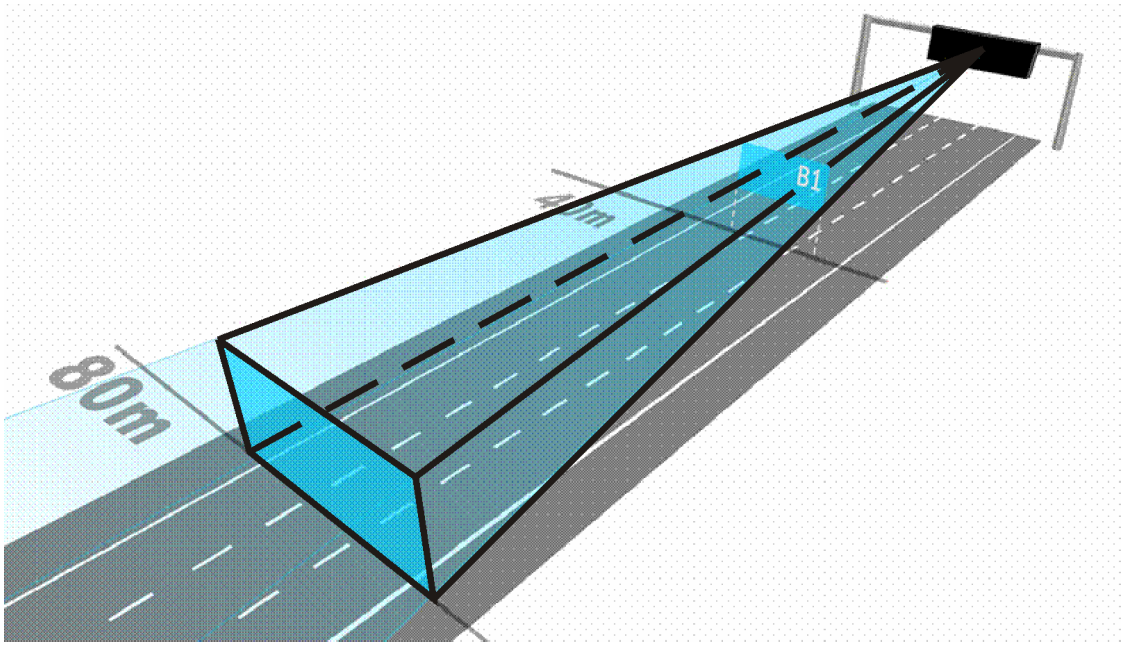


Figure D. 2 — Example of coverage by Beam Width Class B1

Figure D. 3 shows an example of coverage by Beam Width Class B1, B3

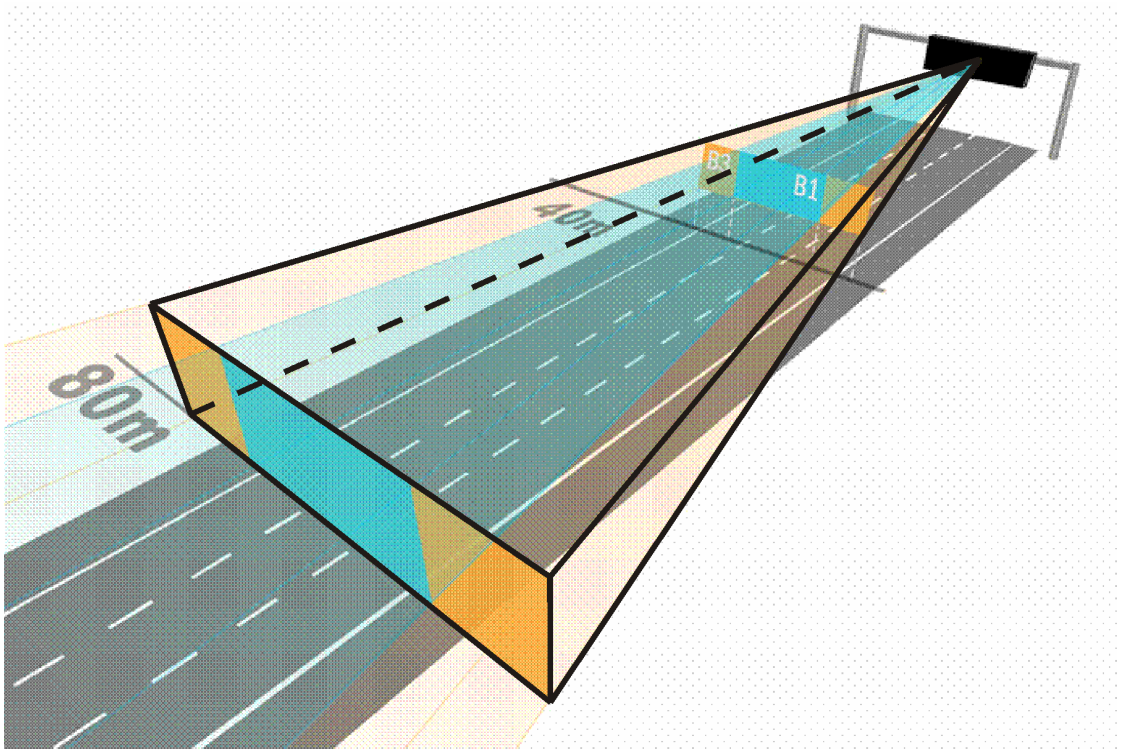


Figure D. 3 — Example of coverage by Beam Width Classes B1, B3

Figure D. 4 shows an example of coverage by Beam Width Class B1, B3, B7

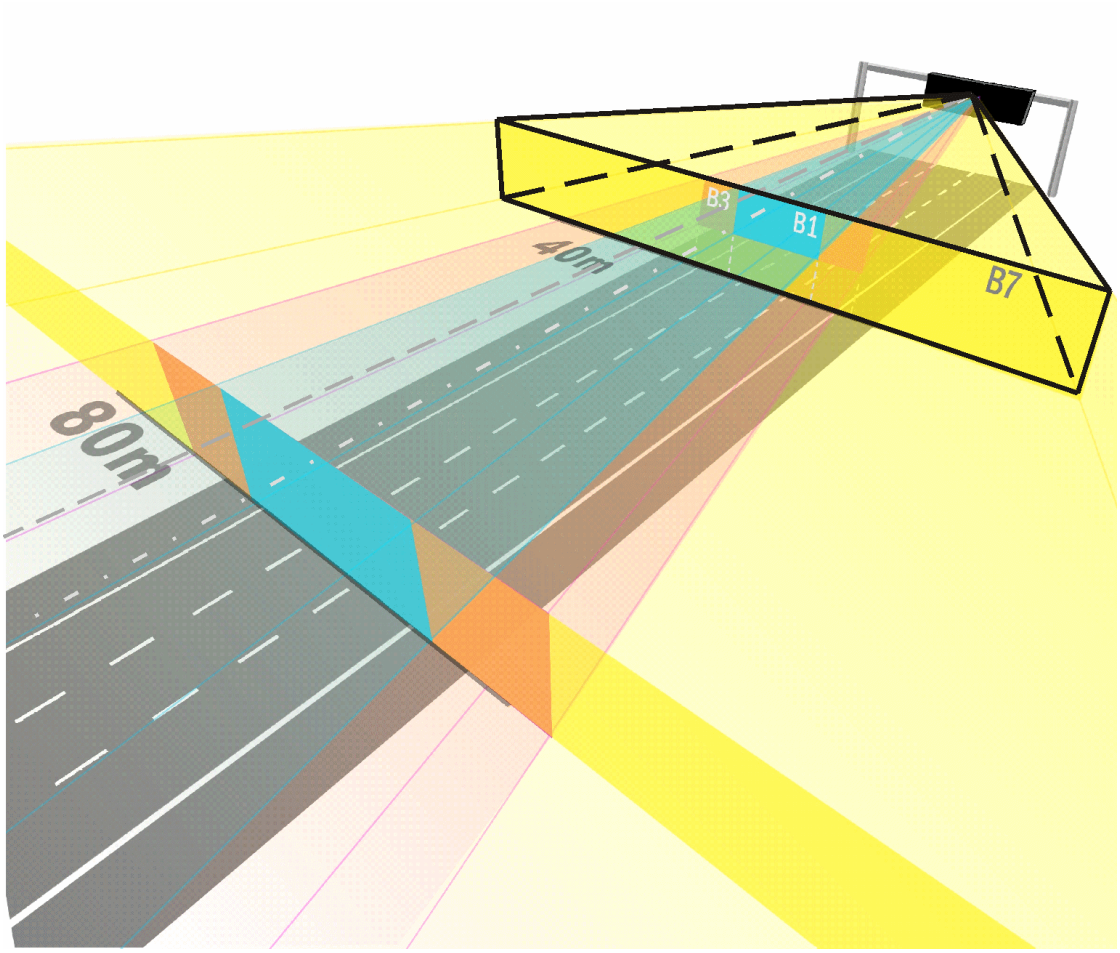


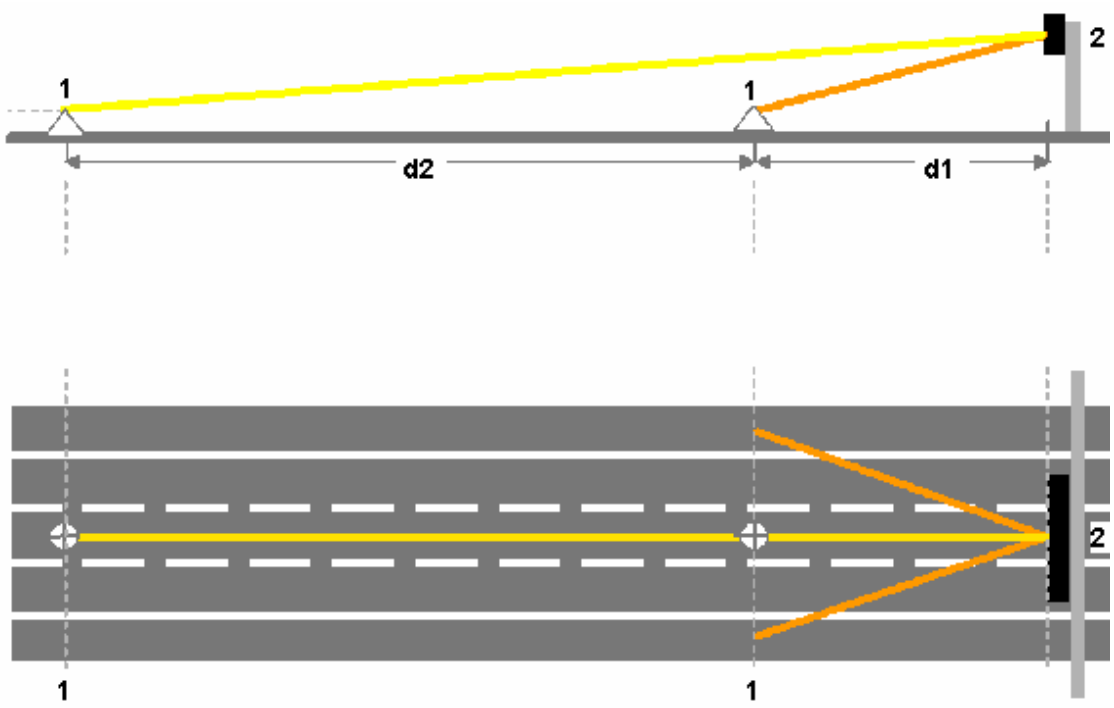
Figure D. 4 — Example of coverage by Beam Width Class B1, B3, B7

Three dimensionally the effect of horizontal and vertical beam widths can be seen dramatically by considering Classes B1, B3 and B7.

By adjusting the sign alignment horizontally and vertically the spread of the beam can be optimised to any given location and road layout.

Figure D. 5, Table D. 5 and Table D. 6 demonstrate that small adjustment to the horizontal and vertical alignments make a big difference to the distances at which messages are viewable.

NOTE: Legibility distance is dependent on various environmental and human parameters.



Key

1 Target, at a height of 1.2m
2 VMS, at a centre height of 7m
d1 Minimum Viewing Distance
d2 Maximum Viewing Distance

Figure D. 5 — Vertical and Horizontal viewing and alignment

From the above it can be observed that B1and B3 are suitable for a high speed roads, B1 for 2 or 3 lane and B3 for 3 to 5 lanes. The B7 horizontal beam width is too wide and simply wastes emitted light in areas where it is of no value to drivers. The vertical angle determines the distance from the sign at which the emitted light touches the driver's eye level and beyond which the message begins to cut out. In the diagram the mounted sign is vertical and has its central point 7 metres above the road surface. Thus, examples of the approximate viewing distances for the classes are shown in Table D. 5:

Table D. 5 — Examples of minimum viewing distance

Class	Vertical	Minimum viewing distance d1 for a central point mounting height of 7m
B1, B2, B3, B5	-5°	66m
B4, B6	-10°	33m
B7	-20°	16m

If this distance is equated to approach speed by noting that at 110 km/h a vehicle travels 30.6 m/s, there is very little time to read the message. It may be better to concentrate on long viewing distances by selecting the

appropriate size range and optical performance than to encourage drivers to read the message on the sign for the last few milliseconds rather than looking at the road ahead. Table D. 6 gives an example of this:

Table D. 6 — Example of viewing distances and reading times

Size range See Table D. 1	Viewing Distance d2	Possible reading time in seconds						
	m	40 km/h	50 km/h	60 km/h	80 km/h	100 km/h	110 km/h	130 km/h
A	60	5.5	4.3	3.5	3	2	-	-
B	90	8.2	6.5	5.4	4	3	-	-
C	150	13.6	10.8	9.0	6.8	5.6	4.9	4.1
D	200	18.2	14.4	12.0	9.1	7.4	6.5	5.5
E	300	27.3	21.6	18.0	13.6	11.1	9.8	8.3

However, in urban applications wider beam widths are necessary where smaller character sizes are deployed and approach speeds are slower.

The correct alignment of a VMS in its location has a major affect on achieving the conspicuity and legibility criteria of success deployment.

D.3.3 Luminance and Luminance Ratio

Taking into consideration driver needs and the possibility of unfavourable environmental conditions it may be best to select Classes L3 / R3. However other luminance / luminance ratio class combinations could be appropriate when taking into consideration the Beam Width requirements, see Table D. 4.

D.4 Energy efficacy

Selecting the correct parameters for a given application has a direct impact on the energy consumption of the VMS. Insisting on beam widths that are too wide for the location costs money, wastes energy and creates light pollution.

For a long range viewing application of, say, 300 metres where size range E is required, Class B1 is probably the right choice depending on the number of lanes to be covered. If B7 is incorrectly selected this will require 24 times the light output wasting 23 times or 96% of the light output and energy.

Annex E
(informative)

Specific design issues

(This annex can be used as a guideline).

E.1 Finish

The finish of all VMS surfaces should not result in specular (mirror) reflection that will distract road users.

E.2 Front panels

The front panels of VMS should be designed in such a way that no part of the message displayed is obscured when observed from the required viewing positions.

VMS should be designed in such a way as to minimise the effects of ice and snow on their functionality.

E.3 Front screens

When front screens are required they should be securely fitted to the VMS housing. They should be made from UV and scratch resistant materials and may be removable to facilitate maintenance.

Manufacturers should detail the measures they have taken to prevent condensation from forming on the front screen.

E.4 Appearance

Manufacturers should detail the measures they take to ensure the homogenous appearance of the complete VMS with particular attention paid to the display surface, because in this specification the uniformity is only measured on the test module.

E.5 Electrolytic compatibility

Components shall comprise materials that when assembled into the VMS are electrolytically compatible and environmentally stable.

E.6 Protection against thermal overload

Special applications may require that VMS should be provided with active and/or passive protection against thermal overload.

E.7 Physical security against unauthorised access

Suitable measures should be taken to prevent unauthorised access to the VMS or its interior.

E.8 Interfaces between VMS, control, and higher order equipment

VMS with incorporated control devices should be provided with means for connecting maintenance and testing equipment to the control system if test devices are not incorporated in the product. As far as possible a standard interface should be used.

Data communication equipment should be designed in accordance with requirements specified by the purchaser.

E.9 Diagnostic

The supplier has to be able to monitor and diagnose the main elements of the VMS in order to guarantee the performance of the product, i.e.:

d) power supply;

e) logic supply;

f) pixel integrity;

g) fans and heaters;

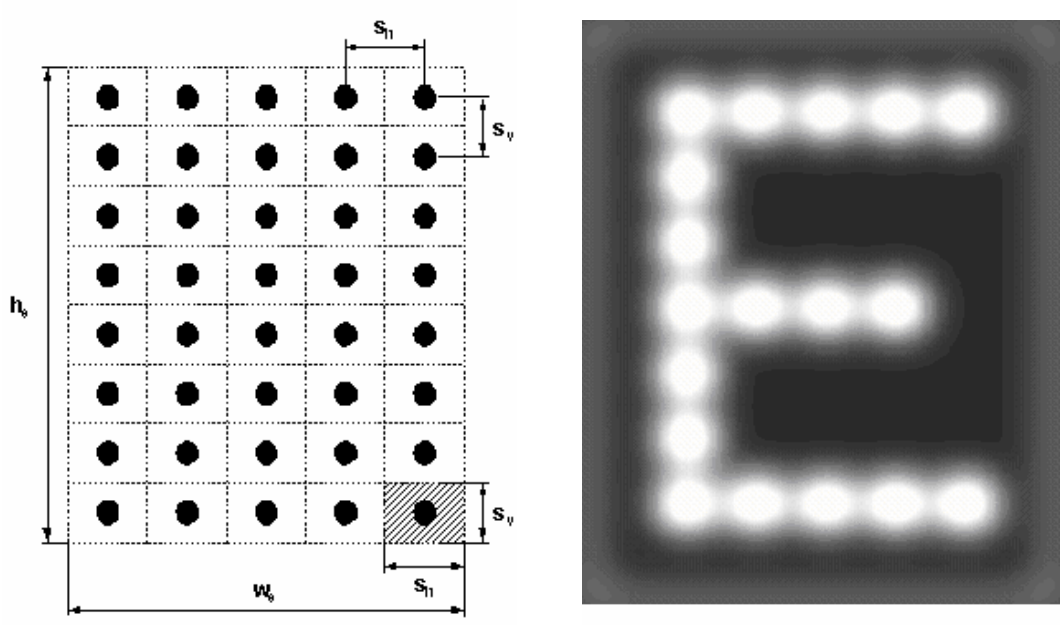
h) communication.

Annex F
(informative)

F.1 Design of VMS messages

For the design of a VMS message that must be perceived from a long distance the equivalent element area rather than the actual physical element size has to be considered. This has consequences for the perceived dimensions of message. In general the perceived size is larger than the physical size. This will be illustrated in the next example.

The left hand side of Figure F. 1 shows an example of a letter consisting of elements on a regular matrix with equal horizontal and vertical element spacing. The square area around each element is the equivalent element area. The shaded area is the equivalent area of the letter. Note that the physical dimensions are smaller than the equivalent dimensions. For the design of a VMS message that must be perceived from a long distance the equivalent element area rather than the actual physical element size has to be considered. This has consequences for the perceived dimensions of message. In general the perceived size is larger than the physical size. This will be illustrated in the next example.



Key

h_e equivalent height
w_e equivalent width
h_{ph} physical height
w_{ph} physical width
D_{ph} physical element diameter
s_h horizontal element spacing
s_v vertical element spacing

Figure F. 1 — Example of the design of the letter E in an orthogonal matrix

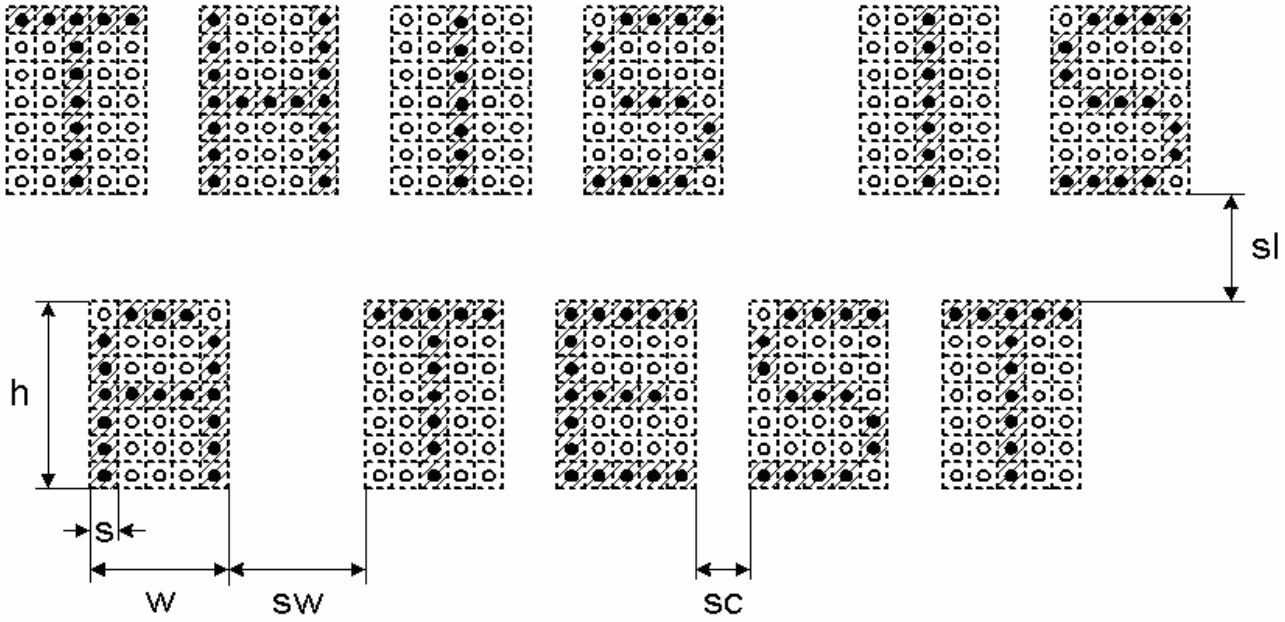
The square area around each element is the equivalent element area. The shaded area is the equivalent area of the letter.

The right hand side shows the appearance of the letter in reality.

In reality the light of one element will not be spread out equally over the square equivalent element area. For the observer the light will be blurred around the centre of the element. As a consequence of this the letter will not have a sharp outline. This is illustrated in the right hand side of Figure F. 1 for the case that each element contains one circular light source. When the elements have more than one light source or have non-circular light sources the blurring may be slightly different.

F.2 Specifying text dimensions

For the specification of VMS message dimensions the equivalent dimensions rather than the physical dimensions shall be used. Figure F. 2 shows the most important text dimensions, namely, character height, character width, stroke width, character spacing, word spacing, and line spacing, specified using equivalent dimensions.



Key

h character height
w character width
s stroke width
sc character spacing
sw word spacing
sl line spacing

Figure F. 2 — Text dimensions based on equivalent dimensions

The shaded areas are the equivalent areas of the text. The dots (white = off, black = on) indicate the physical size of the elements.

Annex ZA
(informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives.

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under a mandate M/111 “Circulation Fixtures” given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of EU Directive 89/106.

WARNING: Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Compliance with these clauses confers a presumption of fitness of the variable message signs covered by this annex for their intended uses indicated herein; reference shall be made to the information accompanying the CE marking.

NOTE 1: In addition to any specific clauses relating to dangerous substances contained in this standard, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

NOTE 2: An informative database of European and national provisions on dangerous substances is available at the Construction web site on EUROPA, accessed through
http://europa.eu.int/comm/enterprise/construction/internal/dangsub/dangmain.htm.

This Annex has the same scope as Clause 1 of this standard with regard to the products covered excluding Portable and temporary VMS. It establishes the conditions for the CE marking of Variable Message Signs intended for the use indicated below and shows the relevant clauses applicable (see Table ZA. 1).

Construction Product:	Variable Message Signs excluding Portable and temporary VMS;
Intended uses:	for the instruction and guidance of road users on public and private roads, including tunnels.

The requirement on a certain characteristic is not applicable in those Member States where there are no regulatory requirements on that characteristic for the intended end use of the product. In this case, manufacturers placing their products on the market of these Member States are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option “No performance determined” (NPD) in the information accompanying the CE marking (see Clause ZA.3) may be used.

The NPD option may not be used, however, where the characteristic is subject to a threshold level

Table ZA. 1 — relevant clauses

Construction product : Vertical road traffic signs – part 1 Variable message signs **Intended use: Variable Message Signs installed permanently for the instruction and guidance of road users on public and private land, including tunnels.**			
Essential characteristics	Requirement clauses in this European Standard	Levels and/or classes	Notes
Resistance to horizontal loads	8.3.2.1 Loads	-	For this item reference is made to EN 12899-1:2001 tables 13 and 15
	8.3.2.2 Deflections		For this item reference is made to EN 12899-1:2001 tables 16 and 17
Impact resistance	8.3.4 Impact resistance	-	For this item reference is made to EN 60598-1 for the test method
Visibility characteristics			
Chromaticity co-ordinates	7.2 Colour	-	For continuous signs reference is made to EN 12899-1
Retro reflectivity (if applicable)		-	Reference is made to EN 12899-1
Optical performance (Luminance)	7.3 Luminance 7.4 Luminance ratio 7.5 Beam width		See Table 1 of this standard
	7.6 Uniformity		Pass / Fail
	7.7 Visible flicker		Pass / Fail
Durability			
Physical performance and optical performance	8.2 Environmental requirements	-	See tables 13, 14, 15, 16, 17, 18 of this standard
	7.3 Luminance 7.4 Luminance ratio 7.5 Beam width		See Table 1 of this standard
	7.6 Uniformity		Pass / Fail
	7.7 Visible flicker		Pass / Fail
Dangerous substances	13 Dangerous substances	-	ppm

ZA.2 Procedure(s) for attestation of conformity of Variable Message Signs

Systems of attestation of conformity

The system of attestation of conformity of VMS indicated in Figure ZA. 1 in accordance with the Decision of the Commission [96/579/EC] as given in Annex III of the mandate for circulation fixtures is shown in Table ZA. 2 for the indicated intended use.

Table ZA. 2 — System of attestation of conformity

Product	Intended uses	Levels and classes	Attestation of conformity system
Vertical road traffic signs – Variable Message Signs	Variable Message Signs installed permanently for the instruction and guidance of road users on public and private land, including tunnels.	All	1
System 1 See Directive 89/106/EEC (CPD) Annex III.2.(i), without audit testing of samples.			

The attestation of conformity of the Variable Message Signs in Table ZA. 1 shall be in accordance with the evaluation of conformity procedure indicated in Table ZA. 3 resulting from the application of the clauses of this European Standard indicated herein.

Table ZA. 3 — Assignation of evaluation of conformity tasks for System 1

Tasks		Content of the task	Evaluation of conformity clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to all characteristics of Table ZA. 1.	12.3
	Further testing of samples taken at factory	All characteristics of Table ZA. 1.	12.3
Tasks for the notified body	Initial type testing	Those characteristics of Table ZA. 1.	12.2
	Initial inspection of factory and of FPC	Parameters related to all characteristics of Table ZA. 1, relevant for the intended use	12.2 12.3
	Continuous surveillance, assessment and approval of FPC.	Parameters related to all characteristics of Table ZA. 1, relevant for the intended use	12.3

When compliance with the conditions of this annex is achieved, the certification body shall draw up a certificate of conformity, (EC certification of conformity), which entitles the manufacturer to affix the CE marking. The certificate shall include:

- name, address and identification number of the certification body;
- name and address of the manufacturer, or his authorised representative established in the EEA, and place of production;
- description of the product (type, identification, use, ...);
- provisions to which the product conforms (i.e. Annex ZA of this EN);

- particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions);
- the number of the certificate;
- conditions and period of validity of the certificate, where applicable;
- name of, and position held by, the person empowered to sign the certificate.

In addition, the manufacturer shall draw up a declaration of conformity (EC Declaration of conformity) including the following:

- name and address of the manufacturer, or his authorised representative established in the EEA
- name and address of the certification body;
- description of the product (type, identification, use, …)and a copy of the information accompanying the CE marking;
- provisions to which the product conforms (i.e. Annex ZA of this EN);
- particular conditions applicable to the use of the product(e.g. provisions for use under certain conditions;
- number of the accompanying EC Certificate of conformity;
- name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or of his authorised representative.

ZA.3 CE marking

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EEC and shall be shown on the VMS. The following information shall accompany the CE marking symbol:

- identification number of the notified body;
- the name or identifying mark and registered address of the producer;
- the last two digits of the year in which the marking is affixed;
- the number of the EC Certificate of conformity or factory production control certificate (if relevant);
- reference to this European Standard EN 12966-1:YYYY;
- description of the product: generic name, material, dimensions … and intended use;
- information on those relevant essential characteristics listed in Table ZA. 1 which are to be declared presented as:
    - declared values and, where relevant, level or class (including “pass” for pass/fail requirements, where necessary) to declare for each essential characteristic as indicated in “Notes” in Table ZA. 1;
    - “No performance determined “ for characteristics where this is relevant;
    - as an alternative, a standard designation which shows some or all of the relevant characteristics (where the designation covers only some characteristics, it will need to be supplemented with declared values for other characteristics as above).

The “No performance determined” (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to the regulatory requirements in the Member state of designation.

Figure ZA. 1 shows the method of identifying the performance characteristics of the product.

The following example provides an illustration of the information required to accompany the CE marking for Variable Message Signs. The label gives the information required and examples of responses.

CE 1234	CE conformity marking Identification number of the certification body
AnyCo Ltd, P.O. Box 21, B – 1050 **03** 1234 – CPD – 9876	Name or identifying mark and registered address of the manufacturer Last two digits of the year, in which the marking was affixed Certificate number
EN 12966-1:2007 **Variable message signs installed permanently for the instruction and guidance of road users on public and private land, including tunnels** **Reaction to horizontal load** WL2; DSL2; TDB2; TDT5 **Impact resistance** Pass **Chromaticity co-ordinates and optical performance** **Durability** T1, P2 **Dangerous substances** Substance x, less then y ppm	Number of European standard Description of product and information on regulated characteristics

	White	White/ yellow	yellow	green	red	blue
Colour(clause 7.2)	C2				C1	
Luminance (clause 7.3)	L3				L3	
Luminance ratio (clause 7.4)	R2				R1	
Beam width (clause 7.5)	B3				B1	

Figure ZA. 1 gives an example of the information to be given on the commercial documents for a VMS emitting red and white light

In addition to any specific information relating to dangerous substances shown above, the product should also be accompanied, when and where required and in the appropriate form, by documentation listing any other legislation on dangerous substances for which compliance is claimed, together with any information required by that legislation.

NOTE: European legislation without national derogations need not be mentioned.