b) Details of any limitations on location or use.

c) Instructions for the handling, maintenance and cleaning of VMS, including component replacement.

d) Safety and environmental instructions and their eventually derived precaution measures in regards to the operating, installing, servicing, transporting or storing VMS.

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 VMS is intended to be installed.

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, characters 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 than 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.

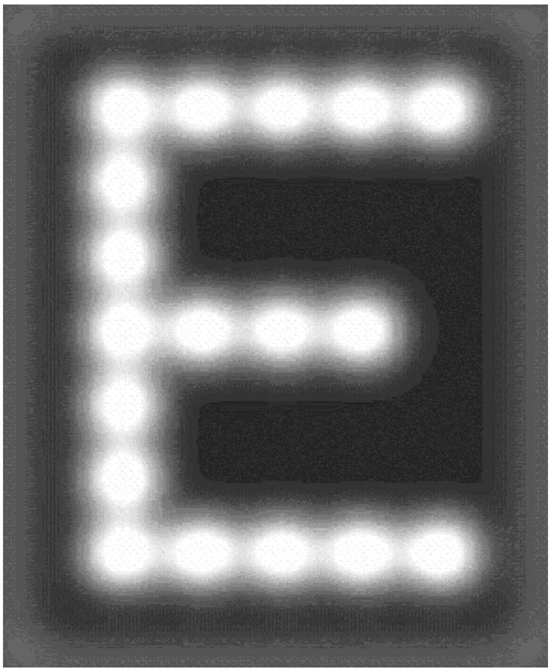


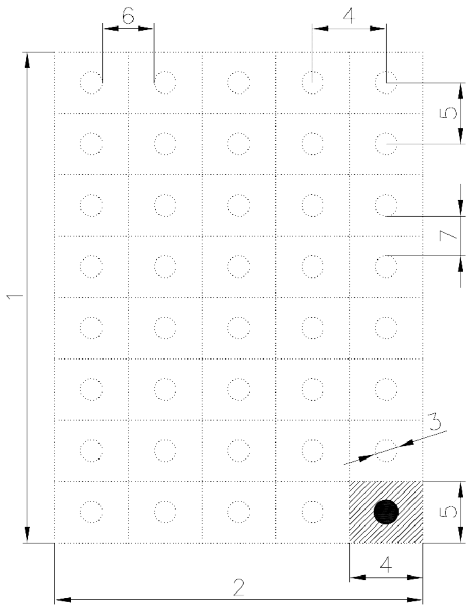
Figure A.1 — Merging of elements

In a regular matrix of a VMS, 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

VMS 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 character of a VMS with a regular orthogonal matrix of (5 × 8) elements (see Figure A.2). The horizontal element spacing is s_h and the vertical element spacing is s_v.



Key

1 equivalent height of the matrix (h_e)

2 equivalent width of the matrix (w_e)

3 physical diameter of the light source of the element

4 horizontal element spacing, width of equivalent of an element (s_h)

5 vertical element spacing, height of equivalent area of an element (s_v)

6 horizontal distance between the light sources of adjacent elements

7 vertical distance between the light sources of adjacent elements

NOTE The shaded area is showing the equivalent area of an element.

Figure A.2 — Character with a regular orthogonal matrix of (5 × 8) elements

The average luminance of the character can be calculated by Formula (A.1)

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

where

L average luminance (cd/m²) measured in the direction of reference axis

I average luminous intensity of a single element (cd)

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

$$s_h s_v = \frac{I}{L} \tag{A.2}$$

where the product s_h s_v is the size of the equivalent element area (m²) - shaded area in Figure A.2.

The luminous intensity (cd) of a single element (I) shall be 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 The equivalent area of an element is the reciprocal of the element density (in terms of number of elements per unit of area).

EXAMPLE 1 Assume that the elements of the character 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 shall be made.

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

$$\frac{12\ \text{cd}}{12\ 400\ \text{cd/m}^2} = 0{,}000\ 968\ \text{m}^2$$

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

$$\sqrt{0{,}000\ 968\ \text{m}^2} = 0{,}031\,1\ \text{m} = 31{,}1\ \text{mm}$$

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

In that case the vertical element spacing is

$$\sqrt{\frac{0{,}000\ 968\ \text{m}^2}{1{,}5}} = 0{,}025\ 4\ \text{m} = 25{,}4\ \text{mm}$$

and the horizontal element spacing is

$1{,}5 \times 25{,}4\ \text{mm} = 38{,}1\ \text{mm}$.

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

$5 \times 38{,}1\ \text{mm} = 190{,}5\ \text{mm}$.

The equivalent height of the test matrix (h_e) is

$8 \times 25{,}4\ \text{mm} = 203{,}2\ \text{mm}$.

The equivalent area of the test matrix is

$0{,}1905\ \text{m} \times 0{,}2032\ \text{m} = 0{,}0387\ \text{m}^2$.

The luminous intensity of the test matrix is

$5 \times 8 \times 12\ \text{cd} = 480\ \text{cd}$.

The luminance of the test matrix is

$$\frac{480\ \text{cd}}{0{,}038\ 7\ \text{m}^2} = 12\ 400\ \text{cd/m}^2\ q.e.d$$

A.3 Calculation of non-matrix equivalent areas

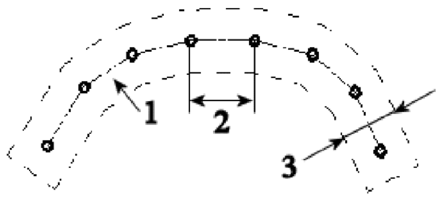
A.3.1 Equivalent area for a line of elements.

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

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

where

- n number of elements
- S_{av} average element spacing
- W_s stroke width ($W_s = S_{av}$)
- S_i element spacing of two elements i and $i+1$.



Key

1 A_e

2 s_i

3 w_s

Figure A.3 — Open line

where

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

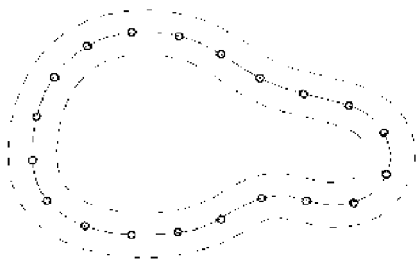


Figure A.4 — Closed line

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 may not only be designed in a matrix but also as an area fully populated with elements as shown in Figure A.5.

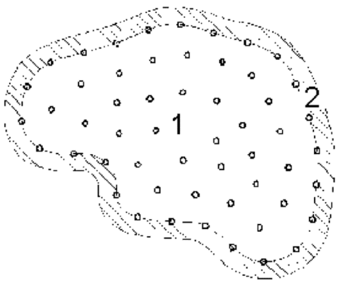
The equivalent area A_e will be calculated as following:

$A_e = S_1 + S_2$

where

S_1 inside area limited by the line of border elements;

S_2 half equivalent area of the border line elements.



Key

1 inside area fully populated with elements (S_1)

2 half equivalent area of the border line elements (S_2)

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 may not only be designed in a matrix but also as an area partially populated with elements as shown in Figure A.6.

The equivalent area A_e will be calculated as following:

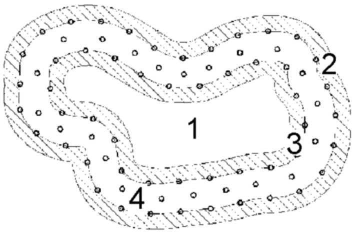
$A_e = S_1 + S_2 + S_3$

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 half equivalent area of outside border line elements *(S_2)*

3 half equivalent area of inside border line elements *(S_3)*

4 inside area fully populated with elements *(S_1)*

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

Annex B
(normative)

VMS performance declaration codes for marking

B.1 General

The following annex establishes a codified way of presenting the performance characteristics, where marking on the VMS or on a label attached to it is required.

B.2 Code for continuous retro-reflective VMS

The following code of performance classes shall be used for the marking of continuous retro-reflective VMS [A1) *deleted text* (A1]:

0	1	2	3	4	5	6	7	8	9	10	11

Key

0 release of dangerous substances
1 temporary deflections caused by wind loads
2 permanent deflections caused by dynamic snow loads
3 temporary bending deflection
4 impact resistance
5 daylight chromaticity & luminance factor
6 application classes / coefficient of retro-reflection
7 vibration resistance
8 corrosion resistance
9 resistance against extreme temperature
10 ingress protection against water and dust (IP) provided by enclosures
11 accelerated weathering cause (natural, 3 years)

NOTE Release of dangerous substances needs only to be declared if there is at least one required dangerous substance which obliges the manufacturer to declare, as relevant in accordance with 4.6.

Figure B.1 — Code of performance classes of continuous retro-reflective VMS

B.3 Code for externally illuminated continuous retro-reflective VMS

The following code of performance classes shall be used for the marking of continuous, externally illuminated retro-reflective VMS [A1) *deleted text* (A1]:

0	1	2	3	4	5	6	7	8	9	10	11	12	13

Key

0 release of dangerous substances
1 temporary deflections caused by wind loads
2 permanent deflections caused by dynamic snow loads
3 temporary bending deflection
4 impact resistance
5 daylight chromaticity & luminance factor
6 mean illuminance
7 uniformity illuminance
8 application classes / coefficient of retro-reflection
9 vibration resistance
10 corrosion resistance
11 resistance against extreme temperature
12 ingress protection against water and dust (IP) provided by enclosures
13 accelerated weathering cause (natural, 3 years)

NOTE Release of dangerous substances needs only to be declared if there is at least one required dangerous substance which obliges the manufacturer to declare, as relevant in accordance with 4.6.

Figure B.2 — Code of performance classes of externally illuminated continuous retro-reflective VMS

B.4 Code for discontinuous VMS

The following code of performance classes shall be used for the marking of discontinuous VMS [A1) *deleted text* (A1]:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Key

0 release of dangerous substances
1 temporary deflections caused by wind loads
2 permanent deflections caused by dynamic snow loads
3 temporary bending deflection
4 impact resistance
5 colour
6 luminance
7 luminance ratio
8 beam width
9 uniformity of luminous intensity
10 visible flicker
11 vibration resistance
12 corrosion resistance
13 resistance against extreme temperature
14 ingress protection against water and dust (IP) provided by enclosures
15 cause for degradation of colour, luminance and luminance ratio

NOTE Release of dangerous substances needs only to be declared if there is at least one required dangerous substance which obliges the manufacturer to declare, as relevant in accordance with 4.6.

Figure B.3 — Code of performance classes of discontinuous VMS

Annex L
(informative)

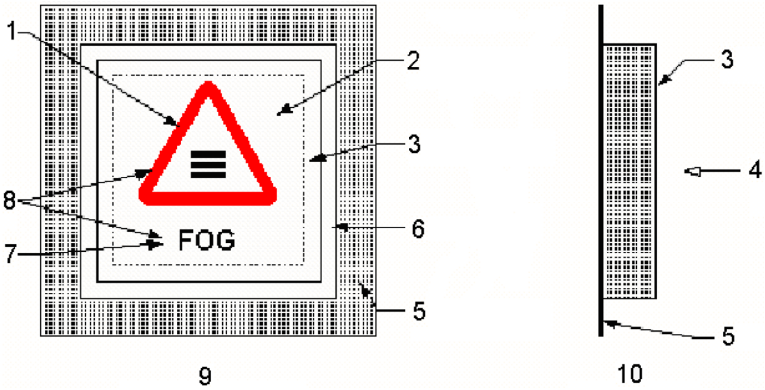
Terminology used in this European Standard

This annex is meant for readers new to the standard, who wish to get a quick introduction into the terminology used throughout this European Standard. Definitions of words inside [squared brackets] can be found in Clause 3.

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 European 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] (see Figure L.1).



Key

1	symbol	6	front panel
2	display surface	7	text
3	front screen	8	message
4	viewing direction	9	front view
5	backing board	10	side view

Figure L.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 VMS / 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 axis and the reference centre. Horizontal and vertical [test angles] describe the angle between the [test axis] and the vertical and horizontal reference planes respectively (see Figure L.2).