HOW TO CREATE BETTER TENDER DOCUMENTS BY THE USE OF EN 12966 EUROPEAN STANDARD FOR VARIABLE MESSAGE TRAFFIC SIGNS

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TOPICS

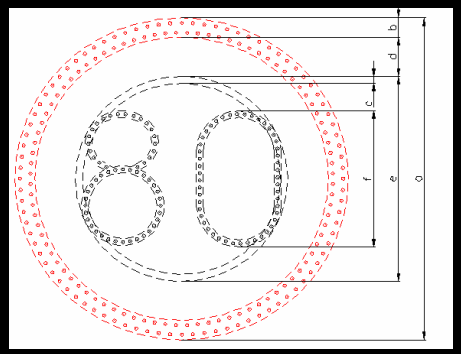
- Overview on informative annexes and guidelines of EN 12966, providing help for the design and purchasing phase to select the appropriate quality and performance of VMS;
- Standardization of test procedure for approvals of VMS
- Explanation on one example how requirements are described and how specific, clear and well defined test sequences have been developed to make sure that requirements are met
- Give guidelines how to evaluate offers for better selection of best offer in respect of efficiency, durability and performance

OVERVIEW ON INFORMATIVE ANNEXES AND GUIDELINES OF EN 12966

Annex C: Guidance on graphics for discontinuous 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 %



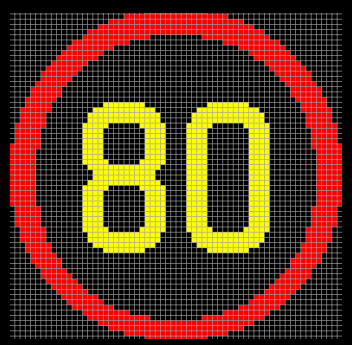
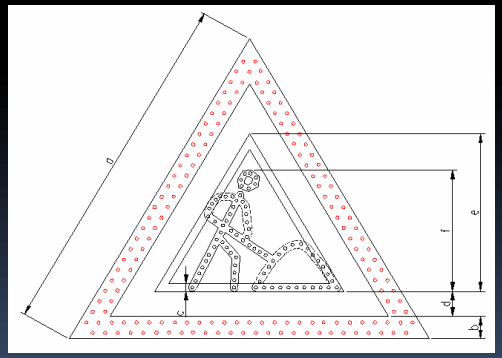


Table D.3 — Dimensions of triangles

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 %



Remark: Revision of EN 12966 (final version is planned to be published in 2014, draft is already available) will provide more detailed information

OVERVIEW ON INFORMATIVE ANNEXES AND GUIDELINES OF EN 12966

Annex D: Guidance on text dimensions for discontinuous light emitting signs

Table D.1 — Dimensions of texts

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

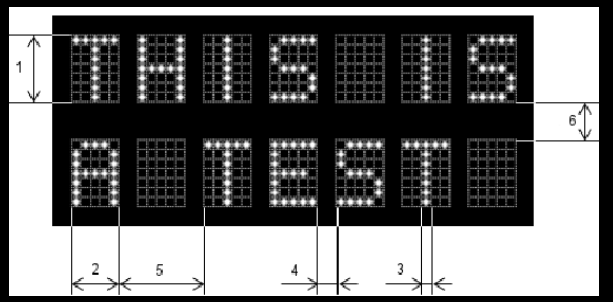
NOTE 1 The minimum character width is equal to 5/7 h.

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.



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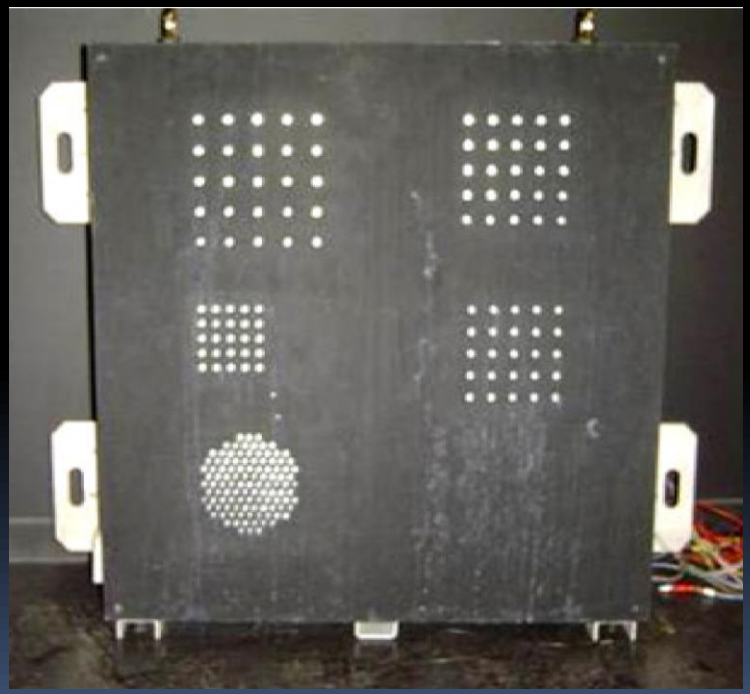
STANDARDIZATION OF TEST PROCEDURE FOR APPROVALS OF VMS

- Due to the complexity of VMS existing in the European market – thousands of VMS using different technologies, sizes, design of the aspects, control algorithms etc. –it is not possible to define a considerable number of standard-VMS's, to be used all over Europe.
- The only possibility for standardization has been to define a test-module, consisting of the same devices and properties as a real sign.
- The test-module is built of the same material, using the same coating and corrosion protection, the same climatic regulations (fans, heaters, drainage holes, air openings) and the same electrically and electronically devices as the real sign.
- The front-display does not show a traffic sign, but well defined areas equipped with light emitting elements (e.g. LEDs) of the colours, light sources, element spacing (i.e. pixel pitch) used in the real signs.

STANDARDIZATION OF TEST PROCEDURE FOR APPROVALS OF VMS

A typical test module may look light this:



STANDARDIZATION OF TEST PROCEDURE FOR APPROVALS OF VMS

During the Initial Type Testing of the test-module – i.e. Assessment and verification of constancy of performance, AVCP - performances of some main characteristics of VMS are justified as pass/fail, others are given by classes, which are designed to be selected by choosing a combination of classes dependent on the situation and purchaser requirements.

All tests-methods, test conditions, processes and test equipment is clearly defined and explained by the European Standard.

Performances, which are justified as pass / fail:

- electrical performance,
- resistance against impacts,
- resistance against vibration,
- resistances against corrosion,
- electromagnetic compatibility,
- uniformity of visual performance,
- visible flicker.

STANDARDIZATION OF TEST PROCEDURE FOR APPROVALS OF VMS

Performances, which are given by classes:

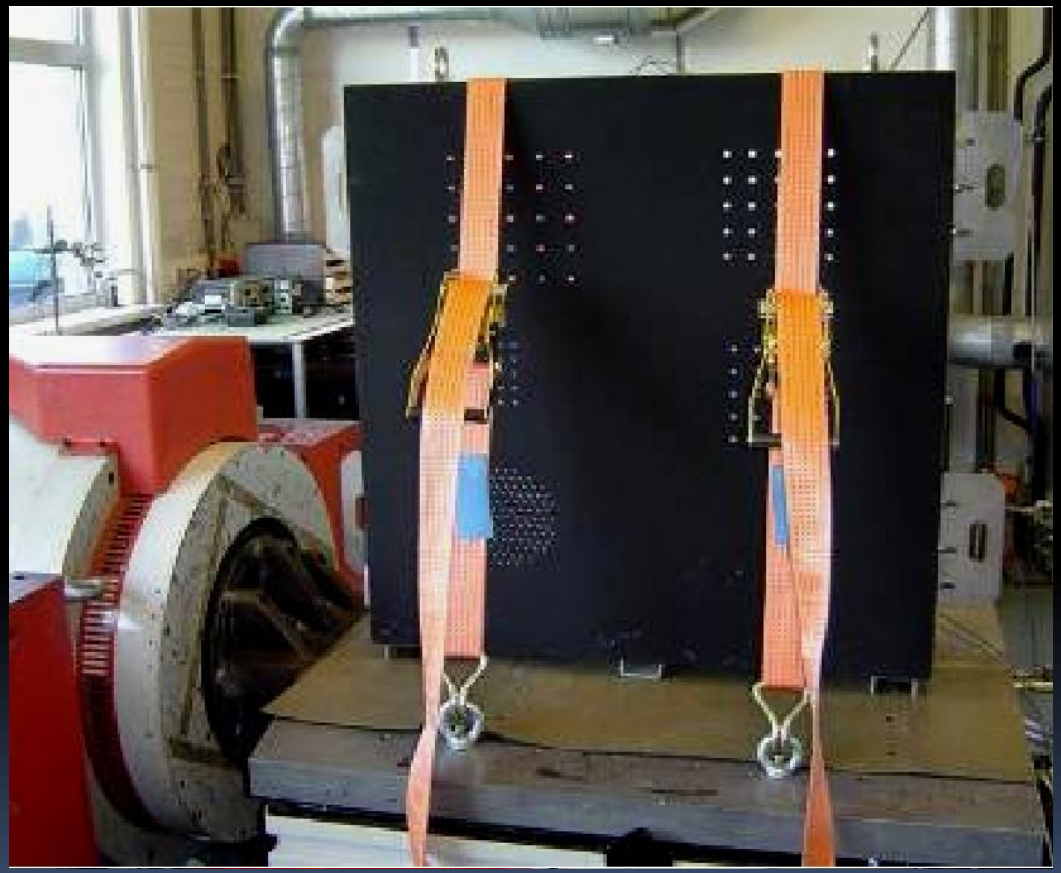
- Temperature: T1, T2, T3
- Protection: P1(IP44), P2(IP54), P3(IP56) [1]
- Wind-Loads: WL0 – WL9 [2]
- Dynamic snow loads: DSL0 – DSL4 (if applicable)
- Temporary deflection by bending: TDB0 – TDB6 (if applicable)
- Colour: C1, C2
- Luminance: L1, L2, L3, L3(*), L1(T), L2(T), L3(T)
- Luminance ratio: R1, R2, R3
- Beam width B1 – B7

[1] Highest class number is the most restrictive requirements and covers in general requirements of lower numbers ; exceptions are requirements for temperature, deflection and – partly - beam width

[2] performances of loads and deflections may be approved by providing static calculation

STANDARDIZATION OF TEST PROCEDURE FOR APPROVALS OF VMS

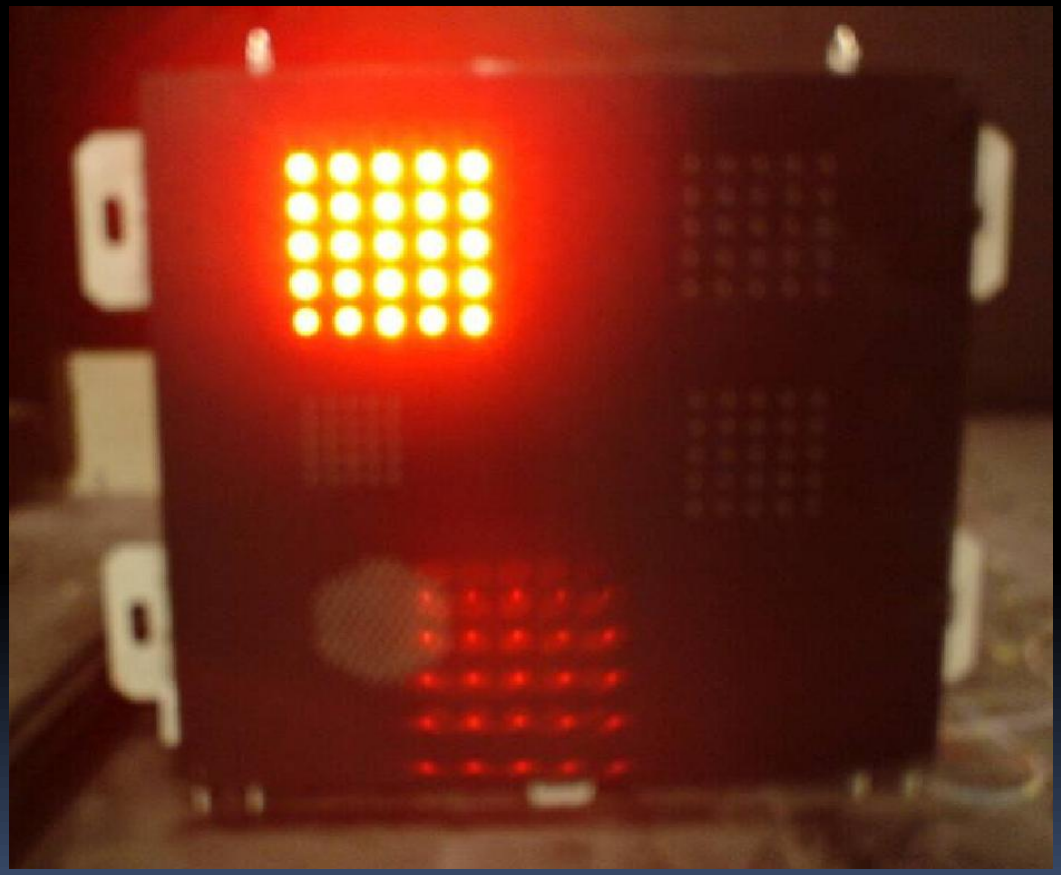
All kind of mechanical tests can be performed in a standardized way, like



- vibration test,
- temperature tests in climatic chamber,
- resistance to loads,
- impact test,
- protection provided by enclosures (IP-level),
- electrical safety test,
- resistance to corrosion and durability by accelerated aging,
- EMC-test

STANDARDIZATION OF TEST PROCEDURE FOR APPROVALS OF VMS

All kind of visual performance tests can be performed in a standardized way, like



- colour,
- luminance,
- luminance ratio, (contrast),
- beam width,
- uniformity,
- visible flicker,
- operating conditions of light source (voltage, current).

STANDARDIZATION OF TEST PROCEDURE FOR APPROVALS OF VMS

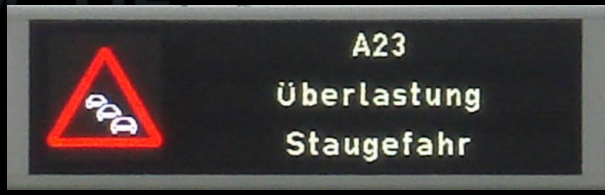
Advantages of using the EN 12966

- **All technical specifications are defined in the Standard document; the test method and approval is clearly described; there is no need for further explanations or definitions.**
- **All offers can be easily compared; test reports, following the same well defined standardized test procedures are available to proof the compliance with the required quality.**
- **Harmonized quality classes are valid for the European market; different environmental conditions and local needs or requirements are covered by various performance classes to be selected by the Traffic Engineer.**
- **The manufacturer exactly knows what he has to offer, there is no room for interpretations or misunderstandings. In case of achieving approvals for the required class combinations he may offer his product.**

EXAMPLE FOR SPECIFICATION OF LED-VMS USING EN 12966

Dynamic Traffic Information Sign

EXAMPLE FOR SPECIFICATION OF LED-VMS USING EN 12966



LED-VMS mounted on walk-on gantry of highway

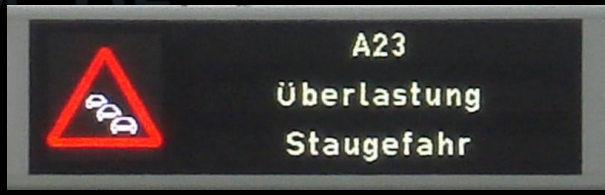
- Performance classes according to EN 12966:

  T2, P2, WL9, C2, L3(*), R3, B6

Requirements in addition to EN 12966:

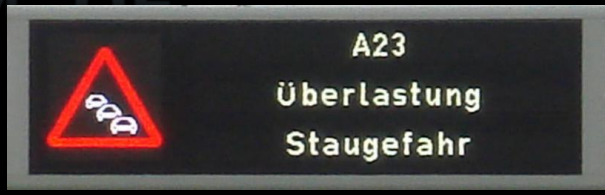
- Mechanical interface: Maximum size 7.000 x 1.900 x 300mm, service access from rear side
  Maximum weight: 700 kg
  Fixing points in combination with specification of the gantry
- Electric interface: Supply Voltage 230/ 50 Hz
  Diameters of supply wires to be used
  Maximum power consumption: 1.000W => max. power consumption is defined as: 50% of white light dots are ON with full intensity and including heater and ventilation (if needed)
- Electronic interface: Communication protocol, requirements for supervision, fault messages, history logging, automatic dimming, request for two light sensors, service interface, …
- Reliability and durability: LED's must never be stressed with more than 20% of the rated maximum current (or less). This has to be approved by test reports of Notified Bodies attached to the offer and by data sheets of the LED's used.

EXAMPLE FOR SPECIFICATION OF LED-VMS USING EN 12966



- Graphical requirements: Letter font as required or provided by purchaser has to be implemented, capacity of controller for storing, up- and downloading of graphical bitmaps, black/white inversion in relation to fixed traffic signs is required.
- Graphical part: Display area shall be at least 1.250 x 1.650 mm (w x h), full colour RGB using at least 80 x 104 pixel to display full colour traffic signs
- Text part: consisting of 3 graphical text lines, display area for each line shall be at least 4.800 x 480 mm formed of at least 240 x 24 pixel , to display white text using proportional letter spacing, text height 360mm for upper case letters; lower case letters and special characters according to local standard have to be provided, letter font xxx has to be used.
- Together with the offer, test reports have to be delivered to prove compliance with the required class combinations, showing element spacing, brand and type of the LEDs used, major operating conditions (e.g. operating LED current, data sheets of LEDs), FPC-report by Notified Body, confirming that series-products comply with the tested prototype, and the signed "Declaration of Performance". European Standard is demanding all accompanying documents which prove compliance with the requirements.

EXAMPLE FOR SPECIFICATION OF LED-VMS USING EN 12966



Reasons for selecting the class combination

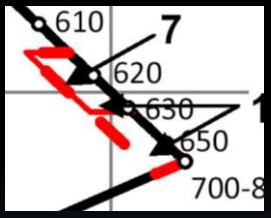
T2, P2, WL9, C2, L3*, R3, B6

T2: VMS has to be approved for environmental temperature of -25°C to +55°C
Remark: Depending on local conditions another class may be chosen

P2: Protection class IP54; it is necessary to provide at least natural air-flow (or enforced ventilation system) as well as drainage holes to avoid humidity inside the VMS

WL9: Wind load up to 1,6kN/m² for resistance against wind-speed up to 180km/h

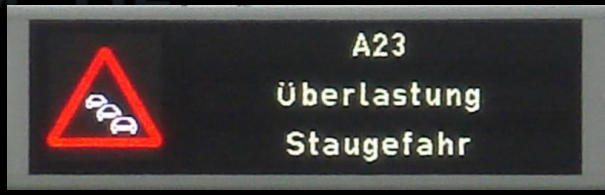
C2: Colour class C1 would allow "pure red" (beyond 630 nm), which is hardly visible for colour blind people



L3(*): For highway applications with speed limits of 100 km/h or more best performance on luminance is necessary to guarantee legibility of at least 200m, even during adverse ambient conditions (e.g. low sun)

R3: Luminance ratio is the most important parameter for good legibility, in combination with L3* reflections are avoided

EXAMPLE FOR SPECIFICATION OF LED-VMS USING EN 12966



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Remark: Depending on local conditions another class may be chosen

P2: Protection class IP54; it is necessary to provide at least natural air-flow (or enforced ventilation system) as well as drainage holes to avoid humidity inside the VMS

WL9: Wind load up to 1,6kN/m² for resistance against wind-speed up to 150km/h

C2: Colour class C1 would allow "pure red" (beyond 630 nm), which is hardly visible for colour blind people

L3(*): For highway applications with speed limits of 100 km/h or more best performance on Luminance is necessary to guarantee legibility of at least 200m.,even during adverse environmental conditions (e.g. low sun)

R3: Luminance ratio is the most important parameter for good legibility, in combination with L3* reflections are avoided

EVALUATION OF BEST OFFER

- **CE-marking is the basic and mandatory condition** to place VMS on the European market is; the manufacturer is only allowed to affix the CE-label on his product, if a CE-Certificate has been issued by a Notified Body;
- The CE-certificate is confirming that all mandatory tests have been passed, and that specific quality classes have been approved; the tested class combinations are acknowledged in the CE-certificate.
- The purchaser has to check carefully whether or not the required class combination has been approved by the Notified Body, confirmed by the CE-Certificate.
- Test reports, which are a part of mandatory accompanying documents to the CE-Certificate, help to verify the compliance with the specification.
- Since 1st of July 2013 a "Declaration of Performance" has to be submitted together with each product, signed by responsible manager of the supplier, confirming the performance and quality classes.

EVALUATION OF BEST OFFER

- If more than one manufacturer can prove to fulfil the required class combination, there may be still differences in the cost price. In most cases the cheapest offer is not the best offer; differences of quality resulting very often in significant differences in operating and maintenance costs during the technical life time.
- EN 12966 is demanding, that VMS have to be "fit for purpose" for at least 10 years; this means, that they have to fulfil all mandatory requirements at least until the end of that period!
- Many products achieving all quality classes initially (at the time the VMS are installed), but suffer very fast on degradation, clearly visible by decreasing light output.
- Based on the test results documented in the test reports by Notified Body it is easily possible, to evaluate the best product in terms of "total cost of ownership" for the intended working period.

EVALUATION OF BEST OFFER

- To compare the technical performance of different products, several properties have to be balanced. Important figures are power consumption, light output, light distribution, readability and legibility, reliability and durability. Key indicators of all of these properties are available in test-reports, issued by Notified Bodies during assessment and verification of constancy of performance (AVPC).
- The key indicator for the power consumption is the LED-current. Test reports, which approve the compliance with optical requirements, have to contain operating current of the LED; if not, the report cannot be used for approval, because any light intensity can be achieved by simply increasing the LED-current, which will reduce the life time of the LED and will increase the degradation of light output dramatically.
- Requirements always ask for minimum light intensity, according to the application. By comparing different products the light output (luminance) according to the data confirmed by the test report has to be used. Luminance is depending on the used pixel-pitch (resolution of light dots), why this has also to be considered, as well as the number of light sources of the same colour per element (light dot).

EVALUATION OF BEST OFFER

- The light distribution according to the required application is approved and confirmed by the test report by measurement of the beam width according to EN12966.
- The value of luminance ratio (contrast) determines readability and legibility. Test report of a representative test module has to approve the achieved luminance ratio value.
- Most important attributes for variable message traffic signs are reliability and durability. Lifetime and stability of the optical performance is mainly depending on the current load of the LED, the ratio of operating current and the maximum allowed current.
- Therefore the data sheet of the LEDs used in the VMS, confirming the maximum current allowed for driving the LED has to be provided to verify reliability and durability.

EVALUATION OF BEST OFFER

All above described attributes are integrated in and respected by a formula, verifying the Optical Performance Efficiency (OPE) as a measure of best and cheapest performance of a VMS during it's technical life time .

$$OPE = (L_R \times I_N \times F_{BW} \times pp^2 \times F_L) / (a \times I^2)$$

L_R: achieved luminance ratio (see test report by Notified Body)

I_N [mA]: maximum allowed forward current (see LED data sheet)

F_{BW}: beam width acc. EN 12966-1 (see test report and table 1)

pp [mm]: element spacing (pixel pitch) acc. to definition of EN 12966-1

F_L: factor depending on the achieved luminance class acc. to EN 12966-1 (see test report of CE-Certificate and table 2)

a: number of light sources per element, LEDs of the same colour per pixel

I [mA]: operating current to meet requirement on luminance and luminance ratio (see test report of CE-Certificate)

table 1 F_{BW}	
B1	0,005
B2	0,007
B3	0,010
B4	0,020
B5	0,015
B6	0,030
B7	0,120

table 2 F_L	
L1	0,25
L2	0,5
L3	1
L3(*)	2

EVALUATION OF BEST OFFER

Example (using dummy values):
Freely programmable VMS, full colour RGB, element spacing 20mm;
Optical performance as L3(*), R3, B3, C2

	white	source of data
L_R	18,2	see test report attached to CE-Certificate
I_N [mA]	110	maximum forward current, see data sheet(s) of LED(s)
F_{BW}	0,010	factor for B3 acc. to test report attached to CE-Certificate, value see table 1
pp [mm]	20	element spacing, see test report attached to CE-Certificate
F_L	2	factor for L3(*) acc. to test report attached to CE-Certificate, value see table 2
a	1	see test report attached to CE-Certificate
I [mA]	35,0	see test report attached to CE-Certificate
OPE	**13,1**	OPE= (18,2 × 110 × 0,010 × 20 ² × 2) / (1 × 35,0 ²)

table 1 F_{BW}	
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B7	0,120

table 2 F_L	
L1	0,25
L2	0,5
L3	1
L3(*)	2

EVALUATION OF BEST OFFER

Example (using dummy values):
Freely programmable VMS, full colour RGB, element spacing 20mm;
Optical performance as L3(*), R3, B3, C2

- When comparing different products, the one with the higher OPE value performs better.
- In case where L3(*) is required, two values of L_R are available; one for low sun illumination [5°], and one for normal illumination [10°]; the smaller of the two values has to be used for OPE-calculation.
- In case of full colour RGB signs, the colour white may be used to be representative for all other colours. The nominal current [I_N] used for calculation is the sum of the total currents of all LED's used to create the white light. Consequently, the sum of the operating currents [I] of all LED's to create the white light in full intensity is used for OPE calculation.

The ratio of the results provides indication of the performance range in terms of efficiency, power consumption, operating costs, fault rate, life time, legibility and durability.

RETROSPECTION TO THE PRESENTATION

- Overview on informative annexes and guidelines of EN 12966, providing help for the design and purchasing phase to select the appropriate quality and performance of VMS;
- Standardization of test procedure for approvals of VMS
- Explanation on one example how requirements are described and how specific, clear and well defined test sequences have been developed to make sure that requirements are met
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THANK YOU FOR YOUR ATTENTION

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