Example for LED-VMS

Dynamic Traffic Information Sign
TOPICS

- Target for Specification of VMS
- Typical Definitions from European Standard EN12966
- Description of Requirements
- OPE – the Model
- Decision making with OPE
- References
Sustainable VMS in respect of triple bottom line:

- Economic → low lifecycle costs
- Ecologic → low energy consumption, longevity
- Social → high user orientation
  Text/graphical content
  good optical performance
  good maintainability
Typical Specification of VMS

- Type of Sign
- Content to be shown
- Mechanical issues
- Electrical issues
- Communication interface to Central System
- Optical performance issues
- Reliability and durability
- Maintenance
How to Describe Requirements???

- Do not do re-use of specification
  - **Con:** Old stuff, miss state of the art development

- Do not use Spec provided by manufacturer
  - **Con:** Do not see other opportunities

- Describe expected properties and performance

- Use specification according to int’l standards
  - **Pro:** Clear performance description
  - **Open question:** which standard to choose...
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

- **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.
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

“Declaration of Performance”

European Standard is demanding all accompanying documents which prove compliance with the requirements.
Reasons for selecting 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 150km/h

C2: Colour class C1 allows “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
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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.

\[ \text{OPE} = \frac{(L_R \times I_N \times F_{BW} \times \text{pp}^2 \times F_L)}{(a \times I^2)} \]

- \( L_R \): 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. EN12966-1 (see test report and table 1)
- \( \text{pp} \) [mm]: element spacing (pixel pitch) acc. to definition of EN12966-1
- \( F_L \): factor depending on the achieved luminance class acc. to EN12966-1 (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)
Example for OPE calculation

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

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

**Table 1** \(F_{BW}\)
<table>
<thead>
<tr>
<th>(F_{BW})</th>
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</thead>
<tbody>
<tr>
<td>B1</td>
<td>0,005</td>
</tr>
<tr>
<td>B2</td>
<td>0,007</td>
</tr>
<tr>
<td>B3</td>
<td>0,010</td>
</tr>
<tr>
<td>B4</td>
<td>0,020</td>
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<td>B5</td>
<td>0,015</td>
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<tr>
<td>B6</td>
<td>0,030</td>
</tr>
<tr>
<td>B7</td>
<td>0,120</td>
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**Table 2** \(F_L\)
<table>
<thead>
<tr>
<th>(F_L)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>0,25</td>
</tr>
<tr>
<td>L2</td>
<td>0,5</td>
</tr>
<tr>
<td>L3</td>
<td>1</td>
</tr>
<tr>
<td>L3(*)</td>
<td>2</td>
</tr>
</tbody>
</table>
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.
Basic condition for being prequalified to place VMS on the European market is CE-marking; the manufacturer is allowed to place a CE-mark on his product, if a CE-Certificate has been issued by Notified Body;

This 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 and is 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 1\textsuperscript{st} 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.
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 for 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.
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).
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.
SWARCO Futurit VMS

All over the world

Different types and application

Proven technology

Made to order
A27 tot Everdingen filevrij
A15 tot Ring Rotterdam filevrij
A27 tot Hooipolder filevrij
Vlaamse overheid
ZWOLNĲ
ВОДИТЕЛИ,
СОБЛЮДАЙТЕ СКОРОСТНОЙ РЕЖИМ!
TEST
Pannenfahrzeug
SIMPLON
23 km
Welcome
Välkommen

SWARCO FUTURIT
WORLD LEADER IN
VMS-SIGNS

Stockholm
The Capital of Scandinavia
226 HUDDINGE
ÄLVSJÖ Mässan