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Uporaba razsvetljave - Razsvetljava v predorih

Lighting applications - Tunnel lighting

Angewandte Lichttechnik - Tunnelbeleuchtung

Eclairagisme - Eclairage des tunnels

Ta slovenski standard je istoveten z: **CEN/TR 14380:2024**

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Angewandte Lichttechnik - Tunnelbeleuchtung

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (CEN/TR 14380:2024) has been prepared by Technical Committee CEN/TC 169 “Light and Lighting”, the secretariat of which is held by DIN.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes CEN CR 14380:2003.

In comparison with the previous edition, the following modifications have been made:

- The whole content has been rewritten to comply with the CEN/CENELEC Internal Regulations part 3 rules applying to Technical Reports (informative document);
- The definitions have been updated following EN 12665:2024, as closely as possible;
- A new Clause 5 (“Dimensioning rules for the lighting of road tunnels”) replaces the previous subclause 4.2 (“Distinction between long and short tunnels”), Clause 5 (“Lighting of long tunnels”) and Clause 6 (“Artificial lighting of short tunnels and underpasses”);
- The clause “Emergency lighting” has been renamed “Lighting in emergency conditions”;
- The term “Standby lighting” has been replaced by “Safety lighting”;
- In Clause 6 “Lighting in emergency conditions”, a Note has been added on the requirement of safety lighting in tunnels concerned by the European Directive 2004/54/EC 12/2022;
- The previous Clause “Traffic signals” has been removed;
- In Annex A and Annex B, the levels of daytime luminance in the interior zone have been adapted in accordance with the latest developments at CIE;
- A new Annex C has been added: “The CIE perceived contrast methodology”;
- Limited adaptations in Annex D “The space and time adaptation method as used in France”;
- A new Annex E has been added: “An energy saving approach: practice from Italy”;
- The previous Annex “Veiling Luminance Method As Used In The Netherlands” has been removed;
- The term “electric lighting” replaces “artificial lighting”;
- The following figures have been updated: Figures 3, Figures A.1, A.2, A.3, Figures C.1, C.2, Figures D.1, D.2, D.3 to D.8, Figures F.1, F.4, F.5, Figures G.1 and G.2.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

CEN/TR 14380:2024 (E)

Introduction

The aim of tunnel lighting is to ensure that users, both during the day and by night, can approach, pass through, and exit the tunnel without changing direction or speed with the degree of safety commensurate to that on the approach road.

To achieve safe passage through a road tunnel, it is necessary that all users have sufficient information regarding the course of the road ahead, possible obstacles and the presence and actions of other users. Furthermore, it is necessary that users, particularly drivers of motor vehicles, have at least an equal sense of security to that experienced on the approach roads.

Principal characteristics that describe the quality of tunnel lighting are:

- the luminance of the road surface,
- the luminance of the walls up to 2 m in height above the road surface,
- the uniformity of the luminance distribution on the road and walls,
- the control of induced glare,
- the avoidance of critical flicker frequencies.

In some cases, the illuminance of the road surface is used.

All photometric quantities are based on photopic photometry.

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1 Scope

This document describes the current practice in the design of the lighting of road tunnels and underpasses for motorized and mixed traffic. This concerns arrangements, levels and other parameters including daylight, which are related only to traffic safety. Aspects concerning visual comfort are generally chosen in agreement with national rules. The information in this report concerns any tunnel or underpass where the decision to provide lighting has been taken by any authority working within national legislation or other constraints. The design is based on photometric considerations, and all values of luminance or illuminance are maintained values.

The main body of the report covers the common aspects of Tunnel Lighting, and the various methods currently used in Europe are detailed in the annexes. No single method is recommended.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12665, *Light and lighting — Basic terms and criteria for specifying lighting requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12665 and the following apply. ISO, IEC and CIE maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp/>
- IEC Electropedia: available at <https://www.electropedia.org/>
- e-ILV International Lighting Vocabulary: available at <https://cie.co.at/e-ilv>

3.1 Tunnel related zones

3.1.1

entrance portal

<of a road tunnel> part of a road tunnel construction that corresponds to the beginning of the covered part of the road tunnel or, when open sun screens are used, to the beginning of the sun screens

[SOURCE: EN 12665:2024, 3.5.41]

3.1.2

exit portal

<of a road tunnel> part of a road tunnel construction that corresponds to the end of the covered part of the road tunnel or, when open sun screens are used, to the end of the sun screens

[SOURCE: EN 12665:2024, 3.5.45]

CEN/TR 14380:2024 (E)**3.1.3****access zone**

<of a road tunnel> part of the open road immediately outside (in front of) the entrance portal, covering the distance over which an approaching driver must be able to see into a road tunnel

Note 1 to entry: The access zone begins at the stopping distance point ahead of the entrance portal and it ends at the entrance portal.

[SOURCE: EN 12665:2024, 3.5.24]

3.1.4**access zone length**

<tunnel lighting> length of the access zone that begins at the stopping distance point ahead of the portal and ends at the portal

Note 1 to entry: Access zone length is expressed in metres (m).

Note 2 to entry: Generally, for curved roads, the access zone is considered to begin from where the driver can see the whole tunnel entrance portal, at least on his/her driving lane.

[SOURCE: EN 12665:2024, 3.5.25, modified – Note 2 to entry added]

3.1.5**threshold zone**

<of a road tunnel> first part of a road tunnel, directly after the entrance portal

Note 1 to entry: The threshold zone starts either at the beginning of the road tunnel or at the beginning of the sun screen when a sun screen is installed. The length of the threshold zone is at least equal to the stopping distance.

[SOURCE: EN 12665:2024, 3.5.78]

3.1.6**transition zone**

<of a road tunnel> part of a road tunnel that follows directly after the threshold zone and ends at the beginning of the interior zone

Note 1 to entry: In the transition zone, the lighting level is decreasing from the level at the end of the threshold zone to the level of the interior zone.

[SOURCE: EN 12665:2024, 3.5.86]

3.1.7**entrance zone**

<of a road tunnel> combination of the threshold zone and the transition zone

Note 1 to entry: Entrance zone refers to the tunnel section where the eye's adaptation passes from the external light level to the interior zone lighting.

Note 2 to entry: In some countries the term entrance zone is also known as reinforcement zone.

[SOURCE: EN 12665:2024, 3.5.42, modified – Notes 1 and 2 to entry added]

3.1.8**interior zone**

<of a road tunnel> part of a road tunnel directly following the transition zone that stretches from the end of the transition zone to the beginning of the exit zone

[SOURCE: EN 12665:2024, 3.5.52]

3.1.9**exit zone**

<of a road tunnel> part of a road tunnel where, during daytime, the vision of a driver approaching the exit is predominantly influenced by the brightness outside the road tunnel

Note 1 to entry: The exit zone begins at the end of the interior zone. It ends at the exit portal of the road tunnel.

[SOURCE: EN 12665:2024, 3.5.46]

3.1.10**parting zone**

<of a road tunnel> first part of the open road directly after the exit portal of a road tunnel

Note 1 to entry: The parting zone is not a part of the road tunnel, but it is closely related to the road tunnel lighting. The parting zone begins at the exit portal. It is advised that the length of the parting zone is equal to 2 times the stopping distance. A length of more than 200 m is not necessary.

[SOURCE: EN 12665:2024, 3.5.66]

3.2 Lighting**3.2.1****visual guidance**

optical and geometrical means that ensure that motorists are given adequate information on the course of the road in the tunnel

3.2.2**threshold zone lighting**

lighting of the threshold zone of the tunnel which allows drivers to see into the tunnel whilst in the access zone

[SOURCE: EN 12665:2024, 3.5.79]

3.2.3**transition zone lighting**

lighting of the transition zone which helps drivers to adapt to the lighting level in the zones ahead

[SOURCE: EN 12665:2024, 3.5.87]

3.2.4**interior zone lighting**

lighting of the interior zone of the tunnel which provides adequate visibility in the interior of the tunnel

Note 1 to entry: At certain moments of the day, the interior zone lighting extends from the entrance portal to the exit portal.

[SOURCE: EN 12665:2024, 3.5.53, modified – removed “irrespective of the use of vehicle headlights”, Note 1 to entry added]

CEN/TR 14380:2024 (E)**3.2.5****exit zone lighting**

<of a road tunnel> lighting that provides the visual contact for the driver still in a road tunnel with the open road beyond the road tunnel

Note 1 to entry: It is assumed that visual contact will provide adaptation to the external condition.

[SOURCE: EN 12665:2024, 3.5.47]

3.2.6**safety lighting**

<of a road tunnel> lighting provided to ensure a minimum visibility for tunnel users to evacuate the tunnel in the event of a breakdown of the main power supply

Note 1 to entry: Safety lighting is usually a part of the normal lighting installation.

3.2.7**daylight screen****daylight louvre**

<tunnel lighting> device that transmits part of the ambient daylight

Note 1 to entry: Screens or louvres may be applied for the lighting of the threshold zone and/or the entrance zone of a tunnel

[SOURCE: EN 12665:2024, 3.4.10, modified – “part of” without brackets, Note to entry reworded]

3.2.8**sun-tight screen**

<tunnel lighting> screen that is constructed in such a fashion that direct sunlight can never reach the road or wall surface under the screen

[SOURCE: EN 12665:2024, 3.4.11]

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3.3 Luminance, illuminance**3.3.1****access zone luminance**

eye adaptation luminance in the access zone

Note 1 to entry: Access zone luminance is expressed in candelas per square metre ($\text{cd} \cdot \text{m}^{-2}$)

[SOURCE: EN 12665:2024, 3.2.38]

3.3.2 **L_{20} access luminance**

L_{20}

<of a road tunnel> average luminance contained in a conical field of view, subtending an angle of 20° with the apex at the position of the eye of an approaching driver and aimed at the tunnel mouth

Note 1 to entry: L_{20} access luminance is assessed from a point at a distance equal to the stopping distance from the tunnel portal at the middle of the relevant carriageway or traffic lane.

Note 2 to entry: L_{20} access luminance is expressed in candelas per square metre ($\text{cd} \cdot \text{m}^{-2}$).

Note 3 to entry: If there is no national definition of the aiming, the definition of CIE 88:2004 can be used (i.e. aimed towards a centred point at a height equal to one quarter of the height of the tunnel entrance portal).

[SOURCE: EN 12665:2024, 3.2.44, modified – “the centre of” removed, Symbol added, Note 3 to entry added]

3.3.3 equivalent veiling luminance

L_{seq}

luminance that, when added by superposition to the luminance of both the adapting background and the object, makes the luminance threshold or the luminance difference threshold the same under the two following conditions: (1) glare present, but no additional luminance; (2) additional luminance present, but no glare

Note 1 to entry: Equivalent veiling luminance is expressed in candela per square metre ($\text{cd}\cdot\text{m}^{-2}$).

[SOURCE: EN 12665:2024, 3.2.41, modified – different Symbol used]

3.3.4 atmospheric luminance

L_{atm}

light veil as a result of the scatter in the atmosphere expressed as a luminance

Note 1 to entry: Atmospheric luminance is expressed in candela per square metre ($\text{cd}\cdot\text{m}^{-2}$).

[SOURCE: EN 12665:2024, 3.4.9]

3.3.5 windscreen luminance

L_{ws}

light veil as a result of the scatter in the vehicle windscreen expressed as a luminance

Note 1 to entry: Windscreen luminance is expressed in candela per square metre ($\text{cd}\cdot\text{m}^{-2}$).

[SOURCE: EN 12665:2024, 3.2.52, modified – Symbol changed]

3.3.6 threshold zone luminance

\bar{L}_{th}

average road surface luminance of a transverse strip at a given location in the threshold zone of the tunnel (as a function of the measurements grid)

Note 1 to entry: Threshold luminance is expressed in candela per square metre ($\text{cd}\cdot\text{m}^{-2}$).

[SOURCE: EN 12665:2024, 3.2.48]

3.3.7 transition zone luminance

\bar{L}_{tr}

average road surface luminance of a transverse strip at a given location in the transition zone of the tunnel (as a function of the measurement grid)

Note 1 to entry: Transition zone luminance is expressed in candela per square metre ($\text{cd}\cdot\text{m}^{-2}$).

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[SOURCE: EN 12665:2024, 3.2.50]

3.3.8**interior zone luminance**
 \bar{L}_{in}

<of a road tunnel> average road surface luminance of a transverse strip at a given location in the interior zone of the tunnel (as a function of the measurement grid)

Note 1 to entry: Interior zone luminance is expressed in candela per square metre ($\text{cd}\cdot\text{m}^{-2}$).

[SOURCE: EN 12665:2024, 3.2.43]

3.3.9**vertical illuminance**
 E_v

illuminance on a vertical plane

Note 1 to entry: Vertical illuminance is expressed in lux (lx).

[SOURCE: EN 12665:2024, 3.2.59, modified – symbol E_v selected]

3.3.10**contrast revealing coefficient**
 q_c

<of a tunnel lighting installation> quotient of the luminance, L , of a road surface and the vertical illuminance, E_v , at a specific location in a tunnel

$$q_c = \frac{L}{E_v}$$

Note 1 to entry: Contrast revealing coefficient is expressed in candelas per square metre per lux ($\text{cd}\cdot\text{m}^{-2}\cdot\text{lx}^{-1}$) which may be simplified to steradian to the power minus one (sr^{-1}).

Note 2 to entry: E_v is the illuminance at a particular location at a height of normally 0,1 m above the road surface, in a plane facing the direction of oncoming traffic. The height of 0,1 m above the road surface is meant to represent the centre of an object of 0,2 m \times 0,2 m. This orientation is an acceptable approximation of the real situation.

[SOURCE: EN 12665:2024, 3.2.39, modified – index of L and E_v adapted, Note 2 to entry added]

3.3.11**threshold luminance ratio**
 k

ratio between the threshold zone luminance \bar{L}_{th} and the access luminance L

$$k = \frac{\bar{L}_{th}}{L}$$

where

\bar{L}_{th} is the threshold zone luminance