BS EN 12665:2011

BSI Standards Publication

Light and lighting — Basic terms and criteria for specifying lighting requirements

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National foreword

This British Standard is the UK implementation of EN 12665:2011. It supersedes BS EN 12665:2002 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee CPL/34/10, Lamps and Related Equipment - Light and Lighting.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Light and lighting - Basic terms and criteria for specifying lighting requirements

Lumière et éclairage - Termes de base et critères pour la spécification des exigences en éclairage

Licht und Beleuchtung - Grundlegende Begriffe und Kriterien für die Festlegung von Anforderungen an die Beleuchtung

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 12665:2011) has been prepared by Technical Committee CEN/TC 169 “Light and lighting”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2011, and conflicting national standards shall be withdrawn at the latest by December 2011.

This document has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2008/57/EC.

For relationship with EU Directive 2008/57/EC, see informative Annex ZA, which is an integral part of this document.

This document supersedes EN 12665:2002.

The main technical changes in this revision are:

— inclusion of terms previously absent collated from EN 1837, EN 1838, EN 12193, EN 12464-1, EN 12464-2, EN 13032-1, EN 13032-2 and EN 15193.

The significant change between EN 12665:2002 and EN 12665:2011 is within the scope of the document. EN 12665:2002 defined basic terms for use in lighting applications, and specialist terms with limited applications were defined in individual standards. In practice this resulted in cases of similar terminology being used to define different concepts, and conversely different terms being used to describe similar concepts. Therefore EN 12665:2011 defines basic terms and definitions for use in all lighting applications. Furthermore some references have been updated.

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Introduction

This European Standard specifies a basic framework to be used for the specification of lighting requirements.

Where a term is contained in CIE Publication 17.4:1987 International Lighting Vocabulary (IEC 60050, International Electrotechnical Vocabulary, Chapter 845 Lighting), the term given in this standard is identical. For some terms additional explanation is given in informative Annex A. An index of terms is given in informative Annex B.

The lighting requirements for a space are determined by the need to provide:

— adequate illumination for safety and movement;

— conditions which will facilitate visual performance and colour perception;

— acceptable visual comfort for the occupants in the space.

The relative importance of these factors will vary for different applications. The lighting requirements for visual comfort and satisfaction of the occupants, will often exceed the requirements for visual performance alone. For example, the visual task may simply require the discrimination of black symbols on a white background; the colour rendering of the lighting is irrelevant to this task but it is important in making the appearance of the room and occupants acceptable. Variations of the lighting in space and time may also be important for visual satisfaction and can help to meet the interpersonal differences found within groups of people.

Considerations should also be given to the energy used by lighting and to maintenance.

The parameters which need to be specified to ensure good visual conditions and an efficient lighting installation are common to many applications. These are dealt with in Clause 4.

1 Scope

This European Standard defines basic terms and definitions for use in all lighting applications. This European Standard also sets out a framework for the specification of lighting requirements, giving details of aspects which have to be considered when setting those requirements.

2 Normative references

The following referenced documents are indispensable for the application 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.

CIE 17.4:1987, *International lighting vocabulary — Chapter 845: Lighting*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Eye and vision

3.1.1
adaptation
process by which the state of the visual system is modified by previous and present exposure to stimuli that can have various luminances, spectral distributions and angular subtenses

NOTE 1 The terms light adaptation and dark adaptation are also used, the former when the luminances of the stimuli are of at least several candelas per square metre, and the latter when the luminances are of less than some hundredths of a candela per square metre.

NOTE 2 Adaptation to specific spatial frequencies, orientations, sizes, etc. are recognized as being included in this definition.

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-07]

3.1.2
accommodation
adjustment of the dioptric power of the crystalline lens by which the image of an object, at a given distance, is focused on the retina

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-44]

3.1.3
visual acuity
1. qualitatively: capacity for seeing distinctly fine details that have very small angular separation

2. quantitatively: any of a number of measures of spatial discrimination such as the reciprocal of the value of the angular separation in minutes of arc of two neighbouring objects (points or lines or other specified stimuli) which the observer can just perceive to be separate

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-43]

3.1.4
brightness
luminosity (obsolete)
attribute of a visual sensation according to which an area appears to emit more or less light

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-28]

3.1.5
contrast
1. in the perceptual sense: assessment of the difference in appearance of two or more parts of a field seen simultaneously or successively (hence: brightness contrast, lightness contrast, colour contrast, simultaneous contrast, successive contrast, etc.)

2. in the physical sense: quantity intended to correlate with the perceived brightness contrast, usually defined by one of a number of formulae which involve the luminances of the stimuli considered, for example: $\Delta L/L$ near the luminance threshold, or $L1/L2$ for much higher luminances

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-47]

3.1.6
brightness contrast
subjective assessment of the difference in brightness between two or more surfaces seen simultaneously or successively

3.1.7
colour contrast
subjective assessment of the difference in colour between two or more surfaces seen simultaneously or successively

3.1.8
glare
condition of vision in which there is discomfort or a reduction in the ability to see details or objects, caused by an unsuitable distribution or range of luminance, or to extreme contrasts

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-52]

3.1.9
flicker
impression of unsteadiness of visual sensation induced by a light stimulus whose luminance or spectral distribution fluctuates with time

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-49]

3.1.10
visual field
area or extent of physical space visible to an eye at a given position and direction of view

NOTE It should be stated whether the visual field is monocular or binocular.

3.1.11
visual performance
performance of the visual system as measured for instance by the speed and accuracy with which a visual task is performed

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-04]

3.1.12
visual comfort
subjective condition of visual well-being induced by the visual environment

3.1.13
reaction time
minimum time interval between the occurrence of an event demanding immediate action and the response to the event (unit: s)

NOTE The reaction time includes the time needed for perception, taking a decision and acting.

3.1.14
visual task
visual elements of the activity being undertaken

NOTE The main visual elements are the size of the structure, its luminance, its contrast against the background and its duration.

3.2 Light and colour

3.2.1
luminous flux
Φ
quantity derived from radiant flux Φ_e by evaluting the radiation according to its action upon the CIE standard photometric observer (unit: lm)

NOTE 1 For photopic vision

$$\phi = \mathrm{K_m} \int_0^\infty \left(\frac{\mathrm{d}\phi_e(\lambda)}{\mathrm{d}\lambda} \right) \times V(\lambda) \mathrm{d}\lambda$$

where

Φ is the luminous flux;

$\frac{\mathrm{d}\phi_e(\lambda)}{\mathrm{d}\lambda}$ is the spectral distribution of the radiant flux;

$V(\lambda)$ is the spectral luminous efficiency function.

NOTE 2 For the values of K_m (photopic vision) and K'_m (scotopic vision), see IEC 60050-845:1987/CIE 17.4:1987; 845-01-56.

[IEC 60050-845:1987/CIE 17.4:1987; 845-01-25]

3.2.2
luminous intensity (of a source, in a given direction)
I
quotient of the luminous flux $\mathrm{d}\Phi$ leaving the source and propagated in the element of solid angle $\mathrm{d}\Omega$ containing the given direction, by the element of solid angle (unit: cd = lm · sr $^{-1}$)

$$I = \frac{\mathrm{d}\phi}{\mathrm{d}\Omega}$$

where

I is the luminous intensity of a source in a given direction;

$\mathrm{d}\Phi$ is the luminous flux leaving the source;

$\mathrm{d}\Omega$ is the solid angle.

[IEC 60050-845:1987/CIE 17.4:1987; 845-01-31]

3.2.3
luminance (in a given direction, at a given point of a real or imaginary surface)
L
quantity defined by the equation (unit: cd · m^{-2} = lm · m^{-2} · sr^{-1})

$$L = \frac{\mathrm{d}\Phi}{\mathrm{d}A\cos\vartheta\mathrm{d}\Omega}$$

where

L is the luminance in a given direction or at a given point of a surface;

$\mathrm{d}\phi$ is the luminous flux transmitted by an elementary beam passing through the given point and propagating in the solid angle $\mathrm{d}\Omega$ containing the given direction;

$\mathrm{d}A$ is the area of a section of that beam containing the given point;

$\mathrm{d}\Omega$ is the solid angle;

ϑ is the angle between the normal to that section and the direction of the beam.

NOTE See notes 1 to 5 to IEC 60050-845:1987/CIE 17.4:1987; 845-01-34.

[IEC 60050-845:1987/CIE 17.4:1987; 845-01-35]

3.2.4
average luminance
$\overline{L}$
luminance averaged over the specified surface or solid angle (unit: cd · m^{-2})

3.2.5
minimum luminance
$L_{\min}$
lowest luminance of any relevant point on the specified surface (unit: cd · m^{-2})

NOTE The relevant points at which the luminances are determined should be specified in the appropriate application standard.

3.2.6
maximum luminance
$L_{\max}$
highest luminance of any relevant point on the specified surface (unit: cd · m^{-2})

NOTE The relevant points at which the luminances are determined should be specified in the appropriate application standard.

3.2.7
maintained luminance
$\overline{L}_{\mathrm{m}}$
minimum average luminance (unit: cd · m^{-2})

NOTE 1 Value below which average luminance should not fall.

NOTE 2 It is the average luminance at the time maintenance should be carried out.

3.2.8
initial average luminance
$\overline{L}_i$
average luminance when the installation is new (unit: cd · m^{-2})

3.2.9
luminance contrast
photometric quantity intended to correlate with brightness contrast, usually defined by one of a number of equations which involve the luminances of the stimuli considered

(see also 3.1.5 [IEC 60050-845:1987/CIE 17.4:1987; 845-02-47])

NOTE Luminance contrast can be defined as luminance ratio

$C_1 = L_2/L_1$ (usually for successive stimuli),

or by the following equation

$C_2 = (L_2 - L_1) / L_1$ (usually for surfaces viewed simultaneously),

when the areas of different luminance are comparable in size and it is desired to take an average, the following equation can be used instead

$C_3 = (L_2 - L_1) / 0{,}5(L_2 + L_1)$

where

L_1 is the luminance of the background, or largest part of the visual field; and L_2 is the luminance of the object;

L_2 is the luminance of the object.

3.2.10
illuminance (at a point of a surface)
E
quotient of the luminous flux $\mathrm{d}\Phi$ incident on an element of the surface containing the point, by the area $\mathrm{d}A$ of that element (unit: lx = lm · m^{-2})

NOTE Equivalent definition: Integral, taken over the hemisphere visible from the given point, of the expression $L \cdot \cos\ \theta \cdot \mathrm{d}\Omega$, where L is the luminance at the given point in the various directions of the incident elementary beams of solid angle $\mathrm{d}\Omega$, and θ is the angle between any of these beams and the normal to the surface at the given point.

$$E = \frac{\mathrm{d}\Phi}{\mathrm{d}A} = \int_{2\pi sr} L \cos\theta \mathrm{d}\Omega$$

where

E is the illuminance at a point of a surface;

L is the luminance at the given point in the various directions of the incident elementary beams of solid angle $\mathrm{d}\Omega$;

Θ is the angle between an incident beam and the normal to the surface at the given point;

$\mathrm{d}\Omega$ is the solid angle.

[IEC 60050-845:1987/CIE 17.4:1987; 845-01-38]

3.2.11
average illuminance
$\overline{E}$
illuminance averaged over the specified surface (unit: lx)

NOTE In practice this can be derived either from the total luminous flux falling on the surface divided by the total area of the surface, or alternatively from an average of the illuminances at a representative number of points on the surface.

3.2.12
minimum illuminance
E_{min}
lowest illuminance at any relevant point on the specified surface (unit: lx)

3.2.13
maximum illuminance
E_{max}
highest illuminance at any relevant point on the specified surface (unit: lx)

3.2.14
maintained illuminance
$\overline{E}_m$
minimum average illuminance (unit: lx)

NOTE 1 Value below which the average illuminance on the specified area should not fall.

NOTE 2 It is the average illuminance at the time maintenance should be carried out.

3.2.15
initial illuminance
$\overline{E_i}$
average illuminance on the specified surface when the installation is new (unit: lx)

3.2.16
spherical illuminance (at a point)
E_o
total luminous flux falling on the whole surface of a very small sphere located at the specified point divided by the surface area of the sphere (unit: lx)

(see also IEC 60050-845:1987/CIE 17.4:1987; 845-01-40 spherical irradiance)

3.2.17
hemispherical illuminance (at a point)
E_{hs}
total luminous flux falling on the curved surface of a very small hemisphere located at the specified point divided by the curved surface area of the hemisphere (unit: lx)

NOTE The base of the hemisphere is taken to be horizontal unless stated otherwise.

3.2.18
cylindrical illuminance (at a point, for a direction)
E_z
total luminous flux falling on the curved surface of a very small cylinder located at the specified point divided by the curved surface area of the cylinder (unit: lx)

NOTE The axis of the cylinder is taken to be vertical unless stated otherwise.

(see also IEC 60050-845:1987/CIE 17.4:1987; 845-01-41 cylindrical irradiance)

3.2.19
semi-cylindrical illuminance (at a point)
E_{sz}
total luminous flux falling on the curved surface of a very small semi-cylinder located at the specified point, divided by the curved surface area of the semi-cylinder (unit: lx)

NOTE The axis of the semi-cylinder is taken to be vertical unless stated otherwise. The direction of the curved surface should be specified.

3.2.20
uniformity (luminance, illuminance)
U_o
ratio of minimum illuminance (luminance) to average illuminance (luminance) on (of) a surface

(see also IEC 60050-845:1987/CIE 17.4; 845-09-58 uniformity ratio of illuminance)

NOTE Use is also made of the ratio of minimum illuminance to maximum illuminance in which case this should be specified explicitly.

3.2.21
reference surface
surface on which illuminance is measured or specified

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-49]

3.2.22
disability glare
glare that impairs the vision of objects without necessarily causing discomfort

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-57]

3.2.23
discomfort glare
glare that causes discomfort without necessarily impairing the vision of objects

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-56]

3.2.24
veiling reflections
specular reflections that appear on the object viewed and that partially or wholly obscure the details by reducing contrast

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-55]

3.2.25
luminous environment
lighting considered in relation to its physiological and psychological effects

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-03]

3.2.26
colour rendering
effect of an illuminant on the colour appearance of objects by conscious or subconscious comparison with their colour appearance under a reference illuminant

NOTE In German, the term “Farbwiedergabe” is also applied to colour reproduction.

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-59]

3.2.27
CIE 1974 general colour rendering index
R_a
mean of the CIE 1974 special colour rendering indices for a specified set of eight test colour samples

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-63]

3.2.28
colour stimulus
visible radiation entering the eye and producing a sensation of colour, either chromatic or achromatic

[IEC 60050-845:1987/CIE 17.4:1987; 845-03-02]

3.2.29
tristimulus values (of a colour stimulus)
amounts of the three reference colour stimuli, in a given trichromatic system, required to match the colour of the stimulus considered

NOTE In the CIE standard colorimetric systems, the tristimulus values are represented by the symbols X, Y, Z and X_{10}, Y_{10}, Z_{10}.

[IEC 60050-845:1987/CIE 17.4:1987; 845-03-22]

3.2.30
chromaticity coordinates
ratio of each of a set of three tristimulus values to their sum

NOTE 1 As the sum of the three chromaticity coordinates equals 1, two of them are sufficient to define a chromaticity.

NOTE 2 In the CIE standard colorimetric systems, the chromaticity coordinates are presented by the symbols x, y, z and x_{10}, y_{10}, z_{10}.

[IEC 60050-845:1987/CIE 17.4:1987; 845-03-33]

3.2.31
chromaticity
property of a colour stimulus defined by its chromaticity coordinates, or by its dominant or complementary wavelength and purity taken together

[IEC 60050-845:1987/CIE 17.4:1987; 845-03-34]

3.2.32
colour temperature
T_c
temperature of a Planckian radiator whose radiation has the same chromaticity as that of a given stimulus (unit: K)

NOTE The reciprocal colour temperature is also used, unit: K^{-1}.

[IEC 60050-845:1987/CIE 17.4:1987; 845-03-49]

3.2.33
correlated colour temperature
T_{cp}
temperature of the Planckian radiator whose perceived colour most closely resembles that of a given stimulus at the same brightness and under specified viewing conditions (unit: K)

NOTE 1 The recommended method of calculating the correlated colour temperature of a stimulus is to determine on a chromaticity diagram the temperature corresponding to the point on the Planckian locus that is intersected by the agreed isotemperature line containing the point representing the stimulus (see CIE Publication No 15).

NOTE 2 Reciprocal correlated colour temperature is used rather than reciprocal colour temperature whenever correlated colour temperature is appropriate.

[IEC 60050-845:1987/CIE 17.4:1987; 845-03-50]

3.2.34
fusion frequency
critical flicker frequency (for a given set of conditions)
frequency of alternation of stimuli above which flicker is not perceptible (unit: Hz)

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-50]

3.2.35
reflectance (for incident radiation of given spectral composition, polarization and geometrical distribution)
ρ
ratio of the reflected radiant or luminous flux to the incident flux in the given conditions (unit: 1)

[IEC 60050-845:1987/CIE 17.4:1987; 845-04-58]

3.2.36
transmittance (for incident radiation of given spectral composition, polarization and geometrical distribution)
τ
ratio of the transmitted radiant or luminous flux to the incident flux in the given conditions (unit: 1)

[IEC 60050-845:1987/CIE 17.4:1987; 845-04-59]

3.2.37
absorptance
α
ratio of the absorbed radiant or luminous flux to the incident flux under specified conditions (unit: 1)

[IEC 60050-845:1987/CIE 17.4:1987; 845-04-75]

3.2.38
photometry
measurement of quantities referring to radiation as evaluated according to a given spectral luminous efficiency function, e.g. $V(\lambda)$ or $V'(\lambda)$

[IEC 60050-845:1987/CIE 17.4:1987; 845-05-09]

3.2.39
access zone luminance
eye adaptation luminance in the access zone (unit: cd · m^{-2})

3.2.40
contrast revealing coefficient
q_c
quotient between the luminance (L) of the road surface, and the vertical illuminance (E_v) at that point (unit: cd · m^{-2} · lx^{-1})

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

where

q_c is the contrast revealing coefficient;

L is the luminance of the road surface at the point;

E_v is the vertical illuminance at the point

3.2.41
diversity (luminance, illuminance)
extreme uniformity
U_d
ratio of minimum illuminance (luminance) to maximum illuminance (luminance) on (of) a surface
(see also 3.2.20 uniformity)

3.2.42
equivalent veiling luminance (for disability glare or veiling reflections)
L_{ve}
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 (unit: $cd \cdot m^{-2}$)

[IEC 60050-845:1987/CIE 17.4:1987; 845-02-58]

3.2.43
glare rating limit
R_{GL}
upper limit of glare by the CIE Glare Rating system

3.2.44
interior zone luminance (of a tunnel)
$\overline{L}_{in}$
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) (unit: $cd \cdot m^{-2}$)

3.2.45
L20 access luminance (of a tunnel)
average luminance contained in a conical field of view, subtending an angle of 20º with the apex at the position of the eye of an approaching driver and aimed at the centre of the tunnel mouth (unit: $cd \cdot m^{-2}$)

NOTE L20 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.

3.2.46
longitudinal uniformity (of road surface luminance of a carriageway)
U_l
ratio of the minimum to the maximum road surface luminance found in a line in the centre along a driving lane

NOTE The longitudinal uniformity is considered for each driving lane.

3.2.47
obtrusive light
spill light which because of quantitative, directional or spectral attributes in a given context gives rise to annoyance, discomfort, distraction or reduction in the ability to see essential information

NOTE 1 In the case of outdoor sports lighting installations, obtrusive light is considered around the installation and not for spectators, referees or players within the sports area.

NOTE 2 In the case of large tertiary buildings with predominantly glazed facades, interior lighting may be considered as obtrusive light if it gives rise to annoyance, discomfort, distraction or a reduction in the ability to see essential information due to light spilling outside of the building structure.

3.2.48
spill light
stray light
light emitted by a lighting installation which falls outside the boundaries of the property for which the lighting installation is designed

3.2.49
threshold zone luminance
$\overline{L}_{\mathrm{th}}$
average road surface luminance of a transverse strip at a given location in the threshold zone of the tunnel (as a function of the measurement grid) (unit: cd · m^{-2})

3.2.50
threshold zone luminance ratio at a point
k
ratio between the threshold zone luminance $\overline{L}_{th}$ and the L20 access zone luminance

$$k = \frac{\overline{L}_{th}}{\text{L20 access zone luminance}}$$

where

k is the threshold zone luminance ratio at a point;

$\overline{L}_{th}$ is the threshold zone luminance

3.2.51
transition zone luminance
$\overline{L}_{\mathrm{tr}}$
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) (unit: cd · m^{-2})

3.2.52
unified glare rating limit
R_{UGL}
upper limit of glare by the CIE Unified Glare Rating system

3.2.53
windscreen luminance
L_{winds}
light veil as a result of the scatter in the vehicle windscreen expressed as a luminance (unit: cd · m^{-2})

3.3 Lighting equipment

3.3.1
lamp
source made in order to produce an optical radiation, usually visible

NOTE This term is also sometimes used for certain types of luminaires.

[IEC 60050-845:1987/CIE 17.4:1987; 845-07-03]

3.3.2
ballast
device connected between the supply and one or more discharge lamps which serves mainly to limit the current of the lamp(s) to the required value

NOTE A ballast may also include means for transforming the supply voltage, correcting the power factor and, either alone or in combination with a starting device, provide the necessary conditions for starting the lamp(s).

[IEC 60050-845:1987/CIE 17.4:1987; 845-08-34]

3.3.3
luminaire
apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes, except the lamps themselves, all the parts necessary for fixing and protecting the lamps and, where necessary, circuit auxiliaries together with the means for connecting them to the electric supply

[IEC 60050-845:1987/CIE 17.4:1987; 845-10-01]

3.3.4
reference ballast
special type ballast designed for the purpose of providing comparison standards for use in testing ballasts, for the selection of reference lamps and for testing regular production lamps under standardized conditions

[IEC 60050-845:1987/CIE 17.4:1987; 845-08-36]

3.3.5
reference lamp
discharge lamp selected for the purpose of testing ballasts and which, when associated with a reference ballast under specified conditions, has electrical values which are close to the objective values given in a relevant specification

[IEC 60050-845:1987/CIE 17.4:1987; 845-07-55]

3.3.6
rated luminous flux (of a type of lamp)
value of the initial luminous flux of a given type of lamp declared by the manufacturer or the responsible vendor, the lamp being operated under specified conditions (unit: lm)

NOTE 1 The initial luminous flux is the luminous flux of a lamp after a short ageing period as specified in the relevant lamp standard.

NOTE 2 The rated luminous flux is sometimes marked on the lamp.

NOTE 3 In French, formerly “flux lumineux nominal”.

[IEC 60050-845:1987/CIE 17.4:1987; 845-07-59]

3.3.7
luminous efficacy of a source
η
quotient of the luminous flux emitted by the power absorbed by the source (unit: $lm \cdot W^{-1}$)

[IEC 60050-845:1987/CIE 17.4:1987; 845-01-55]

3.3.8
light output ratio (of a luminaire)
R_{LO}
ratio of the total flux of the luminaire, measured under specified practical conditions with its own lamps and equipment, to the sum of the individual luminous fluxes of the same lamps when operated outside the luminaire with the same equipment, under specified conditions

NOTE 1 For luminaires using incandescent lamps only, the optical light output ratio and the light output ratio are the same in practice.

NOTE 2 Light output ratio is sometimes signified by the abbreviation LOR.

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-39]

3.3.9
light output ratio working (of a luminaire)
R_{LOW}
ratio of the total flux of the luminaire, measured under specified practical conditions with its own lamps and equipment, to the sum of the individual luminous fluxes of the same lamps when operating outside the luminaire with a reference ballast, under reference conditions

3.3.10
ballast lumen factor
$F_{Ballast}$
ratio of the luminous flux emitted by a reference lamp when operated with a particular production ballast to the luminous flux emitted by the same lamp when operated with its reference ballast

NOTE Ballast lumen factor is sometimes signified by the abbreviation BLF.

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-63]

3.3.11
downward light output ratio (of a luminaire)
R_{DLO}
ratio of the downward flux of the luminaire, measured under specified practical conditions with its own lamps and equipment, to the sum of the individual luminous fluxes of the same lamps when operated outside the luminaire with the same equipment, under specified conditions

NOTE 1 The luminaire attitude should be declared so that appropriate corrections to the DLOR can be made if in application the installed attitude is different.

NOTE 2 Downward light output ratio is sometimes signified by the abbreviation DLOR

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-40]

3.3.12
upward light output ratio (of a luminaire)
R_{ULO}
ratio of the upward flux of the luminaire, measured under specified practical conditions with its own lamps and equipment, to the sum of the individual luminous fluxes of the same lamps when operated outside the luminaire with the same equipment, under specified conditions

NOTE 1 The luminaire attitude should be declared so that appropriate corrections to the ULOR can be made if in application the installed attitude is different.

NOTE 2 Upward light output ratio is sometimes signified by the abbreviation ULOR.

3.3.13
(spatial) **distribution of luminous intensity** (of a source)
display, by means of curves or tables, of the value of the luminous intensity of the source as a function of direction in space

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-24]

3.3.14
utilization factor (of an installation, for a reference surface)
F_{U}
ratio of the luminous flux received by the reference surface to the sum of the individual fluxes of the lamps of the installation

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-51]

3.3.15
utilance (of an installation, for a reference surface)
U
ratio of the luminous flux received by the reference surface to the sum of the individual total fluxes of the luminaires of the installation

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-53]

3.3.16
lamp lumen maintenance factor
F_{LLM}
ratio of the luminous flux of a lamp at a given time in its life to the initial luminous flux

NOTE 1 See also CIE 97.

NOTE 2 Lamp lumen maintenance factor is sometimes signified by the abbreviation LLMF.

3.3.17
lamp survival factor
F_{LS}
fraction of the total number of lamps which continue to operate at a given time under defined conditions and switching frequency

NOTE 1 See also CIE 97.

NOTE 2 Lamp survival factor is sometimes signified by the abbreviation LSF.

3.3.18
luminaire maintenance factor
F_{LM}
ratio of the light output ratio of a luminaire at a given time to the initial light output ratio

NOTE 1 See also CIE 97.

NOTE 2 Luminaire maintenance factor is sometimes signified by the abbreviation LMF.

3.3.19
cut-off
technique used for concealing lamps and surfaces of high luminance from direct view in order to reduce glare

NOTE In public lighting distinction is made between full-cut-off luminaires, semi-cut-off luminaires and non-cut-off luminaires.

[IEC 60050-845:1987/CIE 17.4:1987; 845-10-29]

3.3.20
cut-off angle (of a luminaire)
angle, measured up from nadir, between the vertical axis and the first line of sight at which the lamps and the surfaces of high luminance are not visible (unit: degree)

[IEC 60050-845:1987/CIE 17.4:1987; 845-10-30]

3.3.21
circuit luminous efficacy of a source
c
quotient of the luminous flux emitted by the power absorbed by the source and associated circuits (unit: $lm \cdot W^{-1}$)

3.3.22
cold spot
coldest point on lamp surface

3.3.23
control gear
components required to control the electrical operation of the lamp(s)

NOTE Control gear may also include means for transforming the supply voltage, correcting the power factor and, either alone or in combination with a starting device, provide the necessary conditions for starting the lamp(s).

3.3.24
correction factor
factor to modify the luminaire data as presented on a particular photometric data sheet to those of similar luminaires

NOTE Examples are ballast lumen factor, length, lumen corrections.

3.3.25
emergency ballast lumen factor
F_{EBallast}
ratio of the luminous flux of the lamp, operated with ballast under test, at the lowest voltage which can occur during emergency mode, after failure of the normal supply (for the appropriate start time for the application requirement) and continuously to the end of rated duration of operation, to the luminous flux of the same lamp operated with the appropriate reference ballast supplied at its rated voltage and frequency

$$F_{\mathrm{EBallast}} = F_{\mathrm{Ballast}} \times F_{\mathrm{min}}$$

where

F_{EBallast} is the emergency ballast lumen factor;

F_{Ballast} is the ballast lumen factor;

F_{min} is the worst case of the emergency time dependent factors

3.3.26
emergency lighting charging power
P_{ei}
input power to the charging circuit of emergency luminaires when the lamps are not operating (unit: W)

3.3.27
essential data
lamp and luminaire data required for the verification of conformity to requirements

3.3.28
minimum value emergency factor
F_{min}
worst case of the emergency time dependent factors

3.3.29
lamp code
any combination of letters and numbers by which the lamp type is identified

3.3.30
lamp dimensions
all dimensions of the lamp that are relevant for the luminaire

3.3.31
luminaire code
any combination of letters and numbers by which the luminaire type is identified

3.3.32
luminaire luminous efficacy
l
quotient of the luminous flux emitted by the luminaire by the power absorbed by the lamp and associated circuits of the luminaire (unit: lm · W^{-1})

3.3.33
luminaire parasitic energy consumption
$W_{P,t}$
parasitic energy consumed in period *t*, by the luminaire emergency lighting charging circuit plus the standby control system controlling the luminaires when the lamps are not operating (unit: kWh)

3.3.34
luminaire parasitic power
P_{pi}
input power consumed by the charging circuit of emergency lighting luminaires and the standby power for automatic controls in the luminaire when lamps are not operating (unit: W)

$$P_{pi} = P_{ci} + P_{ei}$$

where

P_{pi} is the luminaire parasitic power consumed by the luminaire with the lamps off, expressed in watts;

P_{ci} is the parasitic power of the controls only during the time with the lamps off, expressed in watts;

P_{ei} is the emergency lighting charging power, expressed in watts

3.3.35
luminaire power
P_i
input power consumed by the lamp(s), control gear and control circuit in or associated with the luminaire, which includes any parasitic power when the luminaire is turned on (unit: W)

NOTE The rated luminaire power (P_i) for a specific luminaire may be obtained from the luminaire manufacturer.

3.3.36
nominal lamp wattage
W_{lamp}
approximate wattage used to designate or identify the lamp (unit: W)

3.3.37
parasitic power of the controls (with the lamps off)
P_{ci}
parasitic input power to the control system in the luminaires during the period with the lamps not operating (unit: W)

3.3.38
practical emergency lamp flux
Φ_{PEL}
lowest luminous flux of the lamp observed during the rated duration of the emergency mode (unit: lm)

$$\Phi_{PEL} = \Phi_{LD} \times F_{EBallast}$$

where

Φ_{PEL} is the practical emergency lamp flux, expressed in lumens;

Φ_{LD} is the initial lighting design lumens at 100 h;

$F_{EBallast}$ is the emergency ballast lumen factor

3.3.39
shielding angle
the angle between the horizontal plane and the first line of sight at which the luminous parts of the lamps in the luminaire are directly visible (unit: degrees)

NOTE The complementary angle to the shielding angle is named cut-off angle.

3.3.40
source
light source
object that produces light or other radiant flux

NOTE The term light source indicates the source is essentially intended for illuminating and signalling purposes.

3.3.41
useful data
lamp and luminaire data beneficial to the designers and users in the planning and operation of lighting installations

3.4 Daylight

3.4.1
solar radiation
electromagnetic radiation from the sun

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-76]

3.4.2
direct solar radiation
that part of the extraterrestrial solar radiation which as a collimated beam reaches the Earth's surface after selective attenuation by the atmosphere

[IEC 60050-845:1987/CIE 17.4:1987; 845 09-79]

3.4.3
diffuse sky radiation
that part of solar radiation which reaches the Earth as a result of being scattered by the air molecules, aerosol particles, cloud particles or other particles

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-80]

3.4.4
global solar radiation
combined direct solar radiation and diffuse sky radiation

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-81]

3.4.5
sunlight
visible part of direct solar radiation

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-82]

NOTE When dealing with actinic effects of optical radiations, this term is commonly used for radiations extending beyond the visible region of the spectrum.

3.4.6
skylight
visible part of diffuse sky radiation

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-83]

NOTE When dealing with actinic effects of optical radiations, this term is commonly used for radiations extending beyond the visible region of the spectrum.

3.4.7
daylight
visible part of global solar radiation

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-84]

NOTE When dealing with actinic effects of optical radiation, this term is commonly used for radiations extending beyond the visible region of the spectrum.

3.4.8
daylight factor
D
ratio of the illuminance at a point on a given plane due to the light received directly or indirectly from a sky of assumed or known luminance distribution, to the illuminance on a horizontal plane due to an unobstructed hemisphere of this sky, excluding the contribution of direct sunlight to both illuminances

NOTE 1 Glazing, dirt effects, etc. are included.

NOTE 2 When calculating the lighting of interiors, the contribution of direct sunlight needs to be considered separately.

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-97]

3.4.9
atmospheric luminance
L_{atm}
light veil as a result of the scatter in the atmosphere expressed as a luminance (unit: $cd \cdot m^{-2}$)

3.4.10
daylight screens
daylight louvres
devices that transmit (part of) the ambient daylight

NOTE They may be applied for the lighting of the threshold zone and/or the entrance zone of a tunnel.

3.4.11
sun-tight screens
screens that are designed in such a fashion that direct sunlight cannot reach the road surface under the screen

3.5 Lighting installations

3.5.1
general lighting
substantially uniform lighting of an area without provision for special local requirements

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-06]

3.5.2
localised lighting
lighting designed to illuminate an area with a higher illuminance at certain specified positions, for instance those at which work is carried out

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-08]

3.5.3
local lighting
lighting for a specific visual task, additional to and controlled separately from the general lighting

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-07]

3.5.4
spacing (in an installation)
distance between the light centres of adjacent luminaires of the installation

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-66]

3.5.5
spacing to height ratio
ratio of spacing to the height of the geometric centres of the luminaires above the reference plane

NOTE For indoor lighting the reference plane is usually the horizontal working plane; for exterior lighting the reference plane is usually the ground.

3.5.6
emergency lighting
lighting provided for use when the supply to the normal lighting fails

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-10]

3.5.7
direct lighting
lighting by means of luminaires having a distribution of luminous intensity such that the fraction of the emitted luminous flux directly reaching the working plane, assumed to be unbounded, is 90 % to 100 %

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-14]

3.5.8
semi-direct lighting
lighting by means of luminaires having a distribution of luminous intensity such that the fraction of the emitted luminous flux directly reaching the working plane, assumed to be unbounded, is 60 % to 90 %

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-15]

3.5.9
general diffused lighting
lighting by means of luminaires having a distribution of luminous intensity such that the fraction of the emitted luminous flux directly reaching the working plane, assumed to be unbounded, is 40 % to 60 %

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-16]

3.5.10
semi-indirect lighting
lighting by means of luminaires having a distribution of luminous intensity such that the fraction of the emitted luminous flux directly reaching the working plane, assumed to be unbounded, is 10 % to 40 %

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-17]

3.5.11
indirect lighting
lighting by means of luminaires having a distribution of luminous intensity such that the fraction of the emitted luminous flux directly reaching the working plane, assumed to be unbounded, is 0 to 10%

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-18]

3.5.12
directional lighting
lighting in which the light on the working plane or on an object is incident predominantly from a particular direction

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-19]

3.5.13
diffused lighting
lighting in which the light on the working plane or on an object is not incident predominantly from a particular direction

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-20]

3.5.14
floodlighting
lighting of a scene or object, usually by projectors, in order to increase considerably its illuminance relative to its surroundings

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-21]

3.5.15
spotlighting
lighting designed to increase considerably the illuminance of a limited area or of an object relative to the surroundings, with minimum diffused lighting

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-22]

3.5.16
stroboscopic effect
apparent change of motion and/or appearance of a moving object when the object is illuminated by a light of varying intensity

NOTE To obtain apparent immobilisation or constant change of movement, it is necessary that both the object movement and the light intensity variation are periodic, and some specific relation between the object movement and light variation frequencies exists. The effect is only observable if the amplitude of the light variation is above certain limits. The motion of the object can be rotational or translational.

3.5.17
installed loading
installed power of the lighting installation per unit area (for interior and exterior areas) or per unit length (for road lighting) (unit: $W \cdot m^{-2}$ (for areas) or $kW \cdot km^{-1}$ (for road lighting))

3.5.18
maintenance factor
light loss factor (obsolete)
ratio of the average illuminance on the working plane after a certain period of use of a lighting installation to the initial average illuminance obtained under the same conditions for the installation

NOTE 1 The term depreciation factor has been formerly used to designate the reciprocal of the above ratio.

NOTE 2 The light losses take into account dirt accumulation on luminaire and room surfaces and lamp depreciation.

NOTE 3 CIE 97 gives further information.

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-59]

3.5.19
room surface maintenance factor
F_{RSM}
ratio of room surface reflectance at a given time to the initial reflectance value

NOTE 1 See also CIE 97.

NOTE 2 Room surface maintenance factor is sometimes signified by the abbreviation RSMF.

3.5.20
life of lighting installation
period after which the installation cannot be restored to satisfy the required performance because of non-recoverable deteriorations

3.5.21
maintenance cycle
repetition of lamp replacement, lamp/luminaire cleaning and room surface cleaning intervals

NOTE See also CIE 97.

3.5.22
maintenance schedule
set of instructions specifying maintenance cycle and servicing procedures

NOTE See also CIE 97.

3.5.23
absence factor
F_A
factor indicating the proportion of time that a space is unoccupied

3.5.24
access zone
part of the open road immediately outside (in front of) the tunnel portal, covering the distance over which an approaching driver should be able to see into the tunnel

3.5.25
access zone length
access zone begins at the stopping distance point ahead of the portal and ends at the portal (unit: m)

3.5.26
annual operating time
t_o
number of hours per annum for which the lamps are operating (unit: h)

$$t_o = t_D + t_N$$

where

t_o is the annual operating time, in hours;

t_D is the daylight time usage, expressed in hours;

t_N is the non-daylight time usage, expressed in hours

3.5.27
background area
area in the workplace adjacent to the immediate surrounding area

3.5.28
built-in luminaire
fixed luminaire installed into structure or equipment to provide illumination

3.5.29
carriageway
part of the road normally used by vehicular traffic

3.5.30
constant illuminance factor
F_C
ratio of the average input power over a given time to the initial installed power to the luminaire

3.5.31
curfew
time period during which stricter requirements (for the control of obtrusive light) will apply

NOTE It is often a condition of use of lighting applied by a government controlling authority, usually the local government.

3.5.32
daylight dependency factor
F_D
level of efficiency that a control system or control strategy exploits the saving potential of daylight in a space

3.5.33
daylight time usage
t_D
annual operating hours during the daylight time, measured in hours (unit: h)

3.5.34
design speed
speed adopted for a particular stated purpose in designing a road (unit: $km \cdot h^{-1}$)

3.5.35
display screen equipment
alphanumeric or graphic display screen, regardless of the display process employed

NOTE Display screen equipment is sometimes signified by the abbreviation DSE.

[90/270/EEC]

3.5.36
emergency escape lighting
part of emergency lighting that provides illumination for visibility for people leaving a location or attempting to terminate a potentially dangerous process before doing so

3.5.37
emergency exit
way out that is intended to be used during an emergency

3.5.38
emergency lane (hard shoulder)
lane parallel to the traffic lane(s) provided for emergency and/or broken-down vehicles only

3.5.39
emergency lighting charge time
t_{em}
operating hours during which the emergency lighting batteries are being charged (unit: h)

3.5.40
energy consumption used for illumination
$W_{L,t}$
energy consumed in period t, by the luminaires when the lamps are operating, to fulfil the illumination function and purpose in the building (unit: kWh)

3.5.41
entrance portal
part of the tunnel construction that corresponds to the beginning of the covered part of the tunnel or, when open sun-tight screens are used, to the beginning of the sun-tight screens

3.5.42
entrance zone
combination of the threshold zone and the first part of the transition zone

3.5.43
escape route
route designated for escape in the event of an emergency

3.5.44
escape route lighting
part of emergency escape lighting provided to ensure that the means of escape can be effectively identified and safely used when the location is occupied

3.5.45
exit portal
end of the covered part of the tunnel or, when open sun-tight screens are used, to the end of the sun-tight screens

3.5.46
exit zone
part of the tunnel where, during day-time, the vision of the driver approaching the exit is influenced predominantly by the brightness outside the tunnel

NOTE The exit zone stretches from the end of the interior zone to the exit portal of the tunnel.

3.5.47
exit zone lighting
lighting of the exit zone which allows drivers to adapt from the interior zone to the lighting outside the tunnel

3.5.48
externally illuminated safety sign
safety sign that is illuminated, when it is required, by an external source

3.5.49
grid points for measurement and calculation
arrangement of calculation and measurement points and their number in each dimension of the reference surface or plane

3.5.50
high risk task area lighting
part of emergency escape lighting that provides illumination for visibility for people involved in a potentially dangerous process or situation and facilitates safe termination of activities

NOTE In EN 12193 it is referred to as ‘Safety lighting for participants’.

3.5.51
integral lighting system (of a machine)
lighting system consisting of lamp(s), luminaire(s) and associated mechanical and electrical control devices which forms a permanent part of the machine, designed to provide illumination in and/or at the machine

3.5.52
interior zone
part of the tunnel following directly after the transition zone. The interior zone stretches from the end of the transition zone to the beginning of the exit zone

3.5.53
interior zone lighting
lighting of the interior zone of the tunnel which provides adequate visibility in the interior of the tunnel, irrespective of the use of vehicle headlights

3.5.54
internally illuminated safety sign
safety sign that is illuminated, when it is required, by an internal source

3.5.55
light centre
point used as origin for photometric measurements and calculations

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-64]

3.5.56
Lighting Energy Numeric Indicator
numeric indicator of the total annual lighting energy required in the building (unit: kWh $\cdot$ m^{-2} $\cdot$ year^{-1})

NOTE 1 The LENI can be used to make direct comparisons of the lighting energy used in buildings that have similar functions but are of different size and configuration.

NOTE 2 The Lighting Energy Numeric Indicator is sometimes signified by the abbreviation LENI.

3.5.57
lighting scheme design
design process in which the lighting designer selects the lighting criteria for the place of interest, chooses the lighting solution, makes lighting calculations, configures the layouts, produces drawings of the lighting scheme and specifies the operating functions of the lighting system

3.5.58
lighting system
lighting equipment or lighting solution (lamps, ballast, luminaire and controls) required for the lighting scheme, its installation and operation during the life of the scheme

3.5.59
machinery
machine
assembly of linked parts or components, at least one of which moves, with the appropriate machine actuators, control and power circuits etc. joined together for a specific application, in particular for the processing, treatment, moving or packaging of a material

NOTE The term “machinery” also covers an assembly of machines which, in order to achieve one and the same end, are arranged and controlled so that they function as an integral whole.

3.5.60
mixed traffic
traffic that consists of motor vehicles, cyclists, pedestrians, etc.

3.5.61
motor traffic (motorized traffic)
traffic that consists of motorized vehicles only

NOTE 1 It depends on national legislation which vehicle types are included in this classification.

NOTE 2 In some countries it only includes vehicles which are capable of maintaining a minimum speed. In others, mopeds are not considered as motorized traffic.

3.5.62
non-daylight time usage
t_N
annual operating hours during the non-daylight time (unit: h)

3.5.63
occupancy dependency factor
F_O
factor indicating the proportion of time that a space is occupied and lighting is required

3.5.64
open area lighting
anti-panic lighting
part of emergency escape lighting provided to avoid panic and provide illumination allowing people to see their way to an escape route

3.5.65
operating time
t
time period for the energy consumption (unit: h)

3.5.66
parting zone
first part of the open road directly after the exit portal of the tunnel

NOTE The parting zone is not a part of the tunnel, but it is closely related to the tunnel lighting. The parting zone begins at the exit portal.

3.5.67
principal area
$A_{\text{Principle}}$
actual playing area needed for the performance of a certain sport

NOTE Usually this means the actual marked out "field" area for that sport (for instance football), but in some cases this area comprises an extra playing area around the marked area (e. g. tennis, volleyball, table tennis). The dimensions of the particular area should be checked at the time when a lighting installation is being installed.

3.5.68
reference area
area defined per sports on which the main lighting requirements apply including the marking lines and any extra area centred around the marked area

NOTE The dimensions of this area are generally based on PA, for the relevant sport and level of competition. For most sports this reference area is limited by a rectangle in the horizontal plane of the ground.

3.5.69
rooflight
daylight opening on the roof or on a horizontal surface of a building

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-104]

3.5.70
safety sign
sign which gives a general safety message, obtained by a combination of colour and geometric shape and which, by the addition of a graphic symbol or text, gives a particular safety message

3.5.71
scene setting operation time
t_s
operating hours of the scene setting controls (unit: h)

3.5.72
speed limit
maximum legally allowed speed (unit: $km \cdot h^{-1}$)

3.5.73
standard year time
t_y
time taken for one standard year to pass, taken as 8 760 h

3.5.74
standby lighting
that part of emergency lighting provided to enable normal activities to continue substantially unchanged

[IEC 60050-845-1987/CIE 17.4:1987; 845-09-13]

3.5.75
stopping distance
stopping distance is the distance needed to bring a vehicle, driving at design speed, to a complete standstill (unit: m)

NOTE The *stopping distance* is usually defined in national legislation or regulation.

3.5.76
surrounding area
immediate surrounding area
band surrounding the task area within the field of vision

3.5.77
task area
area within which the visual task is carried out

3.5.78
threshold zone
first part of the tunnel, directly after the entrance portal

3.5.79
threshold zone lighting
lighting of the threshold zone of the tunnel which allows drivers to see into the tunnel whilst in the access zone

3.5.80
total area
A_{Total}
area generally comprising the principal area plus an additional safety area outside the principal area

NOTE This term may be used in addition to and in relation to playing area and reference area in sports lighting.

3.5.81
total energy used for lighting
W_t
energy consumed in period t, by the luminaires, when the lamps are operating plus the parasitic loads when the lamps are not operating, in a room or zone (unit: kWh)

3.5.82
total installed charging power of the emergency lighting luminaires in the room or zone
P_{em}
input charging power of all emergency lighting luminaires (unit: W)

$$P_{\mathrm{em}} = \sum_i P_{\mathrm{e}i}$$

where

P_{em} is the total installed charging power of the emergency lighting luminaires in the room or zone, expressed in watts;

P_{ei} is the emergency lighting charging power of the individual luminaires, expressed in watts

3.5.83
total installed lighting power in the room or zone
P_{n}
power of all luminaires (unit: W)

$$P_{\mathrm{n}} = \sum_{i} P_i$$

where

P_{n} is the total installed lighting power in the room or zone, expressed in watts;

P_i is the luminaire power expressed in watts

3.5.84
total installed parasitic power of the controls in the room or zone
P_{pc}
input power of all control systems in luminaires when the lamps are not operating (unit: W)

$$P_{\mathrm{pc}} = \sum_{i} P_{\mathrm{c}i}$$

where

P_{pc} is the total installed parasitic power of the controls in the room or zone, expressed in watts;

$P_{\mathrm{c}i}$ is the parasitic power of the controls only during the time with the lamps off, expressed in watts

3.5.85
traffic lane
strip of carriageway intended to accommodate a single line of moving vehicles

3.5.86
transition zone
part of the tunnel following directly after the threshold zone

NOTE The transition zone stretches from the end of the threshold zone to the beginning of the interior zone. In the transition zone, the lighting level is decreased from the level at the end of the threshold zone to the level of the interior zone.

3.5.87
transition zone lighting
lighting of the transition zone which helps drivers' to adapt to the lighting level in the zones ahead

3.5.88
traffic
number of vehicles passing a specific point in a stated time in stated direction(s). In tunnel design, peak hour traffic will be used (unit: vehicles $\cdot$ h^{-1} $\cdot$ $lane^{-1}$)

3.5.89
upward flux ratio
ratio between the flux from all considered luminaires above the horizontal plane passing through the luminaires in their installed position on site plus their flux reflected by the ground and the minimal irreducible flux reflected towards the sky by the sole reference surface

NOTE Upward flux ratio is sometimes signified by the abbreviation UFR.

3.5.90
upward flux maximum
maximum possible value of flux in an installation that is potentially emitted above the horizontal both directly from the luminaire(s) mounted in their installed attitude, and indirectly due to reflection from lit surfaces within the space (unit: lm)

3.5.91
upward flux minimum
minimum possible value of flux in an installation that is emitted above the horizontal (unit: lm)

NOTE This value assumes no upward flux is directly emitted from the luminaire(s) and the task area is lit to just the required level with no spill light onto adjacent areas. UPF_{min} is therefore the flux reflected by the task area under these conditions.

3.5.92
upward light ratio
R_{UL}
proportion of the total luminaire flux that is emitted above the horizontal by all luminaires to the total luminaire flux from all luminaires in an installation, when the luminaires are mounted in their installed attitudes

3.5.93
useful area
A
floor area inside the outer walls excluding non-habitable cellars and un-illuminated spaces (unit: m^2)

3.5.94
window
daylight opening on a vertical or nearly vertical area of a room envelope

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-103]

3.5.95
work place
place intended to house work stations on the premises of the undertaking and/or establishment and any other place within the area of undertaking and/or establishment to which the worker has access in the course of his employment

3.5.96
work plane
working plane
reference surface defined as the plane at which work is normally done

[IEC 60050-845:1987/CIE 17.4:1987; 845-09-50]

3.5.97
work station
combination and spatial arrangement of work equipment, surrounded by the work environment under the conditions imposed by the work tasks

3.6 Lighting measurements

3.6.1
photometer
instrument for measuring photometric quantities

[IEC 60050-845:1987/CIE 17.4:1987; 845-05-15]

3.6.2
colorimeter
instrument for measuring colorimetric quantities, such as the tristimulus values of a colour stimulus

[IEC 60050-845:1987/CIE 17.4:1987; 845-05-18]

3.6.3
illuminance meter
instrument for measuring illuminance

[IEC 60050-845:1987/CIE 17.4:1987; 845-05-16]

3.6.4
luminance meter
instrument for measuring luminance

[IEC 60050-845:1987/CIE 17.4:1987; 845-05-17]

3.6.5
reflectometer
instrument for measuring quantities pertaining to reflection

[IEC 60050-845:1987/CIE 17.4:1987; 845-05-26]

3.6.6
measurement field (of a photometer)
area including all points in object space, radiating towards the acceptance area of the detector

3.6.7
$V(\lambda)$ **correction**
correction of the spectral responsivity of a detector to match the photopic spectral sensitivity of the human eye

(see also IEC 60050-845:1987/CIE 17.4:1987; 845-01-22 and 845-01-23, ISO 11664/CIE S014)

3.6.8
cosine correction
correction of a detector for the influence of the incident direction of the light

NOTE For the ideal detector, the measured illuminance is proportional to the cosine of the angle of incidence of the light. The angle of incidence is the angle between the direction of the light and the normal to the surface of the detector.

4 Framework for the specification of lighting requirements

4.1 General

The principal design parameters which shall be considered when determining the lighting requirements for a specific application are described in 4.2 to 4.9. These parameters shall be specified in the form recommended in 4.2 to 4.9. For some of these parameters it has been possible to give a preferred set of values which shall be used. Additional parameters may be required for some specific applications.

4.2 Illuminance

Illuminance shall be specified as maintained illuminance and shall take one of the following values of $\overline{E}_{\mathrm{m}}$:

$1 \times 10^{\mathrm{N}}$ lx; $1{,}5 \times 10^{\mathrm{N}}$ lx; $2{,}0 \times 10^{\mathrm{N}}$ lx; $3{,}0 \times 10^{\mathrm{N}}$ lx; $5{,}0 \times 10^{\mathrm{N}}$ lx; $7{,}5 \times 10^{\mathrm{N}}$ lx (where N is an integer).

The area over which the illuminance is to be calculated or measured shall be specified.

4.3 Luminance

Luminance shall be specified as maintained luminance and shall take one of the following values of $\bar{L}_m$:

1×10^N cd · m^{-2}; $1{,}5 \times 10^N$ cd · m^{-2}; 2,0 x 10^N cd · m^{-2}; $3{,}0 \times 10^N$ cd · m^{-2}; $5{,}0 \times 10^N$ cd · m^{-2}; $7{,}5 \times 10^N$ cd · m^{-2} (where N is an integer).

The area over which the luminance is to be calculated or measured shall be specified.

4.4 Glare

4.4.1 Disability glare

Disability glare may be expressed in a number of different ways. If threshold increment is used the following values of threshold increment shall be used (see CIE 31):

5 %; 10 %; 15 %; 20 %; 25 %; 30 %.

If glare rating is used the following values of glare rating shall be used (see CIE 112):

10; 20; 30; 40; 45; 50; 55; 60; 70; 80; 90.

4.4.2 Discomfort glare

Discomfort glare may be expressed by means of a 'psychometric scale' derived from psychophysical experiments.

If it is expressed using the unified glare rating the following values of unified glare rating shall be used (see CIE 117):

10; 13; 16; 19; 22; 25; 28.

4.5 Colour

4.5.1 Colour rendering

For design purposes, colour rendering requirements shall be specified using the general colour rendering index and shall take one of the following values of R_a:

20; 40; 60; 80; 90.

4.5.2 Light source colour

The colour of a light source can be expressed by its correlated colour temperature.

4.6 Energy

The energy consumed by a lighting installation to meet the lighting requirements depends on the installed loading, the hours of use and the control regime. Energy targets, in kWh per year per unit area or length, should be set to encourage energy efficiency.

4.7 Maintenance

A maintenance factor shall be specified (see CIE 97).

4.8 Measurements

Measurement procedures shall be given for all lighting applications.

4.9 Accuracy

Accuracy is the estimated tolerance of the values obtained by calculation or measurement. It is normally given in the form ± XX %.

Annex A
(informative)

Additional explanation of defined terms

to **3.1.1 adaptation:** process which takes place as the visual system adjusts to the luminance and colour of the visual field or the final state of this process.

to **3.1.2 accommodation:** adjustment of the power of the lens of the eye for the purpose of focussing an image of an object on the retina.

to **3.1.3 visual acuity:** capacity for seeing distinctly fine details that have very small angular subtense at the eye.

NOTE Quantitatively, it can be expressed by the reciprocal of the angle, in minutes of arc, subtended at the entrance of the pupil by the extremities of the detail separation which is just visible.

to **3.1.4 brightness:** attribute of the visual sensation associated with the amount of light emitted from a given area. It is the subjective correlate of luminance.

to **3.1.8 glare:** see also 3.2.22 and 3.2.23.

to **3.2.1 luminous flux:** quantity derived from radiant flux (radiant power) by evaluating the radiation according to the spectral sensitivity of the human eye (as defined by the CIE standard photometric observer). It is the light power emitted by a source or received by a surface, unit: lumen (lm).

NOTE 1 In this definition, the values used for the spectral sensitivity of the CIE standard photometric observer are those of the spectral luminous efficiency function $V(\lambda)$.

NOTE 2 See IEC 60050-845:1987/ CIE 17.4:1987; 845-01-22 for the definition of spectral luminous efficiency, 845-01-23 for the definition of the CIE standard photometric observer and 845-01-56 for the definition of luminous efficacy of radiation. See ISO 11664/CIE S014.

to **3.2.2 luminous intensity** (of a point source in a given direction)**:** luminous flux per unit solid angle in the direction in question, i.e. the luminous flux on a small surface, divided by the solid angle that the surface subtends at the source (see also IEC 60050-845:1987/CIE 17.4:1987; 845-01-31).

unit: 1 candela (cd) = 1 lm · sr^{-1} (sr = steradian)

NOTE The candela is the fundamental SI photometric unit. For its definition, see IEC 60050-845:1987/CIE 17.4:1987; 845-01-50.

to **3.2.3 luminance:** luminous flux per unit solid angle transmitted by an elementary beam passing through the given point and propagating in the given direction, divided by the area of a section of that beam normal to the direction of the beam and containing the given point (see also IEC 60050-845:1987/CIE 17.4:1987; 845-01-35).

It can also be defined as:

a) the luminous intensity of the light emitted or reflected in a given direction from an element of the surface, divided by the area of the element projected in the same direction;

b) the illuminance produced by the beam of light on a surface normal to its direction, divided by the solid angle of the source as seen from the illuminated surface.

It is the physical measurement of the stimulus which produces the sensation of brightness.

to **3.2.10 illuminance:** The orientation of the surface may be defined, e.g. horizontal, vertical, hence horizontal illuminance, vertical illuminance.

to **3.2.22 disability glare:** Disability glare can be produced directly or by reflection.

to **3.2.23 discomfort glare:** Discomfort glare can be produced directly or by reflection.

to **3.2.26 colour rendering** (of a light source)**:** effect of a light source on the colour appearance of objects compared with their colour appearance under a reference light source.

to **3.2.27 general colour rendering index** (of a light source)**:** value intended to specify the degree to which objects illuminated by a light source have an expected colour relative to their colour under a reference light source.

NOTE R_a is derived from the colour rendering indices for a specified set of 8 test colour samples. R_a has a maximum of 100, which generally occurs when the spectral distributions of the light source and the reference light source are substantially identical. (See CIE publication 13.3).

to **3.2.29 tristimulus** values**:** see also CIE 15:2004.

to **3.2.30 chromaticity coordinates:** see also CIE 15:2004.

to **3.2.31 chromaticity:** see also CIE 15:2004.

to **3.2.32 colour temperature**: see also CIE 15:2004.

to **3.2.35 reflectance:** ratio of the luminous flux reflected from a surface to the luminous flux incident on it.

NOTE The reflectance generally depends on the direction and spectral distribution of the incident light and on the surface finish.

to **3.2.36 transmittance:** ratio of the luminous flux transmitted through a body to the luminous flux incident on it.

NOTE The transmittance generally depends on the direction and spectral distribution of the incident light and on the surface finish.

to **3.2.37 absorptance:** ratio of the luminous flux absorbed in a body to the luminous flux incident on it.

NOTE The absorptance generally depends on the direction and spectral distribution of the incident light and on the surface finish.

to **3.2.38 photometry:** measurement of quantities referring to radiation evaluated according to the spectral sensitivity of the human eye (as defined by the CIE standard photometric observer).

NOTE 1 The values usually used for the spectral sensitivity of the CIE standard photometric observer are those of the spectral luminous efficiency function $V(\lambda)$.

NOTE 2 See IEC 60050-845:1987/CIE 17.4:1987; 845-01-22 for the definition of spectral luminous efficiency, 845-01-23 for the definition of the CIE standard photometric observer and 845-01-56 for the definition of luminous efficacy of radiation. See ISO 11664/CIE S014.

to **3.3.6 rated lamp luminous flux:** for most lamps, in reference conditions the lamp is usually operating at an ambient temperature of 25 °C in still air, freely suspended in a defined burning position and with a reference ballast, but see the relevant IEC standard for the particular lamp.

to **3.3.7 luminous efficacy of a source:** if not otherwise specified, the measurement conditions should be the reference conditions specified in the relevant IEC standard.

to **3.3.13** (spatial) **luminous intensity distribution** (of a source)**:** luminous intensity of a source (lamp or luminaire) as a function of direction in space.

to **3.3.14 utilization factor:** ratio of the luminous flux received by the reference surface to the sum of the rated lamp luminous fluxes of the lamps of the installation.

to **3.5.4 spacing** (in an installation): see IEC 60050-845:1987/CIE 17.4:1987; 845-09-64 for definition of light centre.

to **3.5.18 maintenance factor** (of an installation): ratio of maintained illuminance to initial illuminance (see CIE 97).

NOTE Maintenance factor of an installation depends on lamp lumen maintenance factor, lamp survival factor, luminaire maintenance factor and (for an interior lighting installation) room surface maintenance factor.

Annex B
(informative)

Index of terms

Annex C
(informative)

A deviation

A-Deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN/CENELEC member.

This European Standard falls under Directive 2008/57/EC.

NOTE (from CEN/CENELEC IR Part 3:2009, 3.14.5) Where standards fall under EC Directives, it is the view of the Commission of the European Communities (OJ No C 59; 1982-03-09) that the effect of the decision of the Court of Justice in case 815/79 Cremonini/Vrankovich (European Court Reports 1980, p. 3583) is that compliance with A-deviations is no longer mandatory and that the free movement of products complying with such a standard should not be restricted except under the safeguard procedure provided for in the relevant Directive.

A-deviations in an EFTA-country are valid instead of the relevant provisions of the European Standard in that country until they have been removed.

Denmark

Danish Building Regulations BR 95 and BR S 98

Published by the National Building and Housing Agency

Related to Clause 3 and 4

According to legal Danish Building Regulations BR 95 and BR S 98 the use of DS 700 and DS 704 is mandatory.

DS 704 has a number of definitions in addition to those of Clause 3.

DS 700 has unified glare rating requirements in levels that are one unit higher than those of 4.4.2.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2008/57/EC

This European Standard has been prepared under a mandate given to CEN/CENELEC/ETSI by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 2008/57/EC[1].

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations (see Table ZA.1).

Table ZA.1 — Correspondence between this European Standard, the CR and HS TSI Persons with reduced Mobility and Directive 2008/57/EC

Clause/ subclauses of this European Standard	Chapter/§of the TSI	Relevant Essential Requirements of the Directive 2008/57/EC	Comments
The whole standard is applicable	No direct references in the TSI. Standard recommended by the Application Guide for the following clauses of the TSI 'Persons with reduced mobility': ▪ 4.2.2.5. 'Lighting' 4.3. 'Definitions of terms used in this TSI'	Annex III Essential Requirements 1. General requirements 1.1. Safety 1.1.1 1.1.5 1.5. Technical compatibility	

[1] The Directive 2008/57/EC adopted on 17th June 2008 is a recast of the previous Directive 96/48/EC 'Interoperability of the trans-European high-speed rail system' and 2001/16/EC 'Interoperability of the trans-European conventional rail system' and their revision by Directive 2004/50/EC of the European Parliament and of the Council of 29 April 2004 amending Council Directive 96/48/EC on the interoperability of the trans-European high-speed rail system and Directive 2001/16/EC of the European Parliament and of the Council on the interoperability of the trans-European conventional rail system'

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