SLOVENSKI STANDARD
SIST-TS CEN/TS 18182:2026

01-december-2026

Svetloba in razsvetljava – Ocenjevanje moteče električne svetlobe v zunanjih prostorih

Light and lighting - Assessment of obtrusive electrical light in outdoor spaces

Licht und Beleuchtung - Beurteilung von störendem elektrischem Licht im Außenbereich

Lumière et éclairage - Évaluation de la lumière électrique gênante dans les espaces extérieurs

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ICS:

91.160.20	Zunanja razsvetljava stavb	Exterior building lighting
93.080.40	Cestna razsvetljava in pripadajoča oprema	Street lighting and related equipment

SIST-TS CEN/TS 18182:2026 **en,fr,de**

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TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

CEN/TS 18182

October 2026

ICS 91.160.20

English Version

Light and lighting - Assessment of obtrusive electrical light in outdoor spaces

Lumière et éclairage - Évaluation de la lumière électrique gênante dans les espaces extérieurs

Licht und Beleuchtung - Beurteilung von störendem elektrischem Licht im Außenbereich

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European foreword

This document (CEN/TS 18182:2026) has been prepared by Technical Committee CEN/TC 169 “Light and lighting”, the secretariat of which is held by DIN.

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Introduction

This document covers issues involved in limiting the spilling of electric light towards the sky and/or beyond the surfaces to be illuminated.

Aspects attributable to the energy performance of lighting installations are not covered, as they are already the subject of other specific CEN documents.

Reflected light is not part of the methods given in this document but might be subject to additional considerations under specific conditions by a not yet standardized calculation method.

Since the topic is the subject of legislative activities, this document is intended to constitute a technical reference tool, in order that all operators in the sector can act according to unified procedures.

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1 Scope

This document specifies calculation and verification methods for evaluating the spill light coming from the electric light sources of lighting installations in public and non-public outdoor areas, in the following application fields:

— lighting installations in outdoor workplaces (ref. EN 12464-2);

— road lighting installations (ref. CEN/TR 13201-1, EN 13201 series);

— lighting installations for outdoor sports fields and areas (ref. EN 12193);

— monument and architectural lighting installations;

— lighting installations for the outdoor areas of residential buildings;

— lighting installations for the outdoor areas of parks and gardens.

This document also considers luminous signs and luminous advertising installations in outdoor areas and the light emission from illuminated environments covered by translucent surfaces.

With the exception of lighting installations within premises located and designed for observation from exterior observers light emitted from windows, skylights and shop windows are excluded.

The calculation methods described are intended as an integral part of the lighting design and are suitable for evaluating consistency with any regulatory conditions.

Due to the complexity of the phenomena and the numerous variables, this document does not consider the influence of atmospheric conditions in evaluating obtrusive light.

This document does not apply to lighting installations for tunnels and underpasses and to all signalling devices such as traffic lights, active road signs and the like, or to vehicle headlamps.

This document additionally considers the spectral composition of the light concerned, as well as the room brightening at building openings not intentionally lit in the above application areas and any glare effects from these.

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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 12464-2, *Light and lighting — Lighting of work places — Part 2: Outdoor work places*

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

EN 13201-3:2015, *Road lighting — Part 3: Calculation of performance*

EN 13201-5:2015, *Road lighting — Part 5: Energy performance indicators*

ISO/CIE 19476:2014, *Characterization of the performance of illuminance meters and luminance meters*

CIE 150:2017, *Guide on the limitation of the effects of obtrusive light from outdoor lighting installations*

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12665 and the following apply.

ISO and IEC maintain terminology 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/

3.1
upper half-space
half-space at and above 90°, passing through the photometric centre of a luminaire defined according to EN 13032-1 or EN 13032-4 as applicable

Note 1 to entry: In the C-γ coordinate system the horizontal plane is identified by the angle γ = 90°.

3.2
lower half-space
half-space at and below 90°, passing through the photometric centre of a luminaire defined according to EN 13032-1 or EN 13032-4 as applicable

Note 1 to entry: In the C-γ coordinate system the horizontal plane is identified by the angle γ = 90°.

3.3
design upper luminous flux
$\Phi_{\theta,\psi}$
luminous flux emitted in the upper half-space by a luminaire under the nominal installation conditions θ, ψ and υ

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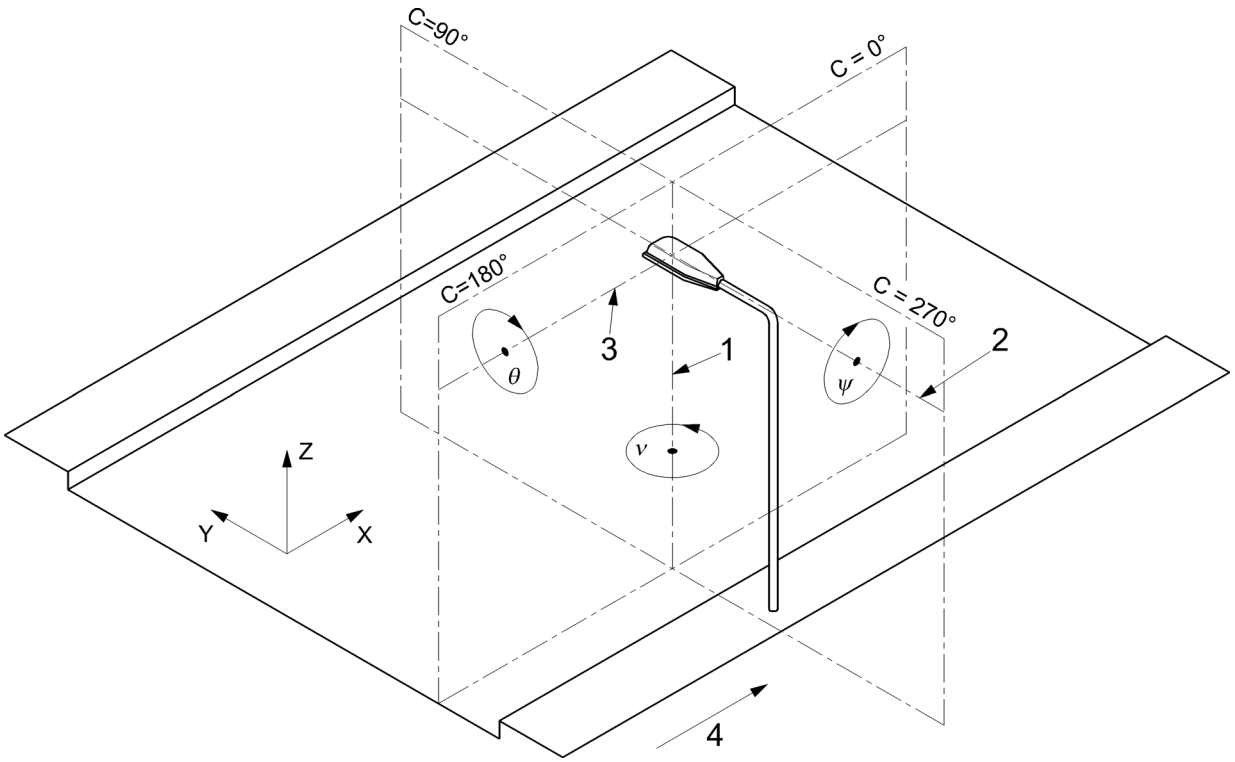
Note 1 to entry: The design upper luminous flux can be determined using EN 13032-4:2015+A1:2019, 6.3.

Note 2 to entry: The design upper luminous flux is expressed in lumens (lm).

Note 3 to entry: See Figure 1.

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Key

1 first axis
2 second axis
3 third axis
4 longitudinal axis

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Figure 1 — Definition of the angles θ, ψ and υ and axes of rotation in relation to the *(x, y)* coordinate system

3.4
upper spill ratio
R_{us}
ratio of the luminous flux emitted in the upper half-space by all luminaires and not intercepted by the structure to the luminous flux of the same luminaires emitted in the entire space

Note 1 to entry: A number of currently available lighting design programs can directly provide parameters that are similar to R_{us} but which are identified with symbols other than those given in this document, see Note to Clause A.4.

Note 2 to entry: structure includes any kind of object such as buildings, walls, trees, columns, mechanical shielding, etc.

3.5
spill light
stray light
<in a lighting installation> light emitted by a lighting installation that falls outside the boundaries of the property or area for which the lighting installation is designed

[SOURCE: EN 12665:2024, 3.2.47]

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3.6
obtrusive light
spill light which, because of quantitative or directional attributes, gives rise to annoyance, discomfort, distraction, or a reduction in ability to see essential information such as transport signals

[SOURCE: CIE S 017:2020, 17-29-181]

3.7
small-scale outdoor lighting installation
outdoor lighting installation pertaining to a single connection point of the distributor (fiscal energy meter) that simultaneously satisfies the following conditions:

— total luminous flux not exceeding 1800 lm emitted by the source (or any group of sources) installed in a luminaire with replaceable source(s) or by a single luminaire with non-replaceable source(s);

— total luminous flux emitted upwards, by the set of luminaires, not exceeding 2250 lm

3.8
business sign
writing in alphanumeric characters possibly supplemented by symbols and trademarks, constructed and supported with materials of any nature and installed in the place of business to which it refers or in the related facilities of that business

Note 1 to entry: It can be luminous both due to its own light and due to indirect light.

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3.9
illuminated advertisement
any word, letter, model, sign, placard, board, notice, awning, blind, device or representation, that is illuminated and employed wholly or partly for the purposes of advertisement, announcement or direction

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Note 1 to entry: The definition includes any hoarding or similar structure used, or designed or adapted for use, and anything else principally used, or designed or adapted principally for use for the display of advertisements, and references to the display of advertisements shall be construed accordingly.

Note 2 to entry: The definition excludes anything employed as a memorial or transport/traffic signal.

Note 3 to entry: A range of modern devices for outdoor are within this definition. These include rotating poster panels, advertisements displayed on permanently fixed blinds.

3.10
digital media display
any electronic display that emits light and is employed wholly or partly for the purpose of displaying digital art, video or other media content

Note 1 to entry: This includes any hoarding or similar structure used, or designed or adapted for use, and anything else principally used, or designed or adapted principally for use for the display of digital art, video or other media content.

3.11
image luminance measuring device
ILMD
digital electronic device, equipped with a lens, a suitable photometric matching filter, a sensor made by a matrix of detector (pixel), and calibrated for measuring the luminance distributions of the framed scene

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[Source: EN 12665:2024, 3.6.9 – modified: Notes to entry omitted]

3.12
virtual container
BB
black box
mathematical model consisting of a container without reflections and a parallelepiped shape that contains the object to be illuminated and the corresponding lighting installation

3.13
background luminance
luminance of the part of a picture, object or scene in the field of view, excluding the main figures or objects of interest

4 Installation evaluation criteria

4.1 Methods of evaluating outdoor lighting installation parameters

For small-scale outdoor lighting installation as defined in 3.7, the method given in 4.2 shall be used to evaluate the lighting installation. For all other outdoor installations, the methods given in 4.3 apply, as described in Table 3.

4.2 Methods of evaluating small-scale outdoor lighting installations

4.2.1 Where national regulations or mandatory requirements do not define small-scale outdoor lighting installation, the definition in 3.7 applies.

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4.2.2 If the photometric data of the luminaires are available (e.g. luminous intensity distribution tables), at the design stage, by means of calculation, compliance with the two conditions referred to in definition 3.7 (luminous flux emitted by the source or by any group of light sources and total luminous flux emitted upwards by the set of luminaires) shall be verified.

NOTE It is not always mandatory to provide photometric data of luminaires sold in stores.

4.2.3 If photometric data of the sources and luminaires used are not available, both at the design stage and during any on-site verifications, the following procedure shall be applied.

a) Estimation of luminous flux emitted by the source: the luminous flux to be considered for the purposes of the calculation is declared on the light source(s) and/or on the commercial packaging.

b) Estimation of upward emission: calculation method simplified by specifying three categories of luminaire with three possible fixed and predefined upward emissions (without the obligation of any measurement):

   1) For luminaires with unshielded upward light emission, i.e. recessed ground luminaires, upward facing projectors, wall lights with upward emission only and other similar cases, the total luminous flux emitted upwards by the individual luminaire is by convention 100 %.

   2) For luminaires with downwards light emission or luminaires inclined downwards and/or partially shielded upwards, e.g. spheres with shielding, luminaires with curved and/or inclined glass and other similar cases, the total luminous flux emitted upward by the individual luminaire is by convention 20 %.

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3) For luminaires with only downwards light emission or luminaires fully shielded upwards, the total luminous flux emitted upward by the individual luminaire is by convention 0 %.

4.3 Methods of evaluating non-small-scale outdoor lighting installations

4.3.1 Method of evaluation for upward light ratio

The calculation of the upward light ratio R_{UL} in the installation conditions of all the luminaires involved shall be carried out considering the following orientation, tilt and rotation angles of a luminaire.

For a road lighting installation, the three orientation angles of a luminaire are specified, considering a right-handed Cartesian coordinate system in space, identified by the axes:

— x parallel to the axis of the road;

— y transverse to the road;

— z perpendicular to the road surface and directed upwards.

For other installation types, the following angles are considered (see Figure 1):

— ν positive rotation angle about the vertical axis of the luminaire from x to y;

— θ positive tilt angle of the luminaire from y to z;

— ψ positive rotation angle of the luminaire from z to x.

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Two different calculation methods are envisaged for spill light in the upper half-space of luminaires in relation to the type of photometry with constant or variable steps, as described in Annex B. In case of θ and ψ equal to 0, the luminous flux calculated in the Annex B is the spill light in the upper half-space; if these angles are not equal to 0, then only B.1 can be applied by adding a correction for angles θ or ψ.

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R_{UL} shall be calculated separately, according to Formula (1):

$$R_{UL} = 100 \frac{\sum_{i=1}^{n} \Phi_{u,i}}{\sum_{i=1}^{n} \Phi_{t,i}} \quad (1)$$

where

n is the total number of installed luminaires;

$\Phi_{t,i}$ is the total luminous flux emitted by the i_{th} installed luminaire;

$\Phi_{u,i}$ is the luminous flux emitted by the i_{th} installed luminaire in the upper half-space in the installation conditions.

NOTE 1 The design specifies to which luminaires the R_{UL} is referring to.

NOTE 2 The calculation of R_{UL} refers to a hypothetical lighting system installed in an empty space, that is, it is considering only the radiation emitted by luminaires, without considering e.g. any shielding provided by trees or reflections from illuminated surfaces.

In the presence of screens which are not part of the original lighting installation and are capable of effectively limiting the luminous flux emitted in the upper half-space, the R_{us} parameter shall be calculated according to 4.3.3.

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4.3.2 Method of evaluation for luminous intensities

4.3.2.1 General

Although the most suitable quantity to characterize the upward spill light is the luminous flux emitted by the installation in the upper half-space (spill light), evaluated using the method described in 4.3.1, by way of simplification it is possible to refer to the distribution of light intensities of the individual luminaire.

By this method, the luminous intensity values in directions at 90° and above with respect to the vertical are considered, with the luminaire oriented in the installation condition.

NOTE The light intensity distribution can be absolute or relative.

4.3.2.2 Conversion from relative photometry to absolute photometry

When photometry is scaled to 1 000 lm, the following Formula (2) is applied to obtain the intensities in absolute values:

$$I_A = I_{nf} \frac{\Phi_t}{1\,000\ \text{lm}} \tag{2}$$

where

I_A is the absolute value for rated luminous intensity (unit: cd);

I_{nf} is the relative value for rated luminous intensity referring to a luminous flux of 1 000 lm, where “nf” in subscript stands for “normalised flux” (unit: candelas per thousand lumens);

Φ_t for luminaires with replaceable lamp(s), it is the total luminous flux of the lamp(s); for LED luminaires with non-replaceable source(s), it is the total luminous flux of the luminaire itself (unit: lm).

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NOTE Formula (2) is derived from EN 13032-4:2015+A1:2019, 6.5.3.

4.3.2.3 Conversion from absolute photometry to relative photometry

When the photometry is absolute, the following Formula (3) is applied to obtain the intensities in values referred to 1 000 lm:

$$I_{nf} = I_A \frac{1\,000\,lm}{\Phi_t} \tag{3}$$

where

I_A is the absolute value for rated luminous intensity (unit: cd);

I_{nf} is the relative value for rated luminous intensity referring to a luminous flux of 1000 lm, where “nf” in subscript stands for “normalised flux” (unit: candelas per thousand lumens);

Φ_t for luminaires with replaceable lamp(s), it is the total luminous flux of the lamp(s); for LED luminaires with non-replaceable source(s), it is the total luminous flux of the luminaire itself (unit: lm).

NOTE Formula (3) originates from EN 13032-4:2015+A1:2019, 6.5.3.

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4.3.3 Method of evaluation for the ratio of the upward flux not intercepted by the structure to the total nominal flux exiting the lighting installation (R_{us})

To determine the ratio of the upward flux not intercepted by the structure to the total nominal flux exiting the lighting installation (R_{us}), the calculation method described in Annex A shall be applied.

In agreement with the purchaser, it is the designer's responsibility to use a 3D model of the object/objects that is sufficiently accurate for the required purpose.

NOTE This method provides a more precise result as soon as the luminaires of the lighting system are positioned in a lower mounting height than the position of the subject to be lighted.

4.3.4 Method of average luminance on the surface to be illuminated

A balanced luminance between the object and background is the parameter that allows visibility of any surface, thus monuments or artefacts lit properly can be enjoyed and seen. Therefore, it is desirable to limit as much as possible the light from the system to minimize obtrusive light produced by reflections.

For the purposes of this document, the average luminance of the surface shall be evaluated for new luminaires and sources, that is, the calculation of this quantity shall be performed with a maintenance factor equal to 1,00.

For the calculation of luminance on the illuminated surface, Lambertian surfaces are conventionally considered; if the reflection factor of the surface is not available, reference may be made to Table 1.

The designer shall indicate in the design the reflectance values of the surfaces used for the calculation.

In the case of complex surfaces for which it is difficult to assess an average reflectance of the illuminated surface, and which can locally result in measured luminance values higher than the designed ones, the verification shall be performed by referring to the calculated illuminance values.

NOTE 1 A discrepancy in the measured luminance values with respect to the calculated values is normally observed in the presence of non-Lambertian surfaces.

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The Formula (4) to be used for calculating the average luminance $\bar{L}$ is the following:

$$\bar{L} = \frac{\bar{E} \cdot \rho \cdot h}{\pi} \tag{4}$$

where

$\bar{E}$ is the average illuminance of the surface of the monument or object;

ρ is the average reflectance of the illuminated surface;

h is the coefficient of the specular component of the surface.

The reflectance values ρ for some materials commonly used for monuments and objects are listed in Table 1.

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