SLOVENSKI STANDARD
SIST EN 12193:2019

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SIST EN 12193:2008

Svetloba in razsvetljava - Razsvetljava športnih objektov

Light and lighting - Sports lighting

Licht und Beleuchtung - Sportstättenbeleuchtung

Lumière et éclairage - Éclairage des installations sportives

Ta slovenski standard je istoveten z: EN 12193:2018

ICS:

91.160.01	Razsvetljava na splošno	Lighting in general
97.220.10	Športni objekti	Sports facilities

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Light and lighting - Sports lighting

Lumière et éclairage - Éclairage des installations sportives

Licht und Beleuchtung - Sportstättenbeleuchtung

This European Standard was approved by CEN on 1 July 2018.

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

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European foreword

This document (EN 12193:2018) 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of an identical text or by endorsement, at the latest by June 2019, and conflicting national standards shall be withdrawn at the latest by June 2019.

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

This document supersedes EN 12193:2007.

In this revision the main technical changes can be divided between the needs of the players and that of the camera. For the players the minimum colour rendering index has been increased from $R_a > 20$ to $R_a > 60$. The tables of requirements have been updated to take into account sports that have become popular since the last edition. Recommendations on the use of Glare Rating for indoor sports areas are now included.

The requirements for television and film recording have been revised to reflect changes in broadcast technology since the last edition. Lighting levels have been reviewed in line with the requirements for HD and 4K transmission as well as production techniques. For cameras colour rendering index has been replaced by Television Lighting Consistency Index (TLCI) which has been developed specifically for broadcast cameras. Requirements for eliminating flicker from slow motion cameras are included as well as lighting of spectators.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard deals with sports lighting to ensure good visual conditions for players, athletes, referees, spectators and CTV transmission. The objective of this document is to provide recommendations and specify requirements for good quality sports lighting by:

— optimizing the perception of visual information used during sports events;

— maintaining the level of visual performance;

— providing acceptable visual comfort;

— restricting obtrusive light.

1 Scope

This document specifies lighting for those indoor and outdoor sports events most practised in Europe. This document only considers artificial lighting. It provides lighting values for the design and control of sports lighting installations in terms of illuminances, uniformity, glare restriction and colour properties of the light sources. All requirements are intended to be as minimum requirements. It also gives methods by which these values are measured. For the limitation of glare, it also points out restrictions on the location of the luminaires for specific applications.

For emergency lighting this document refers to the requirements of EN 1838.

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 1838, *Lighting applications — Emergency lighting*

EN 12665:2011, *Light and lighting — Basic terms and criteria for specifying lighting requirements*

EN 13032-1, *Light and lighting — Measurement and presentation of photometric data of lamps and luminaires — Part 1: Measurement and file format*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12665:2011 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
principal area
PA
actual playing area needed for the performance of a certain sport

Note 1 to entry: 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).

Note 2 to entry: In all tables in Annex A examples of area sizes are given which are most commonly used for that sport. The particular area dimensions should be checked at the time when designing a lighting installation.

3.2
total area
TA
area generally comprising the principal area (PA) plus an additional safety area outside the principal area

Note 1 to entry: 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. An example of a reference area is given in Figure 1 where *l* and *w* stand respectively for the length and the width of

the rectangular reference area. Where a total area (TA) is specified, it will also be necessary to fulfil the requirements as defined in 7.1 a).

3.3
grid points for measurement and calculation
arrangement of calculation and measurement points and their number in each dimension of the reference area

Note 1 to entry: When the reference area is rectangular, *l* and *w* (see Figure 1) define the dimensions of the rectangle limited by the four corner points which are common for calculation and measurement.

Note 2 to entry: When the reference area covers a symmetrical track, is *l* a quarter of the length of the inner limit of the track and *w* the width of the track as defined in Figure 2.

3.4
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 information that is critical to the visual task

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

[Source: EN 12665:2018, 3.2.46, modified]

3.5
curfew sports lighting
time after which stricter requirements (for the control of obtrusive light) will apply

[Source: see CEN/CENELEC Internal Regulations Part 3:2015, D.1.5.]

Note 1 to entry: It is often a condition of use of lighting applied by a government controlling authority, usually the local government.

3.6
average illuminance over a surface
illuminance averaged over the specified surface

[Source: EN 12665:2018, 3.2.11, modified]

Note 1 to entry: Horizontal illuminance calculated at ground level (0 m) and vertical illuminance calculated at a height of 1,5 m, unless stated otherwise.

3.6.1
maintained average illuminance over a surface
value below which the average illuminance on the specified surface is not allowed to fall

Note 1 to entry: It is the average illuminance on the specified surface at the time maintenance is to be carried out.

3.6.2
initial average illuminance over a surface
average illuminance on the specified surface when the installation is new

Note 1 to entry: The initial average illuminance is obtained from the specified maintained value by dividing the latter value by the maintenance factor at the time maintenance is to be carried out.

3.7
principal camera
camera at location which are designated as requiring full calculations

3.8
secondary camera
camera at other fixed location and might not require full calculations over the whole area (e.g. camera behind the goal)

3.9
hand-held (or roving camera)
camera whose position can be anywhere on the principal area; camera that requires at least for the four vertical planes parallel to the edges of the principal area to be calculated

3.10
Television Lighting Consistency Index
TLCI
lighting colour metric developed by the European Broadcasting Union and designed for television

Note 1 to entry: The TLCI Q_a can be a number between 0 (bad) and 100 (perfect). Although designed for productions where cameras would be intercut between different locations and/or lighting, it is also useful for sports lighting.

Note 2 to entry: The EBU requirements are given in EBU Recommendation R.137, EBU Technical document Tech. 3355 [30].

3.11
gradient
percentage change in illuminance over a specified distance

4 Symbols and abbreviations

4.1 Symbols and units

For the purposes of this document, the symbols given in EN ISO 52000-1 and the specific symbols listed in Table 1 apply.

Table 1 — Symbols and units

Symbol	Name of quantity	Unit
b	Width of the principal area (PA)	m
d	Length of the principal area (PA)	m
$E_{\text{hor Min}}$	Minimum Horizontal Illuminance	lx
$E_{\text{hor Max}}$	Maximum Horizontal Illuminance	lx
$E_{\text{hor Ave}}$	Average Horizontal Illuminance	lx
$E_{\text{vert Min}}$	Minimum Vertical Illuminance	lx

Symbol	Name of quantity	Unit
$E_{\text{vert Max}}$	Maximum Vertical Illuminance	lx
$E_{\text{vert Ave}}$	Average Vertical Illuminance	lx
$E_{\text{cam Min}}$	Minimum vertical illuminance towards a specified camera	lx
$E_{\text{cam Max}}$	Maximum vertical illuminance towards a specified camera	lx
$E_{\text{cam Ave}}$	Average vertical illuminance towards a specified camera	lx
$E_{\text{cam Ave Stand}}$	Average vertical illuminance towards a specified camera over the stand	lx
$E_{\text{cam Ave PA}}$	Average vertical illuminance towards a specified camera over the principal area	lx
l	Length of the total area (TA)	m
$U1_{\text{hor}}$	Minimum to Maximum Horizontal Uniformity	—
$U2_{\text{hor}}$	Minimum to Average Horizontal Uniformity	—
$U1_{\text{vert}}$	Minimum to Maximum Vertical Uniformity	—
$U2_{\text{vert}}$	Minimum to Average Vertical Uniformity	—
R_{a}	Colour Rendering Index	—
T_{cp}	Correlated Colour Temperature	K
Q_{a}	Television Lighting Consistency Index	—
P_{w}	Calculation Grid Increment Widthwise	m
P_{l}	Calculation Grid Increment Lengthwise	m
PA	Principal Area	m^2
TA	Total Area	m^2
W_{p}	Calculation Grid Width	m
L_{p}	Calculation Grid Length	m
R_{UG}	Unified Glare Rating	—
R_{G}	Glare Rating	—
R_{ULMax}	Maximum Upward Light Output Ratio	%
R_{LO}	Light Output Ratio	%
I	Luminaire intensity of each source in the potentially obtrusive direction	cd
L_{b}	Building Luminance	$cd\ m^{-2}$
f_{TI}	Threshold Increment	—
w	Width of the total area (TA)	m

Symbol	Name of quantity	Unit
W_{source}	Nominal Wattage	W
F_{LLM}	Lamp Lumen Maintenance Factor	—
F_{LS}	Lamp Survival Factor	—
t_q	Rated Ambient Performance Temperature t_q	°C
L_x	Lumen Maintenance	%
B_y	Rated Useful Life	h
F_{BL}	Ballast Lumen Factor	—
F_{LM}	Luminaire Maintenance Factor	—
F_U	Utilization Factor	—
FF	Flicker factor	%

5 Design data

5.1 General

The following data shall be provided to the designers and users in the planning and operation of lighting installations.

5.2 Essential light source data

5.2.1 General

The following data for the light source shall be provided for verification:

— **Code**: Any combination of letters and numbers by which the light source type can be identified.

— **Dimensions:** All dimensions of the light source that are relevant for the luminaire.

— **Nominal wattage** (W_{source})**:** The nominal light source wattage (W_{source}) as the approximate wattage used to designate or identify the light source may be stated.

— **Luminous Flux.**

— **General colour rendering index** (R_a).

— **Correlated colour temperature** (T_{cp}).

5.2.2 Replacable lamp data

5.2.2.1 Lamp lumen maintenance factor (F_{LLM})

The lamp lumen maintenance factor may be presented as a graph or as data in a table. However, for the designer to set up an optimal maintenance scheme, it is recommended to present such data in tabular form.

5.2.2.2 Lamp survival factor (F_{LS})

The lamp survival factor may be presented as a graph or as data in a table. However, to allow the designer to set up an optimal maintenance scheme, it is recommended to present such data in tabular form.

5.2.3 LED light source data

5.2.3.1 Lumen maintenance: Length of time during which the source light output has fallen to x % (L_x).

5.2.3.2 Rated median useful life: Length of time during which 50 % (B_{50}) of a population of operating LED sources of the same type have parametrically failed, under standard test conditions as declared by the manufacturer or responsible vendor.

5.2.3.3 Rated useful life: Length of time during which y % (B_y) of a population of operating LED sources of the same type have parametrically failed, under standard test conditions as declared by the manufacturer or responsible vendor.

NOTE Lumen maintenance and life are usually quoted for the same time e.g. L_xB_y @ z hours and for a specified ambient temperature.

5.3 Essential luminaire data

5.3.1 General

The following luminaire data shall be provided for verification of conformity to the requirements of this European Standard.

5.3.1.1 Luminaire code: Any combination of letters and numbers by which the luminaire type is identified.

5.3.1.2 Normalized intensity table: In sports lighting designs, the accuracy of illuminance calculations is based primarily upon the quality of interpolation within the intensity table of the luminaires used. For minimum requirements see EN 13032-1.

5.3.1.3 Correction factors: When the electrical performance of the ballast, used in the photometric measurements, deviates more than 5 % from the standard measurement, then a Ballast Lumen Factor (F_{BL}) shall be specified.

5.3.1.4 Dimensions of the luminous parts of the luminaire: The dimensions of those parts of the luminaire from which light is emitted shall be given in m or m^2.

5.3.2 Luminaires with replaceable lamps

5.3.2.1 Luminaire luminous flux: For luminaires the rated luminous flux of the luminaire shall be given.

NOTE For luminaires with replaceable lamps the rated luminous flux of the luminaire can be derived by multiplying the rated luminous flux of the lamp by the light output ratio (R_{LO}) of the luminaire. Ballasts of luminaires may refer to a ballast lumen factor (F_{BL}) value. Where this applies the value of R_{LO} should be multiplied by the value of F_{BL}. For guidance see also EN 13032-1.

5.3.2.2 Rated ambient temperature: Highest ambient temperature around the luminaire related to the safe operation of the luminaire under normal operating conditions, both as declared by the manufacturer or responsible vendor.

5.3.3 LED luminaires

5.3.3.1 Rated ambient performance temperature *tq:* Highest ambient temperature around the luminaire related to a rated performance of the luminaire under normal operating conditions, both as declared by the manufacturer or responsible vendor.

5.3.3.2 Lumen maintenance: Length of time during which the luminaire light output has fallen to x % (L_x).

5.3.3.3 Rated median useful life: Length of time during which 50 % (B_{50}) of a population of operating LED luminaires of the same type have parametrically failed, under standard test conditions as declared by the manufacturer or responsible vendor.

5.3.3.4 Rated useful life: Length of time during which y % (B_y) of a population of operating LED luminaires of the same type have parametrically failed, under standard test conditions as declared by the manufacturer or responsible vendor.

5.3.3.5 Luminaire luminous efficacy: The ratio of the luminaire luminous flux emitted divided by the power consumed by the luminaire including drivers.

NOTE Lumen maintenance and life are usually quoted for the same time e.g. L_xB_y at z hours and for a specified ambient temperature.

5.4 Useful luminaire data

The following luminaire data shall be provided to the designers and users in the planning and operation of lighting installations.

Intensity diagram: The intensity distribution presented as a graph is mainly intended to give a first impression of the shape of the luminous intensity distribution. The graph for floodlights should be in Cartesian format.

Luminaire maintenance factor (F_{LM})**:** The luminaire maintenance factor (F_{LM}) may be presented as a graph or as data in a table. However, for the designer to set up an optimal maintenance scheme, it is recommended to present such data in a tabular form.

Spacing to height ratios: Ratio of spacing to the height of the geometric centres of an array of luminaires above the reference plane in the axial and transverse directions.

NOTE Usually used for indoor facilities in conjunction with UF tables (see below).

Utilization factor tables: The utilization factor (F_U) of a luminaire in an installation is the 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 (see EN 12665).

NOTE Usually used for indoor facilities.

Photometry: Whether relative or absolute photometry has been used.

5.5 Essential installation data

The following installation data shall be provided for verification of conformity to the requirements of EN 12193:

— field dimensions: for example area dimensions see Annex A;

— reflectance of the area (required for glare calculations);

— maintenance factor;

— electrical supply voltage.

6 General principles of the lighting installation

6.1 Reference grid for calculation and measurement

6.1.1 General

Verification of the illuminance values provided by a lighting installation requires regular in situ measurements to be made on site. It is then advisable to define a specific grid so that the lighting designer and customer can have a common ground when carrying out lighting calculations and measurements. These grids are generally rectangular. The illuminances are calculated or measured at every centre of grid rectangles. The grid limits are defined in 3.3. The reference of the grid is generally the ground level for horizontal illuminance evaluation or 1,5 m above for vertical illuminances, unless stated otherwise. The grid points are determined by the length and width of the reference area or, for a track (see Figure 2), by a quarter of the length of its inner limit and its width as described in 6.1.2.

6.1.2 Grid size for calculation and measurements for particular sports

In principle the grid size necessary for calculation and measurement depends on the sports area under consideration, the geometry of the installation, the luminous intensity distribution of the luminaires used, the required accuracy and the photometric quantities to be evaluated. Although this dependence cannot be described in a simple way, in practice, the maximum grid size can be estimated using Formula (1).

$$p = 0,2 \cdot 5^{\log d} \tag{1}$$

where

p is the grid size;

d is the longer dimension of the reference area.

The number of points in the longer dimension is given by the nearest odd whole number of d/p.

The resulting spacing between the grid points is used to calculate the nearest odd whole number of grid points in the shorter dimension. This will give a ratio of length to width of a grid cell near to 1.

NOTE The formula (coming from CIE X005 [3]) has been derived under the assumption log p proportional to log d, where:

p = 0,2 m for d = 1 m;

p = 1 m for d = 10 m;

p = 5 m for d = 100 m.