SLOVENSKI STANDARD
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Razsvetljava - Razsvetljava športnih objektov

Light and lighting - Sports lighting

Licht und Beleuchtung - Sportstättenbeleuchtung

Lumière et éclairage - Éclairage des installations sportives

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Light and lighting - Sports lighting

Lumière et éclairage - Éclairage des installations sportives

Licht und Beleuchtung - Sportstättenbeleuchtung

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European foreword

This document (prEN 12193:2017) has been prepared by Technical Committee CEN/TC 169 “Light and lighting”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document will supersede 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 For cameras colour rendering index has been replaced by Television Lighting Contrast Index (TLCI) which has been developed specifically for broadcast cameras.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.

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; and

— restricting obtrusive light.

1 Scope

This European Standard specifies lighting for those indoor and outdoor sports events most practised in Europe. This standard 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 meant 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 standard refers to the requirements of EN 1838.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1838:1999, *Lighting applications — Emergency lighting*

EN 12193, *Light and lighting — Sports 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.

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 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 5.3 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, lp and wp (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, l will be lp, which is the quarter of the length of the inner limit of the track, 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 essential information

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.

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

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

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 specific maintained value by dividing the latter value by the maintenance factor at the time maintenance is to be carried out.

3.6.3
principal camera
cameras at locations which are designated as being principal cameras that require full calculations

3.6.4
secondary cameras
cameras at other fixed locations and might not require full calculations over the whole area for each one

3.6.5
hand-held or roving cameras
cameras whose position can be anywhere on the principal area and require at least for the four vertical planes parallel to the edges of the principal area to be calculated

3.6.6
Television Lighting Consistency Index
TLCI
lighting colour metric developed by the European Broadcasting Union and designed for television

Note 1 to entry: The TLCI 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 where viewers have no reference.

4 Data to be provided

4.1 Essential lamp data

The following lamp data shall be provided for verification.

Lamp code: Any combination of letters and numbers by which the lamp type can be identified.

Lamp dimensions: All dimensions of the lamp that are relevant for the luminaire.

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

Luminous Flux.

Lamp lumen maintenance factor (LLMF):

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 these data in tabular form.

Lamp survival factor (LSF):

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 these data in tabular form.

General colour rendering index (R_a).

Correlated colour temperature (T_{cp}).

4.2 Useful lamp data

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

4.3 Essential luminaire data

The following luminaire data shall be provided for verification of conformity to the requirements of EN 12193.

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

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.

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 (BLF) shall be specified.

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.

4.4 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 (LMF):

The luminaire maintenance factor (LMF) 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 these 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 (UF) 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.

4.5 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.

5 General principles of the lighting installation

5.1 Reference grid for calculation and measurement

5.1.1 General

Verification of the lighting levels provided by a lighting installation requires lighting 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 level of the grid is generally the ground for horizontal illuminance evaluation or 1.5m 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 5.1.2.

5.1.2 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 as:

$$p = 0,2 \cdot 5^{\log d} \quad (1)$$

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 Report 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.

5.1.3 Grid size for calculation and measurements for multi-sports facilities

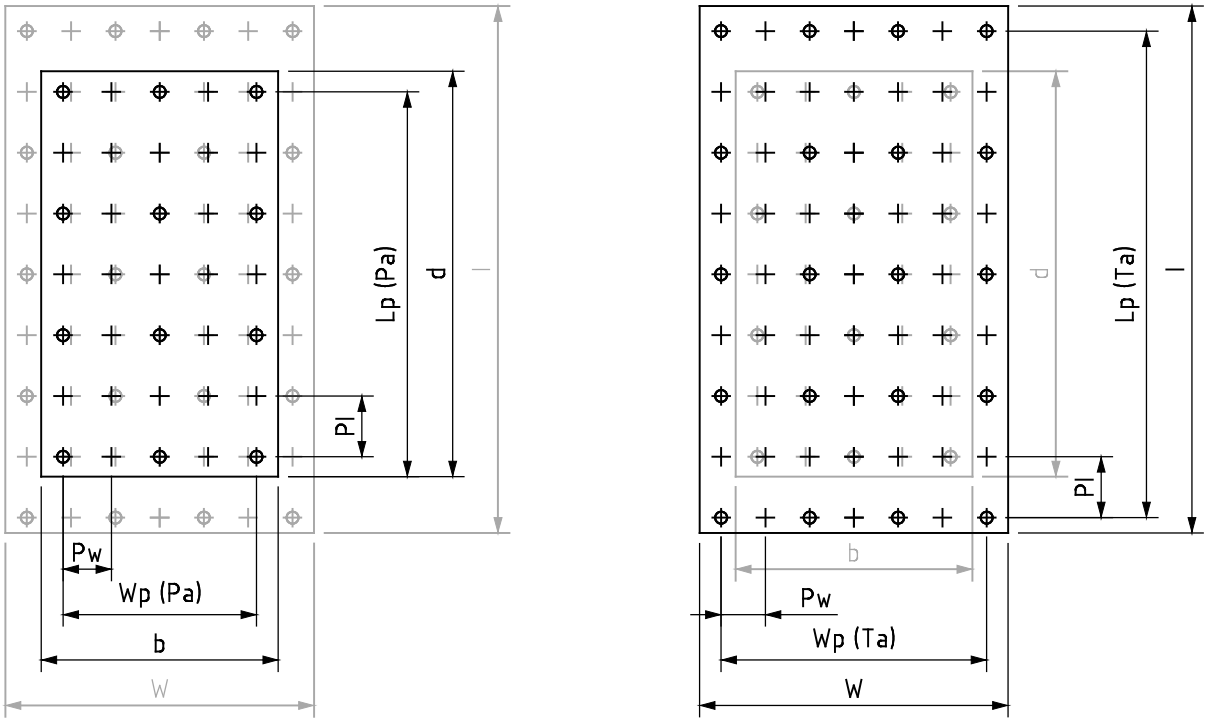
Checks should be performed for any separate playing area within the total area, using the grid specified for the particular sport, for instance when there are specific users or competitions (e.g. badminton, basketball, volleyball). Where there are several marked playing areas within a total area (e.g. multi-use sports hall) a calculation and measurement over the whole area can be made, using the dimensions of this whole area to determine the number of grid points according to the formula in 5.1.2.

5.1.4 Application

The calculation grid is defined to verify the specified performance of a new installation. The measurement grid can be the same as the calculation grid, however this will usually lead to an excessive number of measuring points. A reduced number of points can be taken and measured values compared to calculation at the same points. This reduced grid should be agreed between the designer and the client and used as the basis of checking the installed performance. The numbers of calculation points are defined for most of sports in the grouped tables of lighting requirements (see Annex A). It will be noticed that the proposed calculation grids in 5.1.1 are such that the number of points for length or width is odd and always allows a measurement grid every two points while keeping a symmetric repartition of the points over the reference area. An example of measurement points is given in Figure 1 with encircled points.

NOTE Further guidance on measurement grids can be found in CIE 169:2005 [4].

The average illuminance is determined as the mean arithmetical value obtained from all the points. For new installations the calculation of the initial illuminances shall be compared to actual measurements. The initial illuminances are calculated from the maintained illuminances given in the tables of requirements in Annex A, taking into account an appropriate maintenance factor.



a) Principle area (Pa) **b) Total area (Ta)**

Key

Pw	Calculation grid increment widthwise	l	Length of the total area (Ta)
b	Width of the principal area (Pa)	Lp (Pa)	Calculation grid length principal area
Pl	Calculation grid increment lengthwise	Lp (Ta)	Calculation grid length total area
D	Length of the principal area (Pa)	+	Calculation point
W	Width of the total area (Ta)	⌖	Calculation and measurement point
Wp (Pa)	Calculation grid width principal area		
Wp (Ta)	Calculation grid width total area		

Figure 1 — Reference area, calculation grid points and an example of measurement grid points

For non-rectangular playing areas such as athletics tracks, calculations can be made on a rectangular grid but the intervals between calculation points should be small enough that the playing area contains sufficient points.