BRITISH STANDARD

BS EN
12193:2007

Light and lighting — Sports lighting

ICS 91.160.01; 97.220.10

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 12193:2007. It supersedes BS EN 12193:1999, which will be withdrawn on 30 June 2008.

The UK participation in its preparation was entrusted by Technical Committee CPL/34, Lamps and related equipment, to Subcommittee CPL/34/10, Light and lighting.

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

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2008

ISBN 978 0 580 58697 2

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12193

December 2007

ICS 91.160.01; 97.220.10

Supersedes EN 12193:1999

English Version

Light and lighting - Sports lighting

Éclairagisme - Éclairage des installations sportives

Licht und Beleuchtung - Sportstättenbeleuchtung

This European Standard was approved by CEN on 25 October 2007.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN 12193:2007: E

Contents

Foreword

This document (EN 12193:2007) 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of an identical text or by endorsement, at the latest by June 2008, and conflicting national standards shall be withdrawn at the latest by June 2008.

This document supersedes EN 12193:1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and 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:

— optimising 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 standard specifies lighting for those indoor and outdoor sports events most practised in Europe. 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 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.

EN 12464-1, *Light and lighting – Lighting of work places – Part 1: Indoor work places*

EN 12665:2002, *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 12665:2002 and the following apply.

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

NOTE 1 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 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

3.3
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. 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).

3.4
grid points for measurement and calculation
arrangement of calculation and measurement points and their number in each dimension of the reference area

NOTE 1 When the reference area is rectangular, l_p and w_p (see Figure 1) define the dimensions of the rectangle limited by the four corner points which are common for calculation and measurement.

NOTE 2 When the reference area covers a symmetrical track, l will be l_p, 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.

3.5
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 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.

3.6
curfew
time after 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.

3.7 average illuminance over a surface

3.7.1
maintained average illuminance over a surface
value below which the average illuminance on the specified surface is not allowed to fall

NOTE It is the average illuminance on the specified surface at the time maintenance must be carried out

3.7.2
initial average illuminance over a surface
average illuminance on the specified surface when the installation is new

NOTE The initial average illuminance is obtained from the specific maintained value by dividing the latter value by the maintenance factor at the time maintenance must be carried out.

4 Data to be provided

4.1 Essential lamp data

4.1.1 General

The following lamp data shall be provided for verification.

4.1.2 Lamp code

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

4.1.3 Lamp dimensions

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

4.1.4 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.

4.1.5 Luminous Flux

4.1.6 Lamp lumen maintenance factor (LLMF)

NOTE 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.

4.1.7 Lamp survival factor (LSF)

NOTE 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.

4.1.8 General colour rendering index (R_a)

4.1.9 Correlated colour temperature (T_{cp})

4.2 Useful lamp data

4.2.1 General

Lamp data beneficial to the designers and users in the planning and operation of lighting installations

4.2.2 Lamp energy efficiency class (LEEC)

Lamp energy efficiency class assigned to the lamp in accordance with the energy efficiency index defined in the Lamps Directive 98/11/EC and measured in accordance to EN 50285.

4.3 Essential luminaire data

4.3.1 General

Luminaire data required for verification of conformity to the requirements of EN 12193.

4.3.2 Luminaire code

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

4.3.3 Normalised 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.

4.3.4 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.

4.3.5 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

4.4.1 General

Luminaire data beneficial to the designers and users in the planning and operation of lighting installations.

4.4.2 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.

4.4.3 Luminaire maintenance factor (LMF)

NOTE 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.

4.4.4 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).

4.4.5 Utilisation factor tables

The utilisation 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

4.5.1 Field dimensions. For actual area dimensions see Annex A.

4.5.2 Reflectance of the area (required for glare calculations)

4.5.3 Maintenance factor

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 3.4. The reference level of the grid is generally the ground for horizontal illuminance evaluation or 1 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 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:

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

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 Report X005) 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

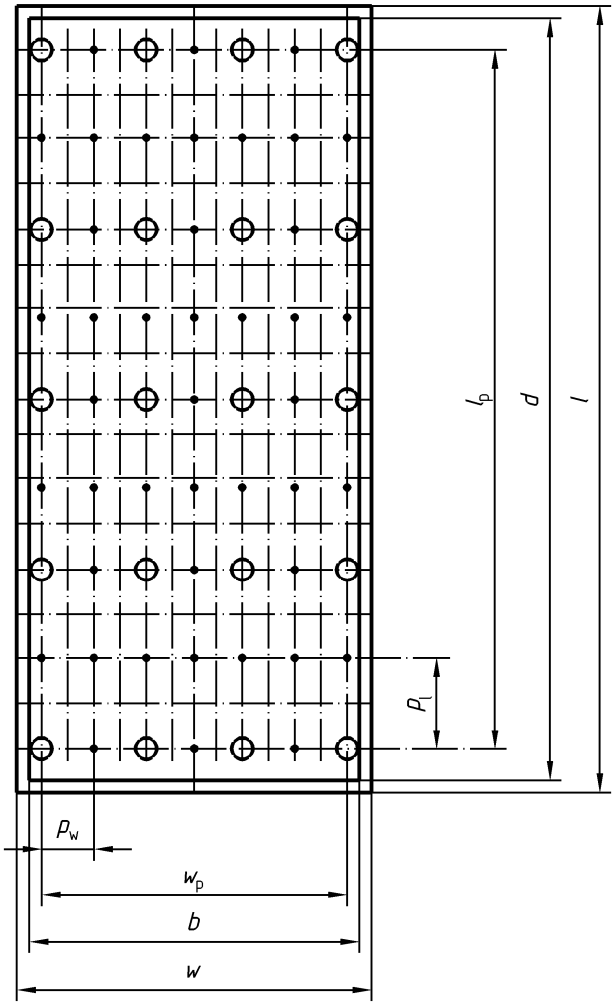
Where there are several marked playing areas within a total area (e.g. multi-use sports hall) a calculation and measurement over the whole area can be made, using the dimensions of this whole area to determine the number of grid points according to the formula in 5.1.2. However checks should be performed 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).

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. It is therefore recommended that a reduced number of points are taken and measured values compared to calculation at these 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 and Figure 2 with encircled points.

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

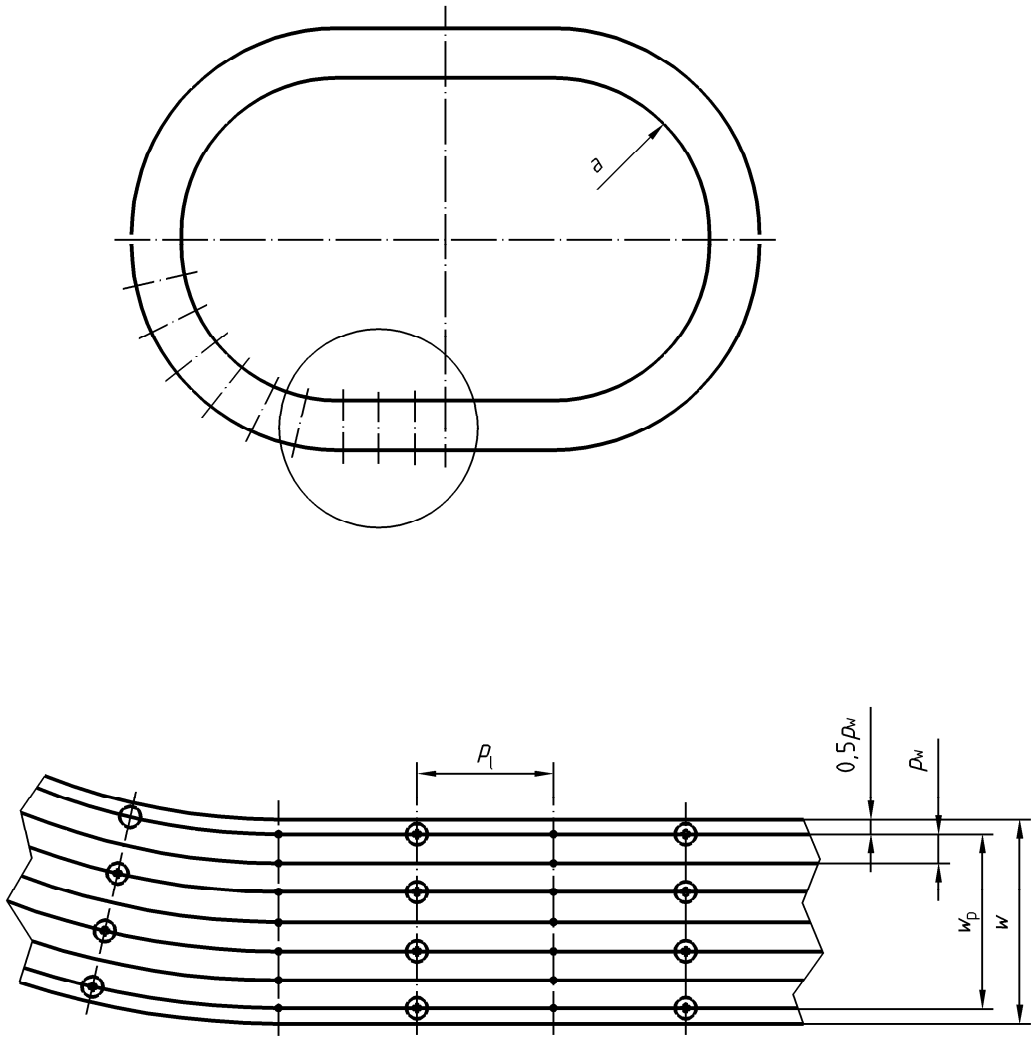
The average illuminance is determined as the mean arithmetical value obtained from all the points. For new installations the calculation of the initial illuminances have to be compared to actual measurements. The initial illuminances are calculated from the maintained illuminances given in the tables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



Key

p_w Calculation grid increment widthwise
b Width of the principal area PA
p_l Calculation grid increment lengthwise
d Length of the principal area PA
w Width of the reference area
w_p Calculation grid width
l Length of the reference area
l_p Calculation grid length
• Calculation point
⊙ Calculation and measurement point

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



Key

a Inner limit of the track
w Width of the track
w_p Calculation grid width
p_l Calculation grid increment lengthwise
p_w Calculation grid increment widthwise
• Calculation point
⊙ Calculation and measurement point

Figure 2 – Reference area, calculation grid points and an example of measurement grid points for a track

5.2 Measuring equipment

The selection of appropriate measuring equipment is important for correct measurement.

NOTE Details of the performance requirements for photometric equipment are given in CIE Publication 69.

5.3 Measurement record

The following details shall be included in the photometric measuring record:

a) nomenclature of the sports ground;

b) date and time of measuring;

c) type of installation and geometric details of luminaires installation;

d) type and number of lamps, control gear, dimmers and luminaires where relevant;

e) age of the luminaires and lamps; number of hours the lamps have operated;

f) time of the last cleaning and number of hours the lamp have operated since this last cleaning;

g) operating voltage while measuring:

- if the operating voltage differs from the nominal voltage of the lamp while measuring, a correction factor for the luminous flux has to be considered;
- operating voltage has to be measured close to the lamps or the ballasts for discharge lamps;

h) ambient temperatures of the measuring units and luminaires;

i) indication of reflectance of the bordering surfaces (in case of interiors);

j) climatic conditions in case of exterior installations;

k) type of measuring unit, manufacturer, serial number, class, calibration;

l) note the location and aiming of any luminaires that are abnormally not operating during the survey.

5.4 Tolerated differences

A difference between the measured and calculated values is likely to occur as a result of:

a) tolerances in manufacturing luminaires, lamps, etc.;

b) tolerances in the photometric measurements;

c) tolerances in position and aiming of luminaires.

Taking these tolerances into account, the differences between the measured and calculated average values shall be ≤ 10 %. Additional differences can be caused by voltage variation, which have to be taken into account.

Verification procedures:

— verification shall be by measurements, calculations or inspection of authenticated data.

— measurements (E values) shall be made with calibrated instruments.

— authenticated data (R_a, GR, UGR, TI, I, ULR) shall be provided with all assumptions declared.

5.5 Maintenance

The lighting level provided by a lighting installation will decrease throughout life as a result of:

— depreciation of the lamps and the luminaires;

— dirt accumulation on the lamps and the luminaires;

— depreciation of room surfaces;

— lamp's survival rate.

Planning the maintenance operation is therefore essential if the original design parameters are to be met throughout the life of the installation. As such, it is expected that lamp change and cleaning intervals will form a part of the lighting design for a specific area.

The maintenance factor shall be agreed between the designer and customer at the outset. This shall include the planned maintenance programme on which the maintenance factor is based.

NOTE To define the maintenance factor information can be taken from CIE Publication 97:2005 for indoor installations and from CIE Publication 154:2003 for outdoor installations.

Special consideration shall be given to the location of luminaires to ensure that maintenance can be carried out with the minimum of disruption.

5.6 Spectator area lighting

For the visual comfort of spectators rather than safety or emergency reasons, the lighting level shall be at least 10 lx.

5.7 Safety for participants and the continuation of an event in case of lighting failure

5.7.1 Safety lighting for participants

Participant safety is ensured by the safe stopping of an event which might otherwise be dangerous to continue in the absence of lighting.

The lighting level for the safe stopping of an event is a percentage of the level for that class (see 6.1). This applies to the following sports and percentages listed below:

— swimming	5% for a minimum period of 30 s
— indoor gymnastics	5% for a minimum period of 30 s
— indoor and outdoor equestrian	5% for a minimum period of 120 s
— speed skating	5% for a minimum period of 30 s
— bobsleigh and toboggans	10% for a minimum period of 120 s

— ski jump and landing	10% for a minimum period of 30 s
— ski slopes	10% for a minimum period of 30 s
— cycle racing	10% for a minimum period of 60 s

The safety lighting shall come on the instant the general lighting fails and last for at least the period specified.

5.7.2 Continuation of a sport

For continuation of a sport, the lighting level shall be at least the Class III level specified for that sport (see tables of Annex A).

5.8 Glare restriction

5.8.1 General

Glare shall be limited to avoid a reduction in visual performance.

5.8.2 Indoor

NOTE 1 Some measures for limiting glare may be taken from CIE Publication 117.

Measures for limiting glare have been developed for working areas mainly with a horizontal viewing direction and a regular layout of ceiling mounted luminaires. It may be necessary, therefore, to take additional measures for limiting glare in indoor sports facilities, depending on the type of sports.

NOTE 2 For example, the risk of glare caused by high brightness light sources in the player's field of view at some critical point in the game, can require special attention to the positioning and screening of light sources to avoid this effect. On the other hand, the viewing direction of a sports participant is constantly changing, whereas in working areas, discomfort glare is aggravated by a relatively fixed viewing position and direction. In indoor sports facilities however, there can be frequently occurring viewing directions for some sports, where discomfort glare should be limited as far as possible. For these sports, additional notes are added to the tables of requirements in Annex A.

In situations similar to working conditions described in EN 12464, glare should be evaluated using the unified glare rating (UGR) method. The limiting value shall be equivalent to those specified in EN 12464-1.

5.8.3 Outdoor

Glare rating values (GR) used in the tables of requirements in Annex A apply. The glare rating shall be calculated for agreed observer positions and angles of view.

NOTE CIE Publication 112 has been taken into account to define the GR values for most sports.

$$GR = 27 + 24 \log\left(\frac{L_{\mathrm{vl}}}{L_{\mathrm{ve}}^{0,9}}\right) \qquad (2)$$

where

L_{vi} is the total veiling luminance in cd m^{-2} caused by the lighting installation and is the sum of the veiling luminances produced by each individual luminaire ($L_{\mathrm{vl}} = L_{\mathrm{vl}} + L_{\mathrm{v2}} + \ldots. L_{\mathrm{vn}}$). The veiling luminance of the individual luminaires is calculated as $L_{\mathrm{v}} = 10(E_{\mathrm{eAuge}}/\theta^2)$, in which E_{eye} is the illuminance at the observer's eye in a plane perpendicular to the line of sight (2 ° below horizontal) and θ is the angle between the observer's line of sight and the direction of the light incident from the individual luminaire.

L_{ve} is the equivalent veiling luminance of the environment in cd m^{-2}. From the assumption that the reflection of the environment is totally diffuse, the equivalent veiling reflection from the environment may be calculated as $L_{ve} = 0{,}035.\rho.E_{hav}.\pi^{-1}$, in which ρ represents the average reflectance and E_{hav} the average illuminance of the area.

5.9 Surface colours and reflection properties

Surface colours shall be chosen taking into account the usual tasks involved in the intended activities including knowledge of the colours of objects to be viewed against the background in question.

NOTE These surfaces should be matt to avoid glare due to the reflection of bright sources.

5.10 Obtrusive light

To safeguard and enhance the night time environment it is necessary to control obtrusive light, which can present physiological and ecological problems to surroundings and people.

The limits of obtrusive light for exterior lighting installations, to minimise problems for people are given in Table 1 and for road users in Table 2.

Table 1 – Maximum obtrusive light permitted for exterior lighting installations

Environmental zone	Light on properties		Luminaire intensity		Upward light
	E_v lx		I cd		ULR
	Pre-curfew[a]	Post-curfew	Pre-curfew	Post-curfew	%
E1	2	0	2 500	0	0
E2	5	1	7 500	500	5
E3	10	2	10 000	1 000	15
E4	25	5	25 000	2 500	25

[a] In case no curfew regulations are available, the higher values shall not be exceeded and the lower values should be taken as preferable limits.

E1 represents intrinsically dark areas, such as national parks or protected sites;

E2 represents low district brightness areas, such as industrial or residential rural areas;

E3 represents medium district brightness areas, such as industrial or residential suburbs;

E4 represents high district brightness areas, such as town centres and commercial areas;

E_v is the maximum value of vertical illuminance on properties in lx;

I is the light intensity of each source in the potentially obtrusive direction in cd;

ULR is the proportion of the flux of the luminaire(s) that is emitted above the horizontal, when the luminaire(s) is (are) mounted in its (their) installed position and attitude.

Table 2 – Maximum values of threshold increment from sports lighting installation

Light technical parameter		Road classification[a]		
	No road lighting	M5	M4/M3	M2/M1
TI[b]	15% based on adaption luminance of 0.1 cd m^{-2}	15% based on adaption luminance of 1 cd m^{-2}	15% based on adaption luminance of 2 cd m^{-2}	15% based on adaption luminance of 5 cd m^{-2}
Limits apply where users of transport systems are subject to a reduction in the ability to see essential information. Values given are for relevant positions and for viewing directions in the path of travel. Table 5.2 in CIE 150:2003 gives corresponding values for the veiling luminance L_v.				
[a] Road lighting classification as given in CIE 115-1995. [b] *TI*-calculation as given in EN 13201-3.				

6 Requirements for the lighting of sports most practised in Europe

6.1 General requirements

Annex A contains 28 tables of requirements to which, in addition, the following general points apply.

a) All illuminances quoted in the tables are maintained and apply to the principal area (PA).

   Furthermore, when total areas (TA) are specified in the tables, their illuminance requirements shall additionally be a minimum of 75 % of those of the principal area (PA) of the sport being considered.

b) In multi-purpose halls better colour rendering than that stated in the tables can be required to reveal the pitch markings.

c) Reference area dimensions are rounded and given only as an indication in order to determine the number of grid points. For exact dimensions the individual sporting federation should be contacted. For some sports there is a variation in the dimensions of the playing area that affects the number of grid points. Typical minimum and maximum dimensions are shown in the tables together with the corresponding number of points.

d) Tables of requirements are based primarily on the needs of the participants. It is necessary to ensure a minimum vertical component. This shall not be less than 30 % of the horizontal level.

e) It is important that the standard of play and spectator viewing distance are both taken into account in selecting the class of lighting to be used. The higher the standard of play and the longer the spectator viewing distance, the higher the class of lighting that shall be selected.

f) Semi-cylindrical illuminances can also be taken into account but no guidance levels have been provided as actual values will be dependant on both viewing positions and type of installation.

The following explanations and Table 3 assist in the selection of the lighting class.

Lighting Class I: Top level competition such as international and national competition which will generally involve large spectator capacities with long potential viewing distances. Top level training can also be included in this class.

Lighting Class II: Mid level competition such as regional or local club competition which generally involve medium size spectator capacities with medium viewing distances. High level training can also be included in this class.

Lighting Class III: Low level competition such as local or small club competition which generally do not involve spectators. General training, physical education (school sports) and recreational activities will also come into this category.

Table 3 – Selection of the lighting class

Level of competition	Lighting class		
	I	II	III
International and National	*		
Regional	*	*	
Local	*	*	*
Training		*	*
Recreational/School sports (Physical education)			*

6.2 Requirements per sport

Table 4 lists the main sports practised in Europe which are included in this standard. For each sport a key number is given referring to the table of requirements of Annex A and a letter A, B or C referring, when applicable, to the group of sports for colour TV transmission (CTV) and film systems as defined in 6.3.2.

Table 4 – List of sports (in alphabetic order)

SPORT		TABLE	CTV GROUP
Aerobics	Indoor	A.3	B
American football	Outdoor	A.21	B
Archery	Indoor	A.5	A
	Outdoor	A.15	A
Athletics (all activities)	Indoor	A.3	A
	Outdoor	A.13	A
Badminton	Indoor	A.1	B
Bandy	Outdoor	A.19	C
Baseball	Outdoor	A.14	B
Basketball	Indoor	A.2	B
	Outdoor	A.21	B
Beach volley	Outdoor	A21	B
Billiards	Indoor	A.11	A
Bobsleigh, Luge and Tobogganing	Outdoor	A.28	
Boccia	Indoor	A.8	A
	Outdoor	A.20	A
Boules	Indoor	A.8	A
	Outdoor	A.20	A
Bowling (10 pin/9 pin)	Indoor	A.5	A
Bowls (flat and short mat)	Indoor	A.9	A
Boxing	Indoor	A.10	C

"to be continued"

Table 4 *(continued)*

SPORT		TABLE	CTV GROUP
Cricket	Indoor	A.1	C
	Outdoor	A.14	C
Cricket nets	Indoor	A.1	C
Curling	Indoor	A.12	A
	Outdoor	A.12	A
Cycle racing	Indoor	A.2	B
	Outdoor	A.18	B
Dancing (aerobics/keep fit)	Indoor	A.3	B
Darts	Indoor	A.7	A
Equestrian	Indoor	A.3	A
	Outdoor	A.13	A
Fencing	Indoor	A.1	C
Fistball	Indoor	A.2	B
	Outdoor	A.21	B
Floorball	Indoor	A.2	B
	Outdoor	A.21	B
Football (5/6-a-side)	Indoor	A.2	B
Football (Association)	Outdoor	A.21	B
Five a side (see Football indoor)			
Go cart	Indoor	A2	B
	Outdoor	A18	B
Golf driving range	Outdoor	A.26	
Gymnastics	Indoor	A.3	B
Handball	Indoor	A.2	B
	Outdoor	A.21	B
Hockey	Indoor	A.1	B
	Outdoor	A.22	B
Horse racing	Outdoor	A.24	B
Horse shows (see Equestrian)			
Ice hockey	Indoor	A.1	C
	Outdoor	A.19	C
Ice sport artistic	Indoor	A.1	B
Judo	Indoor	A.2	B
Korfball	Indoor	A.2	B
Luge and Bobsleigh	Outdoor	A.28	
Martial arts	Indoor	A.2	B
Netball	Indoor	A.2	B
	Outdoor	A.21	B

"to be continued"

Table 4 *(end)*

SPORT		TABLE	CTV GROUP
Pétanque	Indoor	A.8	
	Outdoor	A.20	
Racketball	Indoor	A.1	C
Roller skating	Indoor	A.3	B
Rugby	Outdoor	A.21	B
Running (street/cross country)	Outdoor	A.17	
Rhythmic gymnastics	Indoor	A.3	B
School sports		A.2	
Shooting	Indoor	A.5	A
	Outdoor	A15	A
Skiing: Alpine/freestyle/jumps	Outdoor	A.23	
Skiing: Cross country	Outdoor	A.17	
Snooker	Indoor	A.11	A
Soccer (see Football)			
Softball	Outdoor	A.25	C
Speed skating	Indoor	A.3	B
(400 m and short track)	Outdoor	A.13	B
Squash	Indoor	A.1	C
Swimming (all activities)	Indoor	A.6	A
	Outdoor	A.27	A
Table tennis	Indoor	A.1	C
Tennis	Indoor	A.4	B
	Outdoor	A.16	B
Tobogganing (see Bobsleigh/Luge)			
Tug of war	Outdoor	A.21	B
	Indoor	A2	B
Volleyball	Indoor	A.2	B
	Outdoor	A.21	B
Wall climb	Indoor	A.3	A
Weight lifting	Indoor	A.2	A
Wrestling	Indoor	A.2	B

6.3 Specific requirements for colour television and film recording

6.3.1 Vertical illuminance

The illuminance on a vertical plane forms the basis of the lighting requirements for CTV and film systems.

Where vertical illuminance is determined calculation points shall be as specified in the tables of lighting requirements in Annex A, on grid points at 1 m height (default value).

When the main camera has an undefined position somewhere in an area bordering one of the side-lines of say a football pitch, the illuminances on vertical planes facing that side line shall fulfil the requirements for level and uniformity.

On the rare occasions when only one fixed main camera position is defined, it is possible to take the vertical planes on which the requirements shall be fulfilled as those facing the main camera position.

In the case of an unrestricted choice of camera position, the illuminances on vertical planes facing all four sides of the pitch shall be taken into account.

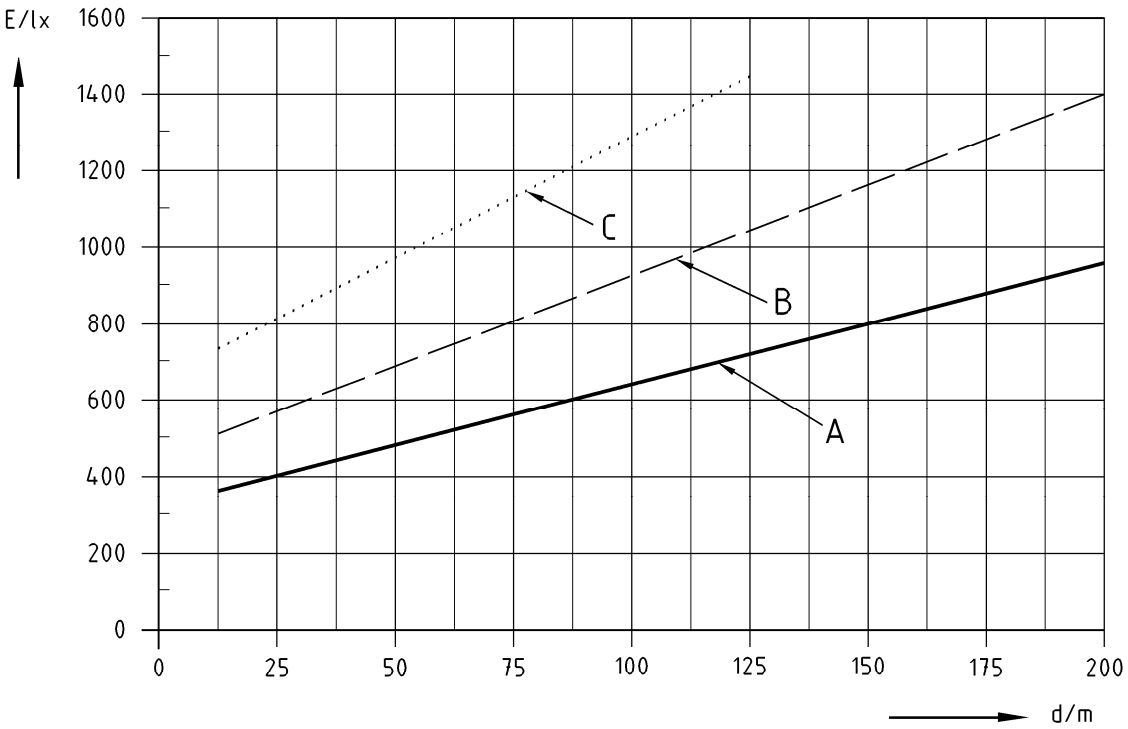
NOTE Where the reference area is not a simple shape like a rectangular football pitch, (e. g. tracks) the orientation of the vertical plane(s) facing the camera position(s) should be decided according to the general principles described in CIE Publication 67.

6.3.2 Level of vertical illuminance

The levels of vertical illuminance depend mainly upon the speed of action, the shooting distance and the lens angle.

Sports can be divided into three groups, A, B and C characterized mainly by the speed of the action occurring during camera shots and the dimension of the object. These CTV groups are defined in the list of 6.2 (see Table 4).

The knowledge of the maximum shooting distance and the CTV group, for the sport envisaged, allows the corresponding maintained vertical illuminance given in Figure 3 to be determined. This graph is not suitable for situations where slow motion recordings are regularly made. In such situation higher lighting levels are needed.



Key
A, B, C CTV groups defined in Table 4.

Figure 3 – Maintained vertical illuminance level as a function of maximum shooting distance

6.3.3 Uniformity of vertical illuminance

6.3.3.1 Uniformity on planes facing a side-line or a fixed main camera position

The vertical illuminance uniformity on planes facing a side-line bordering a main camera area or facing a fixed main camera position shall be:

$$\frac{E_{\text{v min}}}{E_{\text{v max}}} \geq 0{,}4 \tag{3}$$

where

$E_{\text{v min}}$ is the minimum vertical illuminance, in lx;

$E_{\text{v ma}}$ is the maximum vertical illuminance, in lx.

6.3.3.2 Uniformity on vertical planes at a grid point

The uniformity of vertical illuminance at a single grid point over the four planes facing the sides of the playing area shall be:

$$\frac{E_{\text{v min}}}{E_{\text{v max}}} \geq 0{,}3 \tag{4}$$

where

$E_{\text{v min}}$ is the minimum vertical illuminance, in lx;

$E_{\text{v max}}$ is the maximum vertical illuminance, in lx.

6.3.4 Relation between horizontal and vertical illuminance

As the illuminated field forms a major part of the field of view of the camera, an adequate horizontal illuminance is important. A sufficiently good balance between the horizontal and vertical lighting levels is obtained when the average horizontal illuminance to the average vertical illuminance (relative to each of the main camera areas or main camera positions) is such that:

$$0{,}5 \leq \frac{E_{\text{h ave}}}{E_{\text{v ave}}} \leq 2 \tag{5}$$

where

$E_{\text{h ave}}$ is the horizontal average illuminance, in lx;

$E_{\text{v ave}}$ is the vertical average illuminance, in lx.

6.3.5 Uniformity of horizontal illuminance

The uniformity of the horizontal illuminance on the playing field shall be:

$$\frac{E_{\mathrm{h\,min}}}{E_{\mathrm{h\,max}}} \geq 0{,}5 \qquad (6)$$

where

$E_{\mathrm{h\,min}}$ is the minimum horizontal illuminance, in lx;

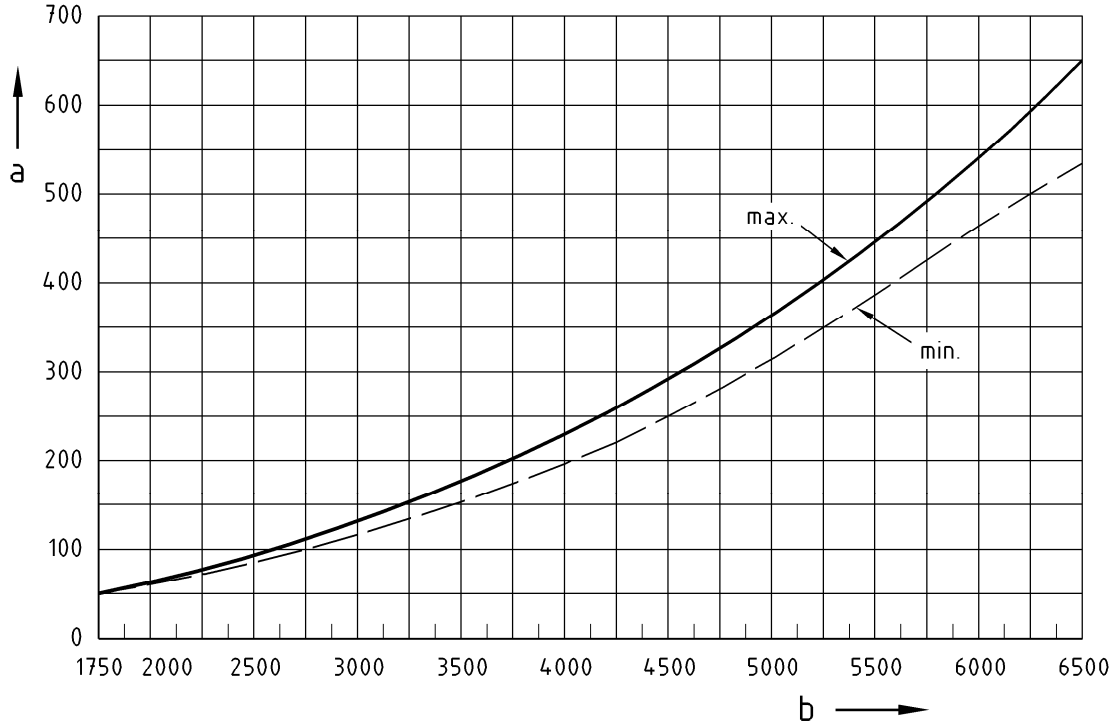
$E_{\mathrm{h\,max}}$ is the maximum horizontal illuminance, in lx.

It is also important that there is not too great a change in horizontal illuminance over a given distance. For example on large playing fields such as football pitches the maximum gradient of horizontal illuminance shall be not greater than 25 % change per 5 m.

6.3.6 Colour temperature of the lighting

In the case of outdoor installations or indoor installations with a significant daylight contribution, the colour temperature of the artificial lighting shall be between 4 000 K and 6 500 K where floodlighting is used during daylight and into dusk. If there is no significant daylight contribution then the range can be extended to between 3 000 K and 6 500 K.

Within the reference area of an installation the colour-temperature shall not deviate from the average value by more than the stated plus and minus limits given in Figure 4.



Key

a Deviation in K

b Colour temperature in K

Figure 4 – Colour temperature tolerances within the reference area

6.3.7 Colour rendering of the lighting

The general colour rendering index R_a of the lighting shall always be better than 65 with a preferred value of at least 80.

6.3.8 Light level on surrounding spectators' areas

NOTE For television camera shooting it is desirable that the areas bordering the playing field should be illuminated to a certain extent; namely to an average vertical illuminance level of at least 0,25 times the average vertical illuminance level on the playing area.

Annex A
(normative)

Tables of requirements

All dimensions of the areas – total area and principal area – listed in Tables A.1 to A.28 are meant as typical information only (see 3.1).

Table A.1

Indoor	Reference Area		Number of grid points	
	Length	Width	Length	Width
	m	m		
Badminton (see NOTE 1) PA:	13,4	6,1	11	5
TA (max):	18	10,5	11	7
Cricket PA:	32	20	15	9
Cricket nets PA:	33	4	15	3
Fencing PA:	14	2	11	3
TA (max):	18	5	11	3
Hockey PA:	40	20	15	7
TA:	44	24	15	7
Ice hockey/Ice sport artistic (see NOTE 3)PA:	60	30	17	9
Racketball (see NOTE 2) PA:	18,3	9,1	11	5
Squash (see NOTE 2) PA:	9,7	6,4	9	5
Table tennis PA:	9	4,5	9	3

Class	Horizontal illuminance		Vertical illuminance (Fencing only)		Horizontal illuminance (Cricket nets)		R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	
I	750	0,7	500	0,7	1 500	0,8	60
II	500	0,7	300	0,7	1 000	0,8	60
III	300	0,7	200	0,7	750	0,8	20

NOTE 1 No luminaires should be positioned in that part of the ceiling which is above the principal area.

NOTE 2 Lights running within 1 m of the side wall should be avoided.

NOTE 3 For mounting heights below 8 m ratio E_{min}/E_{max} should be greater than 0,5. For Class III the uniformity can be relaxed to 0,5.

Table A.2

Indoor			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Basketball (see NOTE 1)	PA		28	15	13	7
	TA		32	19	15	9
Cycle racing (see NOTES 2 and 3 and Figure 2) 250 m	PA		62,5	7	17	3
333,3 m	PA		83,33	7	19	3
Fistball	PA		50	20	17	7
	TA		66	32	17	9
Floorball	PA		40	20	15	7
	TA		43	22	15	7
Football (5/6-a-side)	PA		30 to 40	18,5 to 20	13 to 15	9
	TA (max)		44	24	15	9
Go cart			-	-	-	-
Handball	PA		40	20	15	7
	TA		44	24	15	9
Judo	PA		10	10	11	11
	TA		17	17	11	11
Korfball (see note 1)	PA		40	20	15	7
	TA		44	24	15	9
Martial arts Kendo	PA		11	11	11	11
Karate	PA		8	8	9	9
	TA		11	11	11	11
Netball (see NOTE 1)	PA		30,5	15,3	13	7
	TA		37,5	22,5	15	9
School sports (Physical education) (see NOTE 5)			-	-	-	-
Tug of War			-	-	-	-
Volleyball (see NOTE 4)	PA		24 (see NOTE 6)	15	13 (see NOTE 6)	9
Weight lifting	PA		4	4	7	7
	TA		6	6	9	9
Wrestling	PA		9	9	9	9
	TA		12	12	11	11
Class	Horizontal illuminance					R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	750	0,7				60
II	500	0,7				60
III	200	0,5				20

NOTE 1 No luminaires should be positioned in that part of the ceiling, which is above a 4 m diameter circle around the basket.

NOTE 2 Illuminance is taken on the surface of the track.

NOTE 3 The vertical illuminance at the finishing line should be 1 000 lx for photo-finish equipment and officials.

NOTE 4 No luminaires should be positioned in that part of the ceiling, which is directly above at least the net area.

NOTE 5 Dimensions and grid sizes depend on the specific sport.

NOTE 6 For Class I, international competition at top level may justify a surface of 34 m x 19 m for the principal area (PA). The corresponding number of grid points is then 15 x 9.

Table A.3

			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Aerobics			–	–	–	–
Athletics (see NOTE) Track 200 m PA:			50	4,9 to 9,8	17	3
Field PA:			85 to 93	30 to 42	19	7 to 9
Dancing			–	–	–	–
Equestrian Jumping PA:			60	40	17	11
Dressage PA:			70	30	19	9
Gymnastics PA:			32 to 50	22,5 to 25	15 to 17	9
Roller skating PA:			40	20	15	9
Rhythmic gymnastics PA:			14	14	11	11
Speed skating Short Track PA:			50	6	17	3
400 m PA:			100	8	21	3
Wall climb			–	–	–	–
Class	Horizontal illuminance		Vertical illuminance (Wall climb)			R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$		
I	500	0,7	500	0,7		60
II	300	0,6	300	0,6		60
III	200	0,5	200	0,5		20

NOTE Glare cannot be quantified. It can however be controlled by careful positioning of luminaires e. g. over pole vault area. The vertical illuminance at the finishing line should be 1 000 lx for photo-finish equipment and officials.

Table A.4

Indoor (see NOTE)			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Tennis PA:			36	18	15	7
Class	Horizontal illuminance					R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	750	0,7				60
II	500	0,7				60
III	300	0,5				20

NOTE No luminaires should be positioned in that part of the ceiling which is directly above the area limited by the rectangle of the marked area extended to 3 m behind the base lines.

Table A.5

Indoor			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Archery	Shooting lane	PA	18 to 30	1,3	11 to 15	1
	Target		–	–	–	–
Shooting	Firing line	PA	25	1	13	1
	Target		–	–	–	–
Ten Pin Bowling	Approach and lanes	PA	18,3	1	11	1
	Bowling pins		–	–	–	–

Class	Horizontal illuminance Firing and shooting lines Approach and lanes		Vertical illuminance				R_a
			Pins	Target		Pins/Target	
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$\bar{E}_m$ lx 25 m	$\bar{E}_m$ lx 50 m	$E_{min}/\bar{E}_m$	
I	200	0,5	500	1 000	2 000	0,8	60
II	200	0,5	500	1 000	2 000	0,8	60
III	200	0,5	500	1 000	2 000	0,8	60

Table A.6

Indoor			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Swimming (see NOTE 1)	Diving	PA:	15	10,5	11	7
	Racing (see NOTE 2)	PA	25 to 50	15 to 22	13 to 17	7
	Polo (see NOTE 2)	PA	20 to 30	15 to 20	13 to 15	9 to 11
	Synchronised	PA	25	15	13	7

Class	Horizontal illuminance		Diving-Additional requirement			R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$E_{h\,ave}/E_{v\,ave}$			
I	500	0,7	0,8			60
II	300	0,7	0,5			60
III	200	0,5	0,5			20

NOTE 1 The above are general requirements only. Special requirements can be needed for individual pools.

NOTE 2 No underwater lighting should be used.

Table A.7

Indoor				Reference Area		Number of grid points	
				Length	Width	Length	Width
				m	m		
Darts	Target			–	–	–	–
	Oche	PA:		3,7	2	7	3
Class		Horizontal illuminance on Oche		Vertical illuminance on Target			R_a
		$\bar{E}_m$ lx		$\bar{E}_m$ lx			
I		200		750			60
II		100		500			60
III		50		300			20

Table A.8

Indoor				Reference Area		Number of grid points	
				Length	Width	Length	Width
				m	m		
Boccia		PA:		12,5	6	11	5
Pétanque and Boules		PA:		17,5 to 28	2,5 to 4	11 to 13	3
Class	Horizontal illuminance						R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$					
I	300	0,7					60
II	200	0,7					60
III	200	0,5					20

Table A.9

Indoor				Reference Area		Number of grid points	
				Length m	Width m	Length	Width
Bowls (Short mat) (See NOTE 1) PA:				13,7 to 40	1,8 to 4,5	11 to 15	3
Class	Horizontal illuminance						R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$					
I	500	0,8					60
II (see NOTE 2)	500	0,8					60
III (see NOTE 2)	300	0,5					20
NOTE 1 A banding effect can occur with low mounting heights due to reflectance from the mat. The illuminance gradient should therefore be less than 5% per metre.							
NOTE 2 For purpose built facilities the values for Class I can be applied in all classes.							

Table A.10

Indoor			Reference Area		Number of grid points	
			Length m	Width m	Length	Width
Boxing	PA		7,1 to 11,1	7,1 to 11,1	9 to 11	9 to 11
Class	Horizontal illuminance Ring		Vertical illuminance Ring	Horizontal illuminance Training areas		R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx			
I	2 000	0,8	(see NOTE)	300		80
II	1 000	0,8		300		80
III	500	0,5		300		60
NOTE $E_{v\ ave}$ should be at least 50% of $E_{h\ ave}$.						

Table A.11

Indoor (see NOTE)			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Billiards	PA:		3	1,6	7	3
	TA:		7	5	9	7
Snooker	PA:		3,6	1,8	7	3
	TA :		8	6	9	7
Class	Horizontal illuminance					R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	750	0,8				80
II	500	0,8				80
III	500	0,8				80
NOTE The ratio of $\bar{E}_m$ (TA) to $\bar{E}_m$ (PA) can be relaxed to 0,5.						

Table A.12

Indoor /Outdoor			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Curling	House	PA:	5	4,3	9	7
	Rink	PA:	38,5 to 46,5	4,3 to 4,75	15	3
Class	Horizontal illuminance House		Horizontal illuminance Rink			R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$		
I	300	0,7	200	0,7		60
II	300	0,7	200	0,7		60
III	300	0,7	200	0,7		60

Table A.13

Outdoor			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Athletics (all activities) (see NOTES 1 and 4)	track 400 m	PA:	100	4,9 to 9,8	21	3
	field	PA:	150	80	23	13
Equestrian	Jumping	PA:	110	55	21	11
	Dressage	PA:	65	25	17	7
Speed skating:(see NOTES 2 and 4)	Short track	PA:	50	6	17	3
	400 m PA:	PA:	100	8	21	3

Class	Horizontal illuminance				GR	R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	500	0,7			50	60
II	200	0,5			55	60
III	100 (see NOTE 3)	0,5			55	20

NOTE 1 For discus, javelin and hammer special precautions should be taken to ensure the safety of persons within the stadium since the object being thrown may travel above the line of light and hence be invisible during part of their flight.

NOTE 2 For Class II the colour rendering index limit can be reduced to 20.

NOTE 3 Horizontal illuminance can be reduced to 50 lx for running events.

NOTE 4 The vertical illuminance at the finishing line should be 1 000 lx for photo-finish equipment and officials.

Table A.14

Outdoor			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Baseball	Infield	PA:	27,5	27,5	13	13
	Outfield (see NOTE)	PA:	120	120	21	21
Cricket	Square	PA:	27,4	27,4	13	13
	field	PA:	120	120	21	21

Class	Horizontal illuminance (square/infield)		Horizontal illuminance (field/outfield)		GR	R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$		
I	750	0,7	500	0,5	50	60
II	500	0,7	300	0,5	50	60
III	300	0,5	200	0,3	55	20

NOTE When grid points are outside the playing area they are not included in the calculation.

Table A.15

Outdoor		Reference Area		Number of grid points	
		Length m	Width m	Length	Width
Archery	Shooting lane	–	–	–	–
	Target	–	–	–	–
Shooting	Shooting lane	–	–	–	–
	Target	–	–	–	–

Class	Horizontal illuminance Shooting		Vertical illuminance Target			R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$		
I	200	0,5	750	0,8		60
II	200	0,5	750	0,8		60
III	200	0,5	750	0,8		60

Table A.16

Outdoor		Reference Area		Number of grid points	
		Length m	Width m	Length	Width
Tennis	PA:	36	18	15	7

Class	Horizontal illuminance				GR	R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	500	0,7			50	60
II	300	0,7			50	60
III	200	0,6			55	20

Table A.17

Outdoor			Reference Area		Number of grid points	
			Length m (See NOTE)	Width m	Length (see NOTE)	Width
Running Street /Cross Country				4	11	3
Skiing Cross Country				4	11	3
Class	Horizontal illuminance					R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	20	0,3				20
II	10	0,3				20
III	3	0,1				–
NOTE Between luminaires.						

Table A.18

Outdoor			Reference Area		Number of grid points	
			Length m	Width m	Length	Width
Cycle racing (NOTE and Figure 2)	250 m 333,3 m	PA: PA:	62,5 83,33	4,3 to 4,75 4,3 to 4,75	17 19	3 3
Go Carting			-	-	-	-
Class	Illuminance on track surface				GR	R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	500	0,7			50	60
II	300	0,7			50	60
III	100	0,5			55	20
NOTE The vertical illuminance at the finishing line should be 1000 lx for photo-finish equipment and officials.						

Table A.19

Outdoor			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Bandy (see NOTE) PA:			100	60	21	13
TA:			110	64	21	13
Ice hockey PA:			60	30	17	9
Class	Horizontal illuminance					R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	750	0,7				60
II	500	0,7				60
III	200	0,5				20
NOTE For Bandy colour rendering index should be above 20 for all classes.						

Table A.20

Outdoor			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Boccia	PA:		12,5	6	11	5
Pétanque and Boules	PA:		17,5 to 28	2,5 to 4	11 to 13	3
Class	Horizontal illuminance				GR	R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	200	0,7			50	60
II	100	0,7			50	20
III	50	0,5			55	20

Table A.21

Outdoor		Reference Area		Number of grid points	
		Length	Width	Length	Width
		m	m		
American football	PA:	110 to 117,5	55	21	9 to 11
Basketball	PA:	28	15	13	7
	TA:	32	19	15	9
Fistball	PA:	50	20	17	7
	TA:	66	32	17	9
Floorball PA:	PA:	40	20	15	7
	TA:	43	22	15	7
Football	PA:	100 to 110	64 to 75	19 to 21	13 to 15
	TA:	108 to 118	72 to 83	21	13 to 15
Tug of War		-	-	-	13 to 15
Handball	PA:	40	20	15	7
	TA:	44	27,5	15	9
Netball PA:	PA:	30,5	15,3	13	7
	TA:	37,5	22,5	15	9
Rugby	PA:	144	69	23	11
	TA:	154	79	23	11
Volleyball	PA:	24 (see NOTE)	15	13 (see NOTE)	9
Beach Volleyball					

Class	Horizontal illuminance				GR	R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	500	0,7			50	60
II	200	0,6			50	60
III	75	0,5			55	20

NOTE For Class I, international competition at top level may justify a surface of 34 m x 19 m for the principal area (PA). The corresponding number of grid points is then 15 x 9.

Table A.22

Outdoor			Reference Area		Number of grid points	
			Length	Width	Length	Width
			m	m		
Hockey	PA:		91,4	55	19	11
	TA:		101,4	63	21	13
Class	Horizontal illuminance				GR	R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$				
I	500	0,7			50	60
II	200	0,7			50	60
III	200	0,7			55	20

Table A.23

Outdoor see NOTE 1					Reference Area		Number of grid points	
					Length	Width	Length	Width
					m	m	(see NOTE 3)	(see NOTES 4 and 5)
Skiing	Alpine/freestyle				–	–	11	5
	Jumps	Run down	(see NOTE 2)		–	–	5	1
		Landing			–	–	11	5
Class	Illuminance Alpine/freestyle		Illuminance Jump run down		Illuminance Jump landing		GR	R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$		
I	100	0,5	150	0,5	300	0,7	50	20
II	30	0,3	50	0,3	200	0,6	50	20
III	20	0,2	20	0,3	200	0,6	55	-

NOTE 1 All illuminances are measured on the surface.

NOTE 2 At the point of take off, the illuminance should be the same as the landing.

NOTE 3 The distance between the grid points in length should be:

— for the run down: 2 m or less;

— for the landing area: 5 m or less.

NOTE 4 For the run down it is only necessary to have calculation and measuring points on the centre line.

NOTE 5 The retardation area should have at least 30 % the landing area illumination level but without any uniformity requirement.

Table A.24

Outdoor				Reference Area		Number of grid points	
				Length	Width	Length	Width
				m	m		
				see Figure 2 and apply formula			
Horse racing							
Gallup and Trotting	Home stretch	lengthwise	(see NOTE 1)	–	–	–	–
		crosswise		–	–	–	–
	Back stretch	lengthwise		–	–	–	–
		crosswise		–	–	–	–
	Turn	lengthwise		–	–	–	–
		crosswise		–	–	–	–

Class	Horizontal illuminance		Vertical illuminance						GR	R_a
			Home stretch			Back stretch and turn				
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$		$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$			
				Length	Cross		Length	Cross		
I	200	0,6	750	0,6	0,4	500	0,6	0,4	50	60
II	100	0,4	300	0,6	0,4	200	0,6	0,4	50	60
III	50 (see NOTE 2)	0,2	100	0,3	-	-	-	-	55	20

NOTE 1 The vertical illuminance at the finishing line should be 1 000 lx for photo-finish equipment and officials.

NOTE 2 When the horses are under observation, e. g. by Vets, this value should be 100 lx.

Table A.25

Outdoor				Reference Area		Number of grid points	
				Length	Width	Length	Width
				m	m		
Softball	Outfield		PA:	20	20	13	13
	Infield	(see NOTE)	PA:	90	90	19	19

Class	Horizontal illuminance Infield		Horizontal illuminance Outfield		GR	R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$		
I	750	0,7	500	0,5	50	60
II	500	0,7	300	0,5	50	60
III	200	0,5	100	0,3	55	20

NOTE When grid points are outside the playing area they are not included in the calculation.

Table A.26

Outdoor				Reference area		Numbers of grid points	
				Length	Width	Length	Width
				m	m		
Golf driving range	Tee			–	–	–	–
	Marker			–	–	–	–
Class	Horizontal illuminance on Tee			Vertical illuminance on Distance Marker (at 1 m height)			R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$		$\bar{E}_m$ lx			
I	–	–		–			–
II	–	–		–			–
III	100	0,8		50			20

Table A.27

Outdoor				Reference Area		Number of grid points	
				Length	Width	Length	Width
				m	m		
Swimming	Diving		PA:	15	10,5	11	9
(see NOTE 1)	Racing	(see NOTE 2)	PA:	25 to 50	17 to 22	13 to 17	7 to 9
	Polo	(see NOTE 2)	PA:	20 to 30	15 to 20	13	9
	Synchronised		PA:	25	15	13	7
Class	Horizontal illuminance			Diving-Additional requirement			R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$		$E_{h\,ave}/E_{v\,ave}$			
I	500	0,7		0,8			60
II	300	0,7		0,5			60
III	200	0,5		0,5			20

NOTE 1 The above are general requirements only. Special requirements can be needed for individual pools.

NOTE 2 No underwater lighting should be used.

Table A.28

Outdoor	Reference area		Number of grid points	
	Length	Width	Length	Width
	m	m		
Bobsleigh and Luge	50	1,5	17	3
Class	Horizontal illuminance			R_a
	$\bar{E}_m$ lx	$E_{min}/\bar{E}_m$		
I	300	0,7		60
II	200	0,5		20
III	50	0,4		20

Annex B
(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 does not fall under any Directive of the EC.

In the relevant CEN/CENELEC country this A-deviation is valid instead of the provisions of the European Standard until it has been removed.

Clause Deviation:

Annex A **Denmark** (national building regulation BR 1995) Values for the vertical semi-cylindrical illumination method for specific sports are not given in the tables of Annex A, as specified in the Danish Standard DS 707 "Sports facility lighting" where 11 sports categories are listed. DS 707 is part of the national building regulation BR 1995.

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