LICENCE

for

AS 2560.2.3-2007 (R2017) Sports lighting Specific applications - Lighting for football (all codes)

Licensee: WAFC - Facilities Manager 08 9287 5507

Date: 30-Aug-2017

Licence Agreement

This is an agreement between the end user of the Product ("Licensee") and SAI Global Limited, Level 37, 680 George Street, Sydney NSW 2000 AUSTRALIA, ABN 67 050 611 642.

1. Definitions and Interpretations

Australian Standards means Australian Standards and includes Joint ISO/Australian Standards, Joint NZ/Australian Standards, current Draft Australian Standards, and amendments to Australian Standards.

Concurrent Users means the maximum number of people able to access the Product at any one time, and is limited to the number of Licences purchased.

ISO Standards means Standards published by the International Organization for Standardization (ISO), for which SAI Global is an authorised distributor.

IEC Standards means Standards published by the International Electrotechnical Commission (IEC), for which SAI Global is an authorised distributor.

Internal use means use of the Product within the Licensee's organization.

Licence means the right to access and use the Product.

Licensee means the purchaser and user of the Product.

Product means Australian Standards, ISO Standards and IEC Standards ordered and purchased through the infostore, and downloaded as electronic PDF files.

2. Product Availability

2.1. The Product is available via the World Wide Web through the use of a web browser. Documents are provided as PDF files, viewable through the use of the latest version of Adobe Reader®.

3. Licence Agreement

3.1. By using the Product the Licensee agrees to be bound by the Licence Agreement for the Product.

3.2. The Licensee is granted a non-exclusive and non-assignable Licence to use the Product.

Click on the red box above to activate the Licence Agreement scroll bar

- Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation
- Know when a Standard has changed
- Visit our store to find more Publications

AS 2560.2.3—2007
Reconfirmed 2017

AS 2560.2.3—2007

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

Australian Standard®

Sports lighting

Part 2.3: Specific applications—Lighting for football (all codes)

This Australian Standard® was prepared by Committee LG-009, Sports Lighting. It was approved on behalf of the Council of Standards Australia on 26 October 2007.
This Standard was published on 7 December 2007.

The following are represented on Committee LG-009:

- Association of Consulting Engineers Australia
- Australian Electrical and Electronic Manufacturers Association
- Confederation of Australian Sport
- Department of Local Government, Planning, Sport and Recreation, Qld
- Energy Networks Association
- IES: The Lighting Society
- Parks and Leisure Australia
- Sport and Recreation Victoria
- Sport Industry Australia
- Tennis Australia
- Tennis Coaches Australia
- Tennis Court and Sports Field Builders Association of Australia

---

This Standard was issued in draft form for comment as DR 07056.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

Keeping Standards up-to-date

Australian Standards® are living documents that reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued.

Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments that may have been published since the Standard was published.

Detailed information about Australian Standards, drafts, amendments and new projects can be found by visiting **www.standards.org.au**

Standards Australia welcomes suggestions for improvements, and encourages readers to notify us immediately of any apparent inaccuracies or ambiguities. Contact us via email at **mail@standards.org.au**, or write to Standards Australia, GPO Box 476, Sydney, NSW 2001.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

STANDARDS AUSTRALIA

RECONFIRMATION

OF
AS 2560.2.3—2007
Sports lighting
Part 2.3: Specific applications—Lighting for football (all codes)

RECONFIRMATION NOTICE

Technical Committee LG-009 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

Certain documents referenced in the publication may have been amended since the original date of publication. Users are advised to ensure that they are using the latest versions of such documents as appropriate, unless advised otherwise in this Reconfirmation Notice.

Approved for reconfirmation in accordance with Standards Australia procedures for reconfirmation on 16 June 2017.

The following are represented on Technical Committee LG-009:
Australian Football League
Australian Industry Group
Baseball Australia
CIE Australia
Confederation of Australian Sport
Consult Australia
Cricket Australia
Department of National Parks, Recreation, Sport and Racing
IES: The Lighting Society
Lighting Council Australia
Office for Recreation and Sport (SA)
Parks and Leisure Australia
Sports And Play Industry Association
Sports and Recreation Victoria
Tennis Australia

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

NOTES

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

Australian Standard®

Sports lighting

Part 2.3: Specific applications—Lighting for football (all codes)

Originated as AS 2560.2.3—1986.
Previous edition 2002.
Third edition 2007.

COPYRIGHT

© Standards Australia

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher.

Published by Standards Australia GPO Box 476, Sydney, NSW 2001, Australia

ISBN 0 7337 8470 4

PREFACE

This Standard was prepared by the Standards Australia Committee LG-009, Sports Lighting, to supersede AS 2560.2.3—2002, *Sports lighting, Part 2.3: Specific applications—Lighting for football (all codes)*.

When revision of the AS 2560 series of Standards is completed, it will consist of the following:

AS		
2560	Sports lighting	
2560.1	Part 1:	General principles
2560.2.1	Part 2.1	Specific applications—Lighting for outdoor tennis
2560.2.2	Part 2.2:	Specific applications—Lighting of multipurpose indoor sports centres
2560.2.3	Part 2.3:	Specific applications—Lighting for football (all codes) (this Standard)
2560.2.4	Part 2.4:	Specific applications—Lighting for outdoor netball and basketball
2560.2.5	Part 2.5:	Specific applications—Swimming pools
2560.2.6	Part 2.6:	Specific applications—Baseball and softball
2560.2.7	Part 2.7:	Specific applications—Outdoor hockey
2560.2.8	Part 2.8:	Specific applications—Outdoor bowling greens

NOTE: Until the revision of this series is complete some of the above Standards might have, as a main title, ‘Guide to sports lighting’.

The proper application of this Standard will require reference to AS 2560.1 for the definitions of various technical parameters and the explanation of basic concepts and principles.

In the preparation of this Standard consideration was given to the following documents:

CIE Publication No. 57 (1983), Lighting for Football, International Commission on Illumination (CIE).

IES Lighting Guide—Sports, Publication No. 7 (1974), The Illuminating Engineering Society, London.

The term ‘informative’ has been used in this Standard to define the application of the appendix to which it applies. An ‘informative’ appendix is only for information and guidance.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

CONTENTS

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

STANDARDS AUSTRALIA

Australian Standard
Sports lighting

Part 2.3: Specific applications—Lighting for football (all codes)

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

1 SCOPE

This Standard contains recommendations and requirements (the requirements refer to methods of assessment and measurement and levels of performance) specific to the lighting of outdoor football grounds for all codes commonly played in Australia, namely—

(a) Rugby League;

(b) Rugby Union;

(c) Australian Rules; and

(d) Soccer

and for derivatives of Rugby including touch football and 'touch and tag'.

This Standard deals with training and competition levels of play and takes into account spectator viewing requirements associated with these levels of play.

The Standard does not address the amenity and emergency lighting which may be required in public areas associated with stadiums.

Additional recommendations and requirements applicable to all sports venues, including those for football, are contained in AS 2560.1.

The Standard does not detail special requirements of lighting for colour television broadcasting.

This Standard makes recommendations, but does not set requirements, for obtrusive light released into the environment from sports lighting installations (see Clause 10).

2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS	
2560	Sports lighting
2560.1	Part 1:General principles
4282	Control of the obtrusive effects of outdoor lighting
AS/NZS	
3827 (all parts)	Lighting system performance—Accuracies and tolerances
CIE*	
112	Glare evaluation system for use within outdoor sports and area lighting

* International Commission on Illumination, Vienna

3 DEFINITIONS

For the purpose of this Standard the definitions given in AS 2560.1 as qualified below for the specific instances of football playing areas apply. Some critical definitions are also repeated in this Standard.

3.1 Maintained illuminance (E_m)

The defined level below which the average illuminance on the reference plane of a lighting system is not allowed to fall.

NOTE: It is the minimum illuminance at which maintenance is to be carried out.

3.2 Principal playing area (PPA)

All portions of the playing surface within the boundary lines, including the in-goal areas in Rugby but excluding the areas within the goal nets in the case of soccer.

3.3 Shall

Indicates a mandatory requirement. It is necessary that such requirements be followed strictly in order to comply with this Standard.

3.4 Should

Indicates a recommendation. It is not necessary that such recommendations be followed in order to comply with this Standard.

4 CHARACTERISTICS OF SPORT AND IMPLICATIONS FOR LIGHTING

NOTE: This Clause assumes that the reader is familiar with how each of the football codes dealt with is played.

4.1 Rugby

NOTE: As identical illumination requirements apply to both Rugby League and Rugby Union, the following applies to both codes.

The major elements of the game influencing visual tasks are the fast pace, deliberate heavy body contact, low-trajectory passes generally across the PPA and kicks ranging from along the ground to high trajectory (including kicks at goal) generally parallel to the long axis of the PPA.

The PPA proportions, together with typical orientation of high-trajectory kicks, make side lighting systems convenient and appropriate. Refer also to Clauses 6, 7 and 8.

4.2 Australian Rules

Despite the significant differences in play, the visual tasks for participants are the same as for Rugby. However the high proportion of low- to medium-trajectory kicks in all directions and marking of high-trajectory kicks, together with the proportionally greater width of the elliptical PPA, dictate that floodlights be positioned evenly around the area, rather than straight along the sides, but not near the goalposts. Refer also to Clauses 6, 7 and 8.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

© Standards Australia

4.3 Soccer

Despite the significant differences in play, the visual tasks in soccer are similar to those of Australian Rules, with low- to medium-trajectory passes in all directions being common, and scoring kicks always being low to medium trajectory.

Due to the importance of the goalkeeper's role, some back lighting from a corner location is recommended. Refer also to Clauses 6, 7 and 8.

5 GENERAL DESIGN OBJECTIVES

The main objectives of a lighting installation intended to provide an adequate visual environment for football are as follows:

(a) Provision of a level of illumination appropriate to the class of play and the number of spectators (see Clause 6 and AS 2560.1).

(b) Provision of an appropriate uniformity of illumination of the ball throughout its flight (see Clause 7).

(c) Control and restriction of glare (see Clause 8).

(d) Provision of colour rendering properties suitable for rapid identification of team colours (see Clause 9).

(e) Addressing of environmental considerations, including obtrusive light to surrounding properties, as appropriate and as required by relevant local authorities (see Clause 10).

(f) Provision of an installation suitable for anticipated or likely future upgrading to a higher level.

(g) Provision of an installation suitable for all football codes for which it is expected to be used.

(h) Selection of lighting equipment of appropriate type and the location and arrangement of such equipment in a manner that will facilitate necessary maintenance during the life of the installation.

Where lighting appropriate to training or lower levels of competition is to be installed, consideration should be given to the likelihood of future upgrading of the installation as making provision for such (in pole sizes, cabling, etc.) can significantly reduce the cost of the future upgrading.

Where a football lighting installation is also to be used for other sports, requirements in the relevant part of the AS 2560.2 series shall be observed in addition to those in this Standard.

6 ILLUMINANCE LEVELS

6.1 General

A basic requirement for illumination of a football field is that the ball is adequately illuminated at all times while in play.

This Standard specifies requirements for horizontal illuminance of the PPA surface only. It does not explicitly address vertical illuminance immediately above the PPA or illumination of the ball on medium- and high-trajectory paths.

While complying levels of illumination of the horizontal PPA surface will generally provide adequate vertical illumination to a minimum of 1.5 m above the PPA, adequate illumination of the ball while at heights substantially above this can usually be achieved by addressing the following design considerations:

(a) Design of the lighting envelope such that the ball does not leave it while in play.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

(b) Illumination of the ball from several directions at all times, including from below (usually by reflected light).

(c) Control of backgrounds so as to provide good contrast at all times.

(Refer also to Clause 7.1.)

6.2 Allowance for depreciation

Allowance shall be made for the progressive reduction in the illuminance provided by the installation which will occur as the result of lamp lumen depreciation (LLD) and luminaire dirt depreciation (LDD).

The extent of the allowance required will depend on the type of lamp selected, the location of the installation, and the cleaning and lamp replacement cycles adopted. (Refer to the relevant Clauses in AS 2560.1 for information on determining these quantities.)

The combined effect of these allowances will determine the illuminance which should initially be provided by the installation in order to ensure that the maintained illuminance required by Table 1 can be provided at all times (refer to Clause 3.1).

6.3 Measurement and calculation details

6.3.1 *Height above PPA*

All measurements or calculations of horizontal illuminance levels, including those for horizontal illuminance uniformity, shall be made at the level of the PPA.

6.3.2 *Calculation points*

To check the conformance of the lighting design with the relevant illuminance parameters by means of calculation, the illuminance levels shall be calculated at points located on a 5 m x 5 m grid located within the PPA as specified in Clause 6.3.4.

6.3.3 *Measurement points*

To check the conformance of an installed lighting scheme with the criteria specified in Table 1 by means of measurement, it is not practicable to measure all of the calculation points required. The illuminance levels shall be measured at points located on a 10 m x 10 m grid contained within the PPA as specified in Clause 6.3.4.

6.3.4 *Location of calculation and measurement grids*

6.3.4.1 *Soccer and Rugby*

A 5 m x 5 m calculation grid shall be fitted within the perimeter of the PPA such that all points immediately inside that perimeter are within 2.5m (i.e. half-a-grid space) of the relevant boundary line or lines.

With regard to measurement points, one point shall be located at each corner of the above grid and thence on a 10 m x 10 m grid, expanding from each corner to cover the relevant quarter of the PPA. In some cases this will result in rows of measurement points only 5 m apart on either side of either the longitudinal or transverse axis of the field, or both. Refer to Figure 1, parts (a) and (b), for examples.

6.3.4.2 *AFL*

Construction lines shall be established along the tangents to the PPA perimeter at the points of intersection of the longitudinal and transverse axes of the field with that perimeter. Calculation and measurement points shall be located within the rectangle thus formed in accordance with Clause 6.3.4.1 so then all points lying outside the PPA shall be deleted. Refer to Figure 1(c) for an example.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

 © Standards Australia

6.3.5 *Measurement requirements*

Except where specifically stated otherwise in this Standard, illuminance measurements shall be made in accordance with the relevant sections of AS 2560.1.

6.4 Illuminance requirements

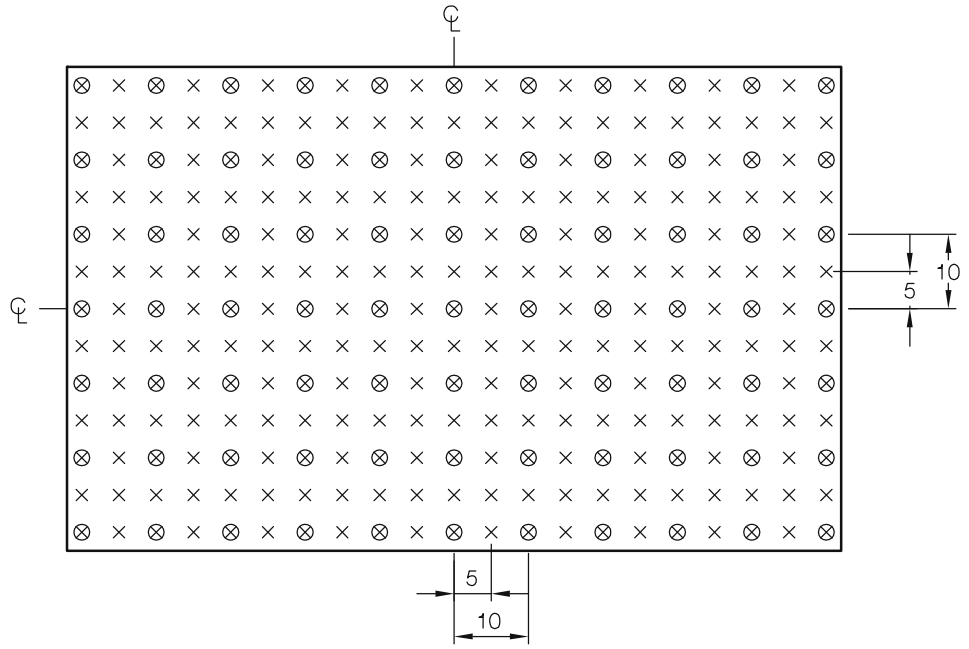
The maintained average horizontal illuminance within the PPA, determined in accordance with Clause 6.3, shall be not less than the appropriate value specified in Table 1.

The adoption of maintained illuminance higher than those in Table 1 will generally lead to improved visual conditions for participants and spectators, provided that all other requirements and recommendations of this Standard are observed.

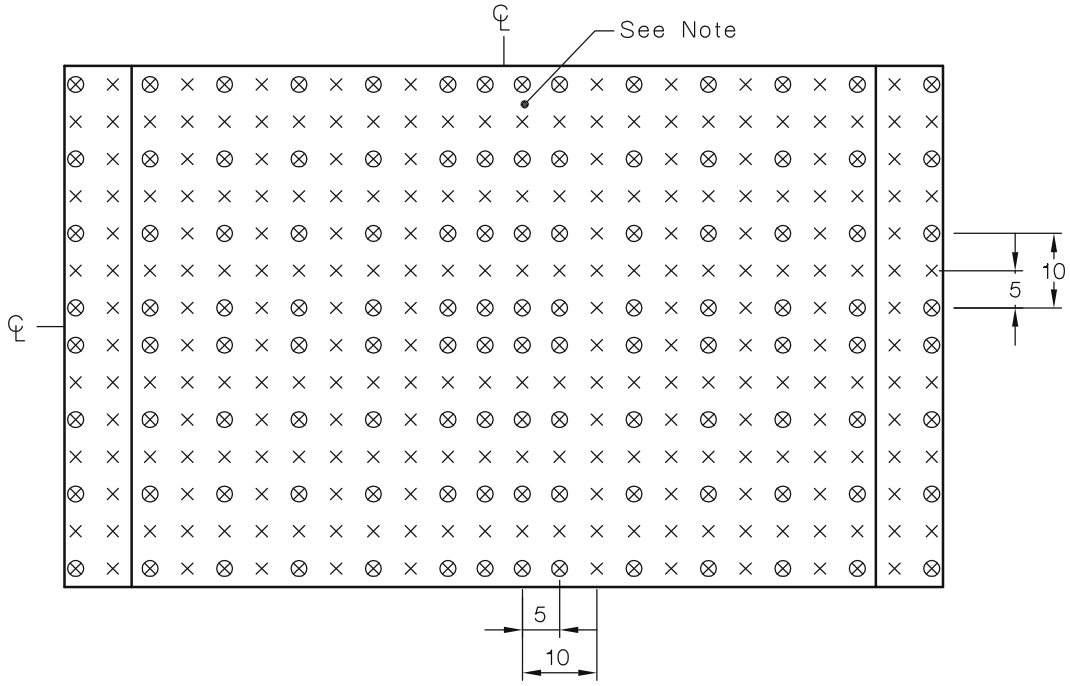
NOTE: Attention is drawn to the fact that the presence of mist, dust or smoke in the atmosphere can significantly reduce measured illuminance values because of the long light throws normally associated with football grounds.

The client should be queried at the early stages of the design process regarding any factors that might require a higher illuminance level than that specified in Table 1 for the apparent relevant level of play.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing



(a) Soccer



(b) Rugby League and Rugby Union

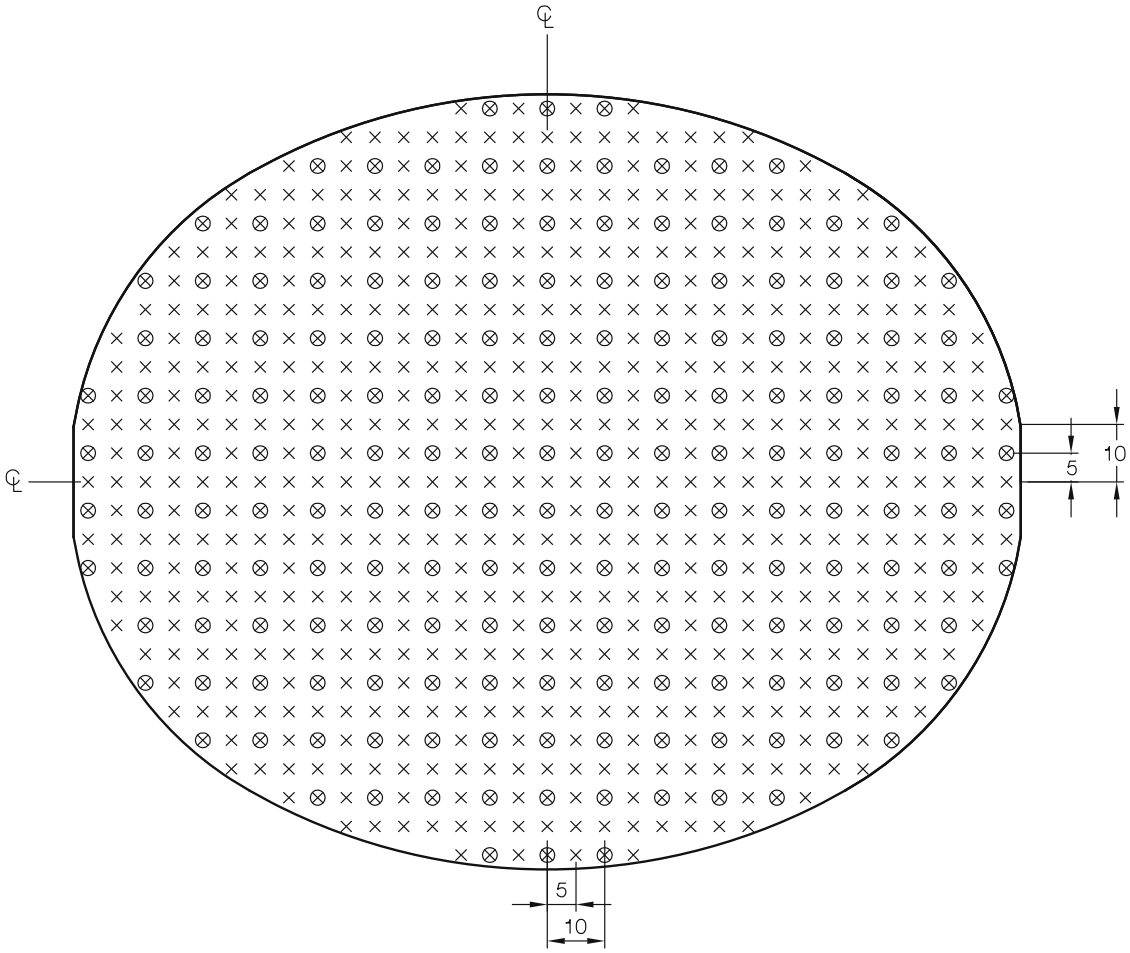
LEGEND:
⊗ = Calculation and measurement points
× = Calculation only points

NOTE: The adjacent rows of measurement points are not peculiar to Rugby, but dictated by the exact dimensions of the PPA. Refer to Clause 6.3.4.

FIGURE 1 (in part) EXAMPLE GRIDS FOR THE CALCULATION/MEASUREMENT OF ILLUMINANCE VALUES

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

© Standards Australia



(c) Australian Rules

LEGEND:
⊗ = Calculation and measurement points
× = Calculation points only

FIGURE 1 (in part) EXAMPLE GRIDS FOR THE CALCULATION/MEASUREMENT OF ILLUMINANCE VALUES

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

TABLE 1

LIGHTING CRITERIA

Level of play	Maintained average horizontal illuminance[a),b)] ($\bar{E}_{mh}$) lux	Minimum horizontal uniformities[c)]		Maximum glare rating (GR_{max})	Minimum colour rendering index ($R_{a\ min}$)	Maximum uniformity gradient
		(U_1)	(U_2)			
Recreational level						
Touch and tag	50	0.3	N/A	N/A	65	N/A
Amateur level						
Ball and physical training[e)]	50	0.3	N/A	N/A	65	N/A
Club competition and match practice	100	0.5	0.3	50	65	N/A
Semi-professional level						
Ball and physical training[e)]	50	0.3	N/A	N/A	65	N/A
Match practice	100	0.5	0.3	50	65	N/A
Semi-professional competition	200	0.6	0.4	50	65[d)]	N/A
Professional level						
Ball and physical training[e)]	100	0.5	0.3	50	65	N/A
Match practice	200	0.6	0.4	50	65	N/A
Professional competition	500	0.7	0.5	50	65[d)]	20% per 5 m

a) For the height above the playing surface at which the illuminance is to be measured refer to Clause 6.3.1.

b) Values of illuminance measured at the time of commissioning an installation (i.e. initial or close to) should be higher than the maintained illuminance values (see Clause 6.2).

c) Being ratios, U_1 and U_2 can be calculated with equal accuracy by using either all initial or all maintained values.

d) If future upgrading to a level suitable for television broadcasting is intended or likely, the selection of light sources with $R_a \geq 90$ should be considered.

e) Ball and physical training is considered to differ from match practice in that ball and physical training is more controlled, involves fewer participants (typically two to four) and the paths of the participants and that of any ball used are more predictable than in a match-practice environment.

NOTES:

1 The above values are chosen to be adequate to provide for the safety of the participants and the level of visual tasks anticipated. Factors such as large crowds (e.g. ≥10000) with consequent longer viewing distances might require higher values to be chosen than initially indicated above.

2 If the lighting installation is likely to be upgraded to provide for higher levels, consideration should be given to making provision for the mounting of the additional floodlight which will be required to achieve the higher values of maintained illuminance.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

© Standards Australia

7 UNIFORMITY OF ILLUMINANCE

7.1 General

As the participants are required to observe the football well above the PPA, the distribution of light across the space above the PPA needs to be reasonably uniform as large variations in illuminance across this space will cause apparent uneven flight of the ball and hence poor judgement by the participants.

This Standard specifies requirements for the uniformity of horizontal illuminance of the PPA only. It sets no requirements for the uniformity of vertical illuminance at any height; however, this parameter can be addressed by considering items (a), (b) and (c) of Clause 6.1.

7.2 Determination requirements

Except where specifically stated in this Standard, determination (by calculation or measurement) of horizontal illuminance uniformity shall be made in accordance with the relevant sections of AS 2560.1.

7.3 Horizontal illuminance uniformity requirements

The horizontal illuminance uniformity ratios determined from illuminance levels calculated or measured, as appropriate, in accordance with Clause 6, shall be not less than the relevant value stated in Table 1.

The client should be queried at the early stages of the design process about any factors that might require higher levels of uniformity than those specified in Table 1 for the apparent relevant level of play.

7.4 Uniformity gradient

7.4.1 *General*

The uniformity gradient (refer to AS 2560.1 for definition) indicates the rate of change of illuminance between any grid point and the eight immediately adjacent grid points. Thus, calculating the uniformity gradient for every grid point in a lit area and considering values considerably higher or lower than the norm can indicate the presence of any excessively bright or dark spots in the design or installation.

These variations can be important for high-speed sports because a fast-moving object passing from a light space to a dark space can appear to change speeds due to different visual processing times for different adaptation levels as the visual system responds more slowly at lower adaptation levels. However, even for extremely fast movement, the capabilities of human vision are such that uniformity gradients considerably in excess of 20% usually provide little difficulty.

7.4.2 *Uniformity gradient requirements*

The highest uniformity gradient determined from illuminance levels calculated or measured, as appropriate, in accordance with Clause 6, shall be not greater than the relevant value specified in Table 1.

8 CONTROL OF GLARE

8.1 General

Glare from floodlights which are not correctly positioned and aimed with respect to the PPA may negate any benefits gained from the increases they provide in illumination.

In the design of football ground lighting installations, careful consideration should be given to visual requirements for the comfort of the participants and the spectators.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

Ideally no glare should be introduced into the field of view; however, the need to limit glare conflicts with other lighting requirements. For example, light at near-horizontal angles will assist in the clear view of the football in the air above the PPA, but light at these angles may also give rise to troublesome glare for both participants and spectators.

This Standard specifies requirements for the glare rating (GR) calculated for viewing angles below the horizontal only. The reduction of glare above this angle should be addressed by means of the control measures set out in Clause 8.2.

8.2 Control measures

The principal means of controlling glare in football lighting installations involves the application of a combination of the measures prescribed in (a) and (b) which follow:

(a) *Selection of appropriate locations for floodlights* Floodlights should be located in positions which will give rise to the least glare to participants and, where applicable, spectators, by placing the light sources away from normal lines of sight so that the ball is seldom viewed against the bright portions of the luminaires. Recommendations and requirements on locations for floodlights are shown in Figures 3, 4 and 5.

(b) *Installation of floodlights at an adequate mounting height* Floodlights should be installed at a height such that a line from the lowest luminaire to the centre of the PPA is at an angle to the horizontal that is not less than a given value, the value depending on the level of play being designed for. See Figure 2.

The relevant values for this angle, and the formula for calculating the height to the lowest luminaire, are set out in Table 2.

TABLE 2

RECOMMENDED MINIMUM FLOODLIGHT MOUNTING HEIGHTS

Level of play	Minimum angle of elevation	Formula for determining h^*
Professional competition	25°	$h = 0.47 \times d^\dagger$
All others	20°	$h = 0.36 \times d^\dagger$

* h is the minimum required height above the centre of the PPA which will typically differ from the height above the base of the pole. In determining the required pole or tower height it will be necessary to take into account this difference and also the distance between the lowest and highest floodlights on that pole or tower.

† d is the horizontal distance from a point immediately below the floodlight(s) under consideration to either the centre of the PPA or the major axis through it in accordance with the applicable example in Figures 3, 4 and 5.

For a given lighting layout and floodlight aiming points, glare to participants and spectators will be further reduced by adopting mounting heights above the minimum values required.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

 © Standards Australia

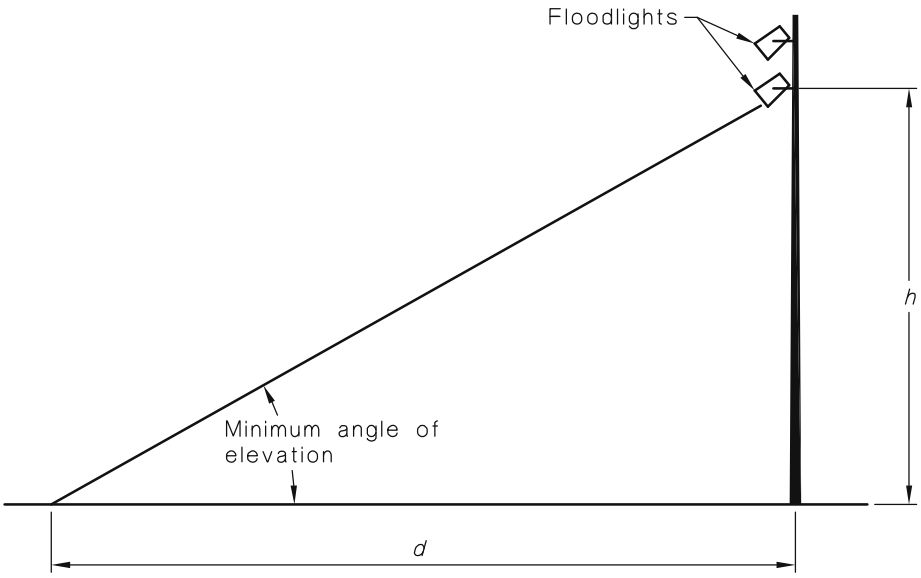


FIGURE 2 MINIMUM MOUNTING HEIGHT FOR FLOODLIGHTS

8.3 Glare rating (GR) details

8.3.1 *Playing surface reflectance*

The calculated GR value depends upon the reflectance of the playing surface. For typical football fields a diffuse reflectance value of between 0.15 and 0.25 usually applies. Some surfaces of particularly high or low reflectance will lie outside this range.

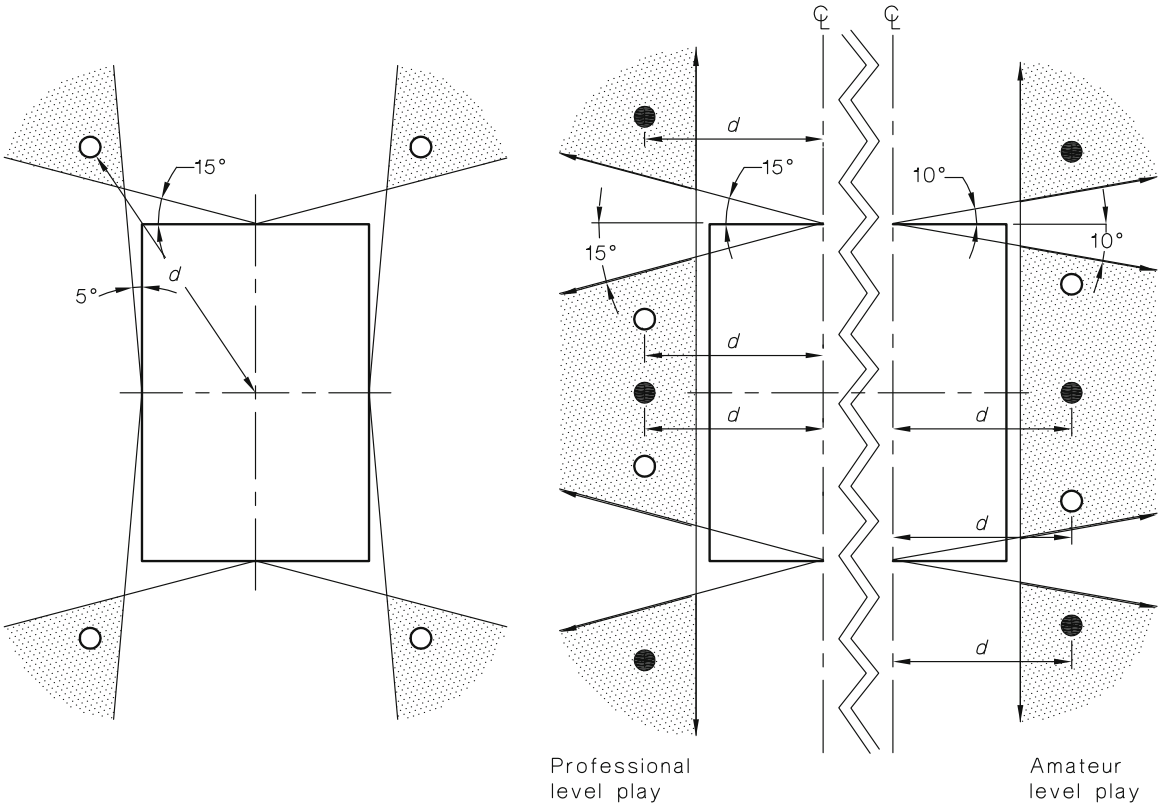
8.3.2 *Calculation requirements*

Except where specifically stated in this Standard, the calculation of GR shall be made in accordance with CIE 112.

8.4 Glare rating (GR) requirements

The GR applicable to each of the observer positions specified by the applicable part of Figure 6 when viewing all of the calculation points specified by the applicable calculation grid of Figure 1 from a height of 1.5 m above the PPA shall be in accordance with the relevant limiting value specified in Table 1.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing



(a) Corner pole scheme (All levels of play)

(b) Side pole schemes

LEGEND:

= Permitted zones for installation of luminaires

= Example location of floodlight in six-pole scheme of floodlighting

= Example location of floodlight in four-pole scheme of floodlighting

d = Horizontal distance to calculate pole height

NOTES:

1 To minimize the risk of injury to players, poles should be located behind the boundary fence, if any, or set back at least 5 m outside the limits of the PPA.

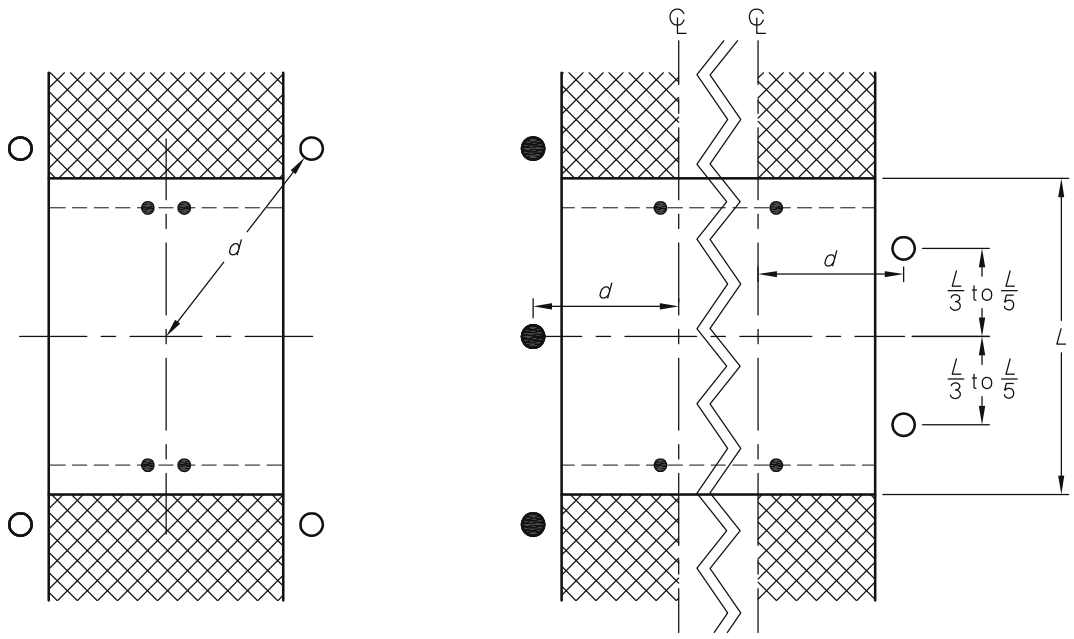
2 See Clause 8.2 for the minimum mounting heights for floodlights.

3 For the purpose of providing sufficient modelling and good vertical illumination, a side pole lighting scheme with a minimum of two poles per side is recommended.

FIGURE 3 RECOMMENDED LUMINAIRE LOCATION ZONES AND POLE LOCATION EXAMPLES FOR SOCCER

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

© Standards Australia



(a) Corner pole scheme (b) Side pole schemes

LEGEND:

● = Goalpost

○ = Example location of floodlight(s) in four-pole scheme of floodlighting

● = Example location of floodlight(s) in six-pole scheme of floodlighting

⊠ = Recommended that no floodlights be located in this area

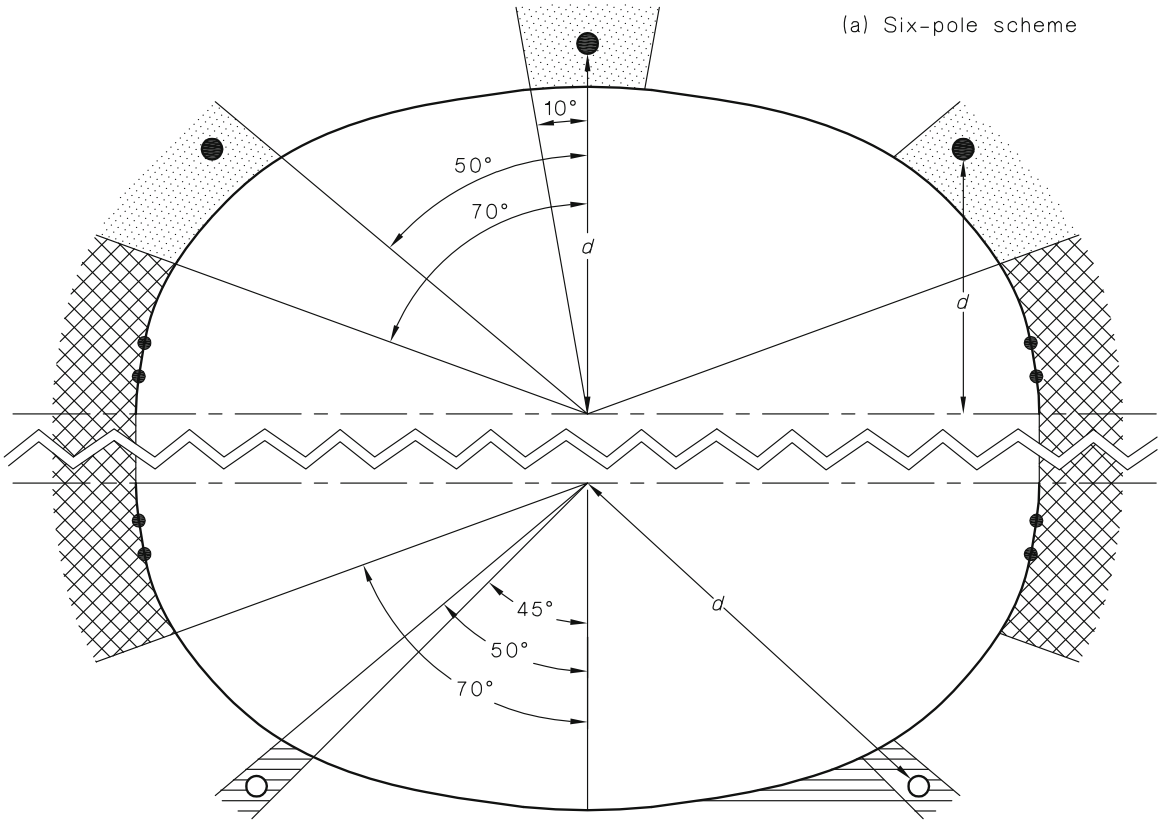
d = Horizontal distance used to calculate pole height

NOTES:

1. For the purpose of providing sufficient modelling and good vertical illumination, a side pole lighting scheme with a minimum of two poles per side is recommended.
2. To minimize the risk of injury to players, poles should be located behind the boundary fence, if any, or set back at least 5 m outside the limits of the PPA.
3. See Clause 8.2 for the minimum mounting heights for floodlights.

FIGURE 4 RECOMMENDED LUMINAIRE LOCATION ZONES AND POLE LOCATION EXAMPLES FOR RUGBY

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing



LEGEND:

- ● = Goalpost or 'behind' post
- ○ = Example location of floodlight(s) in four-pole scheme of floodlighting
- ● = Example location of floodlight(s) in six-pole scheme of floodlighting
- = Recommended zones for a 'corner' pole scheme of floodlighting
- = Recommended zones for a 'side' pole scheme of floodlighting
- = Recommended that no floodlights to be located in this area
- *d* = Horizontal distance used to calculate pole height

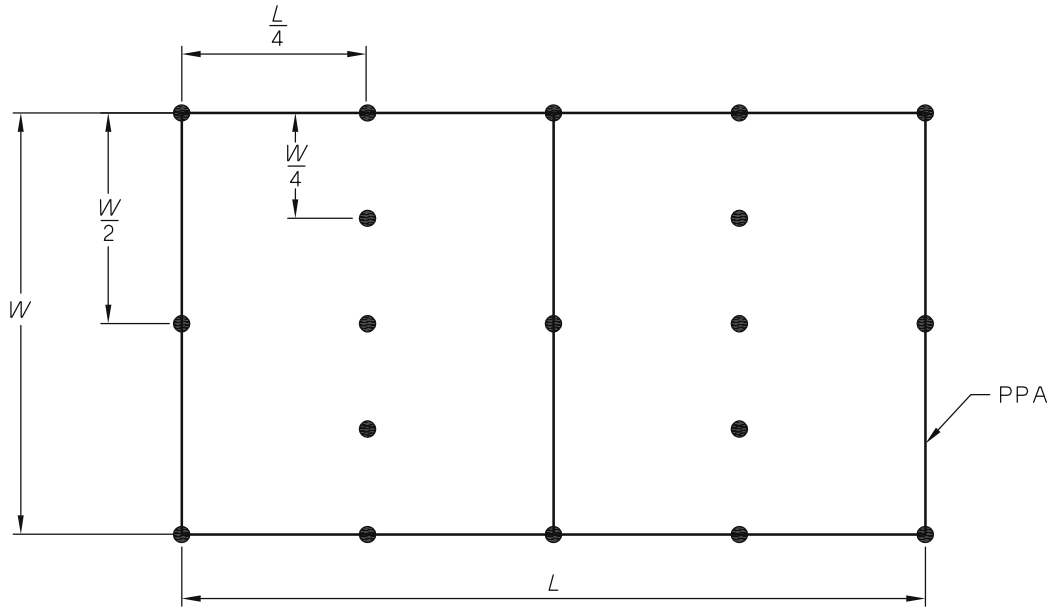
NOTES:

1. To minimize the risk of injury to players poles should be located behind the boundary fence, if any, or set back at least 5 m outside the limits of the PPA.
2. For the purpose of providing sufficient modelling and good vertical illumination, a lighting scheme with a minimum of two poles per side is recommended.
3. See Clause 8.2 for the minimum mounting heights for floodlights.

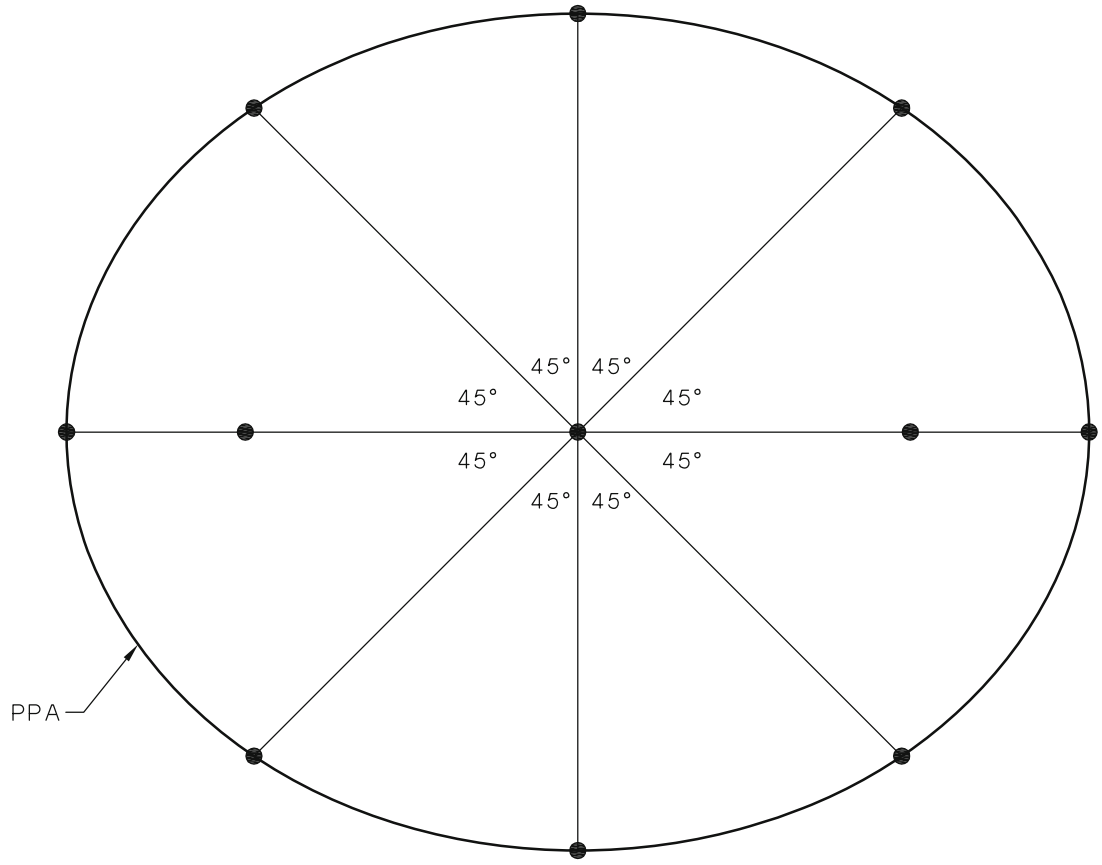
FIGURE 5 RECOMMENDED LUMINAIRE LOCATIONS ZONES AND POLE LOCATION EXAMPLES FOR AUSTRALIAN RULES

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

© Standards Australia



(a) Soccer and Rugby



(b) Australian Rules

NOTE: Use symmetry, if applicable, to reduce calculations.

FIGURE 6 OBSERVER POSITION FOR GLARE CALCULATIONS

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

9 COLOUR RENDERING REQUIREMENTS

The types of lamps used for competition levels of play shall have a CIE general colour rendering index (R_a) in accordance with Table 1.

NOTE: See AS 2560.1 for information on the colour rendering properties of various lamp types.

The client should be queried at the early stages of the design process about any factors that might require a higher colour rendering index than that specified in Table 1 for the apparent relevant level of play.

10 ENVIRONMENTAL CONSIDERATIONS

10.1 Control of obtrusive light

Consideration should be given at the design stage to the effect of glare and obtrusive light in the areas surrounding an installation and to the requirements of any local authorities.

Refer to AS 2560.1 for background information and to AS 4282 for detailed information on the control of the effects of obtrusive light.

10.2 Aesthetic considerations

Due consideration should be given to the daytime appearance of the lighting system.

11 SURROUND BRIGHTNESS

The apparent brightness of the floodlights as seen by the participants and spectators and hence the discomfort glare experienced depends on the gradient of the brightness that is experienced when the eye moves from the bright PPA to the floodlights.

Where the PPA is surrounded by vertical or near-vertical surfaces that provide an appropriate level of luminance, the effect of this glare is very much reduced. Such a level of luminance can usually be produced by objects such as stands, terraces or fences, having at least a moderate reflectance and receiving at least one quarter (approximately) of the average vertical illuminance experienced on the PPA. This illuminance value can usually be achieved by the spill-light from a well-aimed installation with floodlights from among the type recommended in Appendix A.

Low surround brightness is a common problem on small grounds which do not have stands and terraces; however, it has been observed that even the brightness provided by a low, light-coloured fence surrounding the PPA can significantly reduce discomfort glare and enhance the visual effectiveness of the floodlighting.

12 VERIFICATION OF COMPLIANCE

12.1 General

All measurements and calculations should be made with reference to the AS/NZS 3827 series of Standards for advice on accuracies and tolerances applicable when calculating or measuring the illuminance provided by a lighting design or system.

12.2 Verification by calculation

12.2.1 *Compliance of the design*

The design of a lighting scheme shall be deemed to comply with this Standard if, when created in accordance with the relevant requirements of this Standard and AS 2560.1, calculations indicate that it would satisfy the lighting criteria of Table 1 at all times throughout its projected life when considered together with the maintenance assumptions made in Clause 6.2 and the maintenance schedule provided in AS 2560.1.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

© Standards Australia

12.2.2 *Ongoing compliance of the installation*

After installation of a lighting design complying with Clause 12.2.1, the installation shall be deemed to continue to comply with this Standard if—

(a) a statement is provided that the installation accurately implements the final design documentation (i.e. 'as-built' verification);

(b) the final design documentation includes any changes to the original design made or agreed to by the designer in response to circumstances arising during installation and these changes do not cause non-compliance of the design with the requirements of Clause 12.2.1; and

(c) either—

  (i) the maintenance regime specified in any maintenance schedule forming part of the design has been carried out (refer to AS 2560.1 for details on maintenance); or

  (ii) an alternative maintenance regime has been implemented that can be demonstrated to provide a maintenance factor equal to, or better than, the design value.

12.3 Verification of compliance by measurement

12.3.1 *At the time of construction*

In instances where the client requests verification by measurement of a recently installed lighting scheme, measurements shall be taken soon after installation is completed, at a time after all lamps have passed the burning-in phase, but prior to any significant depreciation in the lumen output of the lamps or the luminaires.

The use of symmetry of an installation to reduce the area of the field to be measured to ½ or ¼ of the PPA shall be acceptable if agreed to by the client.

NOTE: Because the lighting criteria specified in Table 1 are maintained values, they should be easily exceeded at this stage of the life of an installation. Accordingly, the value measured should be compared to the initial values predicted by the design and thus used as a check on the design itself and the accuracy with which the installation reflects the design.

12.3.2 *During the life of the installation*

Where measurements are taken at any other time during the life of an installation, they shall be compared initially to the values of Table 1 and then to values calculated from the design, based on the age of the installation, pattern of use, and the maintenance regime that has been applied.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

APPENDIX A

ILLUSTRATION OF FLOODLIGHT CLASSIFICATIONS

(Informative)

Two systems for classifying floodlights are described in AS 2560.1, namely—

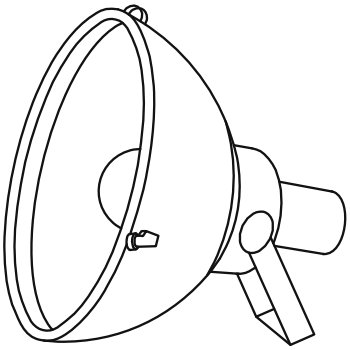
(a) a classification system based on the general shape of the light beam provided, designated Type A, B, C, C cut-off, or D; and

(b) a classification system based on the degree of divergence of the light beam, separately evaluated in both horizontal and vertical planes through the floodlight, designated Class NN, N, 1, …..6 or 7.

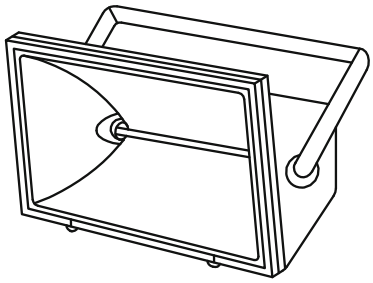
Reference should be made to AS 2560.1 for the details of these systems. For the purpose of this Standard, Figures A1 and A2 illustrate the classification system described in (a).

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

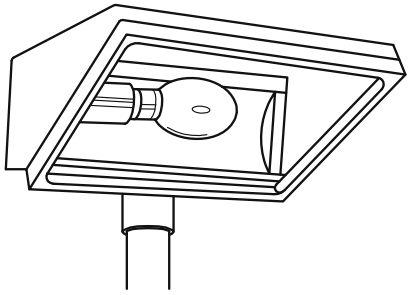
© Standards Australia



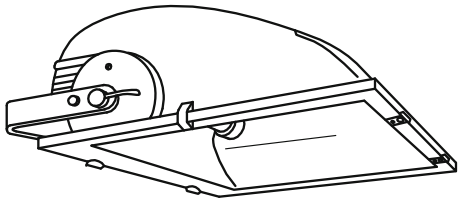
(a) Type A floodlight giving a circular symmetric beam



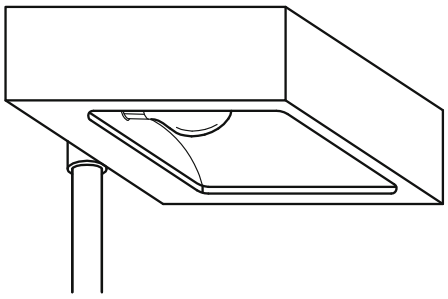
(b) Type B floodlight giving a rectangular-shaped beam



(c) Type C floodlight giving a fan-shaped beam with an asymmetric distribution in the vertical plane



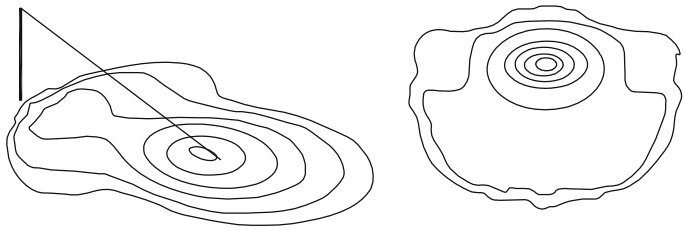
(d) Type C cut-off floodlight giving a fan-shaped beam with an asymmetric distribution in the vertical plane



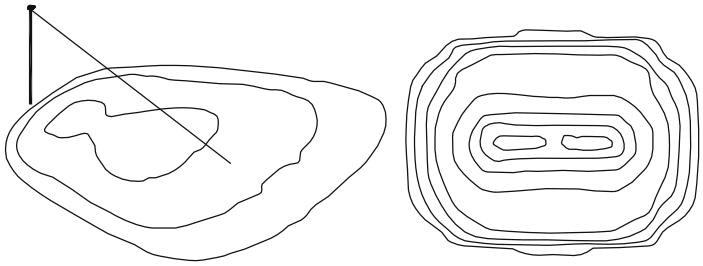
(e) Type D fixed floodlight with a flat glass giving a fan-shaped beam with an asymmetric distribution in the vertical plane

FIGURE A1 TYPICAL FLOODLIGHT TYPES SHOWN DIAGRAMMATICALLY

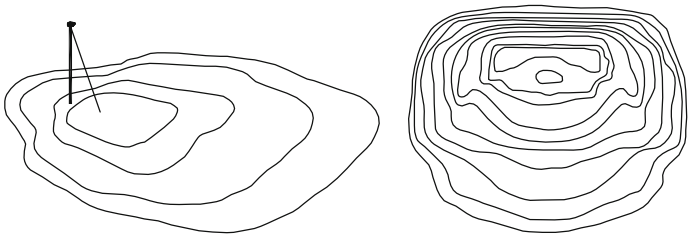
Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing



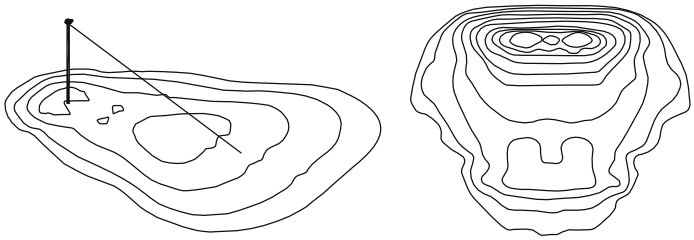
(a) Type A floodlight



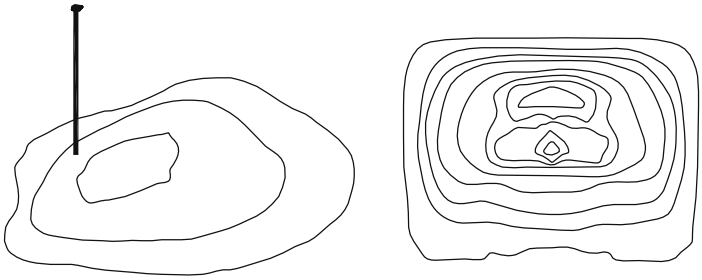
(b) Type B floodlight



(c) Type C floodlight



(d) Type C cut-off floodlight



(e) Type D floodlight

FIGURE A2 TYPICAL BEAM CROSS-SECTIONS AND LIGHT PATTERN PRODUCED ON HORIZONTAL SURFACE

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

© Standards Australia

NOTES

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

NOTES

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

NOTES

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

Standards Australia

Standards Australia develops Australian Standards® and other documents of public benefit and national interest. These Standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. Through a Memorandum of Understanding with the Commonwealth Government, Standards Australia is recognized as Australia's peak non-government national standards body. Standards Australia also supports excellence in design and innovation through the Australian Design Awards.

For further information visit **www.standards.org.au**

Australian Standards®

Committees of experts from industry, governments, consumers and other relevant sectors prepare Australian Standards. The requirements or recommendations contained in published Standards are a consensus of the views of representative interests and also take account of comments received from other sources. They reflect the latest scientific and industry experience. Australian Standards are kept under continuous review after publication and are updated regularly to take account of changing technology.

International Involvement

Standards Australia is responsible for ensuring the Australian viewpoint is considered in the formulation of International Standards and that the latest international experience is incorporated in national Standards. This role is vital in assisting local industry to compete in international markets. Standards Australia represents Australia at both the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

Sales and Distribution

Australian Standards®, Handbooks and other documents developed by Standards Australia are printed and distributed under license by SAI Global Limited.

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

Licensed to WAFC - Facilities Manager 08 9287 5507 on 30-Aug-2017. 1 user personal license only. Copying, copy/pasting, storage & distribution or use on network prohibited.
Get permission to copy from or network this publication www.saiglobal.com/licensing

For information regarding the development of Standards contact:
Standards Australia Limited
GPO Box 476
Sydney NSW 2001
Phone: 02 9237 6000
Fax: 02 9237 6010
Email: mail@standards.org.au
Internet: www.standards.org.au

For information regarding the sale and distribution of Standards contact:
SAI Global Limited
Phone: 13 12 42
Fax: 1300 65 49 49
Email: sales@sai-global.com

ISBN 0 7337 8470 4