

GUIDE TO THE ARTIFICIAL LIGHTING OF HOCKEY PITCHES



Sixth Edition

Foreword

There is an increasing desire to use an outdoor hockey facility over a long period of time each day. This will often entail the use of artificial lighting. At one level, this maximises the value of an investment in a synthetic turf pitch because of the longer periods of use for evening training or local matches. At another level, it enables international competition matches to be held in the evening when spectators are more able to attend and, in some climates, when it is cooler.

However, it is important that the lighting is of an appropriate type and quality for four fundamental reasons:

- to ensure the safety of players and others involved in the game
- to provide better viewing for spectators and television where applicable
- to ensure the effective use of money spent on capital and operating costs over time
- to be environmentally sensitive.

This Guide provides information about the things to consider when installing or perhaps upgrading artificial lighting. It is part of a series of FIH publications providing advice to national hockey associations and to the owners of hockey pitches.

It provides guidance and does not necessarily include detailed specifications for all the requirements. However, it is a good starting point for planning artificial lighting. Where appropriate, references are made to more detailed information.

The lay reader should not be put off by the technicalities in some sections of the Guide. If they convey the message that pitch lighting is a little more complex than erecting a few masts and mounting some floodlights on top then they have served their purpose. These more detailed sections will be of direct benefit to lighting engineers involved in the installation. FIH recommends that assistance from professionally accredited lighting engineers should be used in all installations. Further, owners of hockey pitches are reminded to address National Standards and ensure there are no conflicts particularly for the recommended lighting level modes and obtrusive light.

International Hockey Federation

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Introduction

Unless played in good daylight, hockey like all other sports requires good lighting for it to be played safely and enjoyably. This is true whether the game is being played at the recreational level or at an international televised event.

As with all projects, the budget available is a key factor in determining the outcome. There is a growing awareness of the added value of good quality lighting for any sports venue. Both the contract price and life-cycle operating costs should be considered in determining the supplier for your project. Even though it requires investment, lighting represents only a modest proportion of the total cost of the installation and, as a rule, it is true to say that where the right lighting is installed the users, players, spectators, and venue owners are never disappointed. However, if a poor, second rate system is installed this almost always leads to complaints and eventually to a very costly change or upgrade.

The Guide is intended for anyone involved in the planning or maintenance of hockey venues from local recreational pitches through to play at the highest levels. It provides the information needed to work through the process to ensure a good result is achieved for players, spectators, television viewing, and for the environment.



Where To Begin

There are several components that need to be included in an accurate comparison of lighting proposals. Initial costs as well as the cost of ownership over time should be considered.

1 Planning Matrix

The chart below shows the 3 general components of a lighting system and the 3 basic functions needed in order to have a complete system.

	Lighting	Electrical	Structural
Design			
Supply			
Install			

In order to compare various bidders, you should make sure they have included costs for each of these. Other considerations should be the cost of owning the system over time. We recommend you ask bidders to furnish a minimum of 10 year life-cycle costs to include maintenance, parts replacement, and necessary relampings.

2 Life-Cycle Cost Comparison

(Example using 40 2K fittings, 300 hrs of use per year, in Euros)

A Energy consumption

Number of luminaires		40	
kW demand per luminaire	x	2 kW	
kW rate	x	€0.12	
Annual usage hours x 10 years	x	300	
	=	€2880	→ €2880

B Demand charges, if applicable

= _____ + _____

C Spot relamping and maintenance over 10 years

Assume 3 repairs at € 500 each
if not included = €1500 → + €1500

D Group relamps during 10 years

Annual usage hours x 10 years		3000	
Lamp replacement hours	÷	3000	
€250 lamp and labour	x	€250	
Number of luminaires	x	40	
	=	€10,000	→ + €10,000

E TOTAL 10-Year Life-Cycle Operating Cost

= €14,380

3 Warranty and Guarantee

Warranties vary greatly in length and coverage. We recommend obtaining warranty documents from each manufacturer that clearly states what is covered. Product warranties are a good gauge of a manufacturer's confidence in their products. Periods covered can range from 2 years to 25 years, and details of covered items and conditions vary greatly. Request warranties that include guaranteed light levels, parts, labour, and lamp replacements.

The Sports Lighting Design Process

As every project is unique, it is not possible to have an exact prescription, but in broad terms the following process should be followed to avoid pitfalls:



- Determine the level of play and objectives at the venue.
For example, non-televised or televised?
- Initial lighting design by a professionally accredited sports lighting engineer to help define difficulties, to raise questions, and to enable the necessary budget to be assessed.
- Detailed lighting design with input from venue management, architects, engineers, broadcasters (if the venue will be used for televised events) and knowledgeable hockey participants. Careful consideration should be given to the integration of lighting with existing or designed structures to ensure that the aiming is according to the lighting design, and that the commissioning and maintenance of luminaires is possible.
- After installation, aiming should be checked against the lighting design and measurements taken to ensure the results are in line with the requirements.

Televised or non-televised?

Determining how matches will be watched at a venue is essential as the two lighting design approaches are very different.

For non-televised matches, the illuminance horizontally on the pitch is considered as the plane of reference for the pitch. This approach in practice will then provide sufficient illuminance for players to see each other and for the ball to be seen clearly.

For televised events, there are a number of potential reference points. The first is the level of illuminance in the direction of a fixed camera. The second is the illuminance on a vertical plane and this is used where there are to be mobile cameras. The third is the horizontal illuminance level. The fourth is to calculate the illuminance level in the stands in the direction of a certain camera to ensure there is sufficient light to get spectator images. And finally, an equally important criteria is the uniformity ratio or the rate of change in light levels across the pitch. All of these calculations are the realm of a professionally accredited lighting engineer.

FIH Criteria for Lighting Indoor Facilities

Non-televised Events

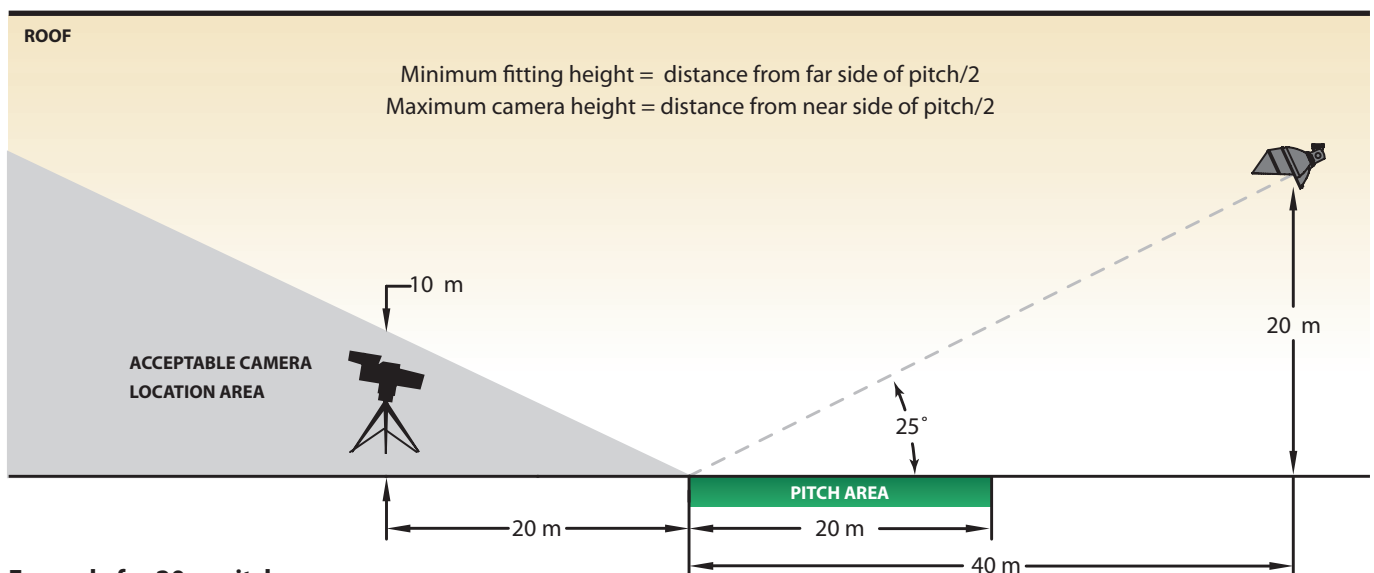
For Class I, II, III events it is acceptable to use a high bay or down light style of fitting. It is important for the light levels to be uniform across the entire pitch as well as a 1.5m perimeter surrounding the field of play. The light levels and uniformities are per *The Recommendations* contained in this document.

Televised Events

It is likely that supplemental lighting will be needed for broadcasts to achieve adequate vertical light levels for the camera. Because indoor surfaces can be much more reflective than outdoor surfaces, care should be exercised in locating the camera in relationship to the lighting. If the camera is located in the reflective angle of the lighting, the ability to achieve high level broadcast results will be compromised. It is also recommended that the lighting used for televised events be of the same type and colour temperature to assure high quality results.

It is recommended that the aiming angle of light fittings is a minimum of 25 degrees from horizontal or 65 degrees from nadir. It is also recommended that all fittings have external glare control devices.

The diagram below shows an easy method to determine if a particular building is going to be acceptable for broadcast purposes. If the recommended aiming angles or camera criteria cannot be achieved, you should consult with a lighting company or consultant with experience in televised events.



Example for 20 m pitch:

If camera stand is 20 m from pitch, maximum height is 10 m.

If mounting location for lighting is 40 m from far side of pitch, minimum mounting height is 20 m

The Recommendations

Below are the recommendations for indoor and outdoor hockey venues which include recommendations for:

- Non-competitive including physical education: Class III.
- Ball training as well as junior and low grade club competitions: Class II.
- High grade national club and international competition: Class I.
- Televised events divided into regional, national and international levels of competition.

	Activity	Eh maint lux	Ev maint lux	horizontal		vertical		GR max	Ra min	Tk*
				U1	U2	U1	U2			
Non-Televised	Class III	>200	n/a	>0.5	>0.7	n/a	n/a	<55	>65	>4000
	Non-competitive including physical training									
	Class II	>250	n/a	>0.5	>0.7	n/a	n/a	<50	>65	>4000
	Ball training as well as junior and low grade clubs competitions									
	Class I	>500	n/a	>0.5	>0.7	n/a	n/a	<50	>65	>4000
	High grade national club and international competition									
Televised	Regional	800-1000	>750	>0.65	>0.7	>0.65	>0.7	<50	>65	>4000
	National	1500-3000	>1400	>0.65	>0.7	>0.65	>0.7	<50	>65	>4000
	International	1500-3000	>2000	>0.7	>0.8	>0.65	>0.8	<50	>65	>4000

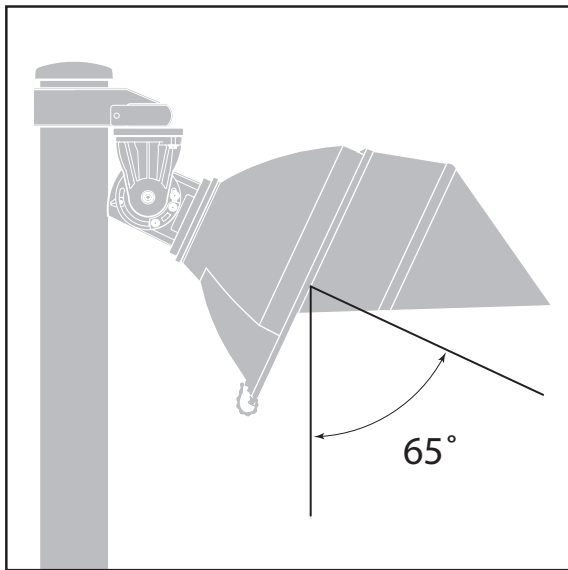
U1 = Minimum/Maximum illuminance

U2 = Minimum/Average illuminance

* The same colour temperature lamps should be used for a venue

Maintenance Factors/Constant Light

To guarantee the recommended average illuminances during the whole of the period of operation of an installation, particularly for televised matches, the lighting level *should not fall below* the targeted values during use. The recommended illuminances are "maintained" values. To arrive at initial values a maintenance factor as recommended by a professionally accredited lighting engineer should be applied to the indicated values. Such factors should be at least 1.40 for normal artificial sports lighting. Some newer technology provides "Constant Light" which guarantees that target levels are maintained rather than predicting performance based on numerical factors.



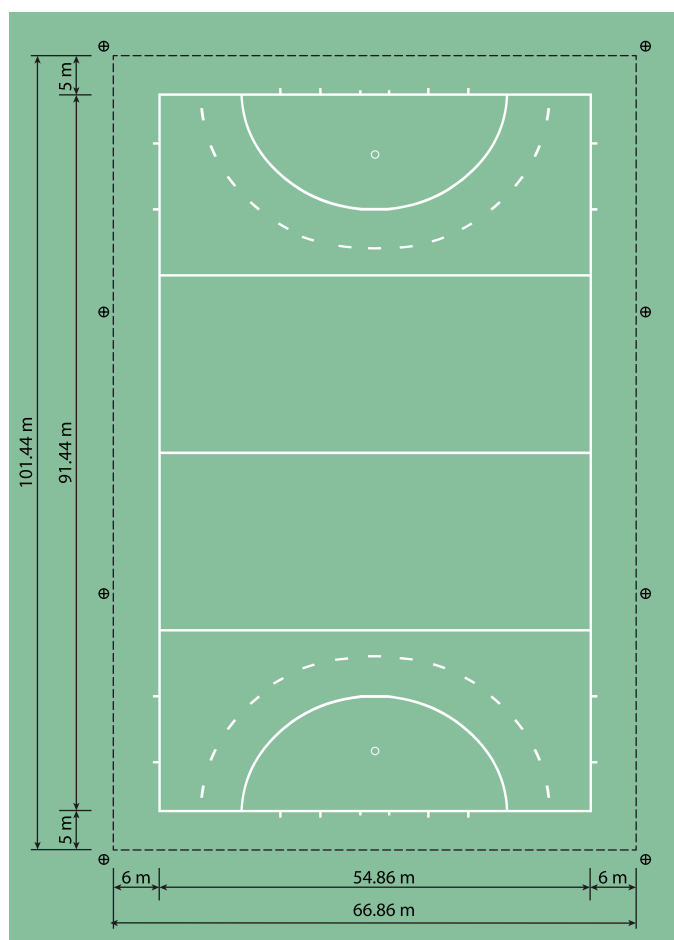
Playability

Aiming logic and placement of masts are critical elements in the quality of the lighting result

Aiming Logic

Aiming angles are a function of both mounting height and the distance from fitting to aiming point on the pitch. For class I, II, and III a minimum vertical aiming angle of 65 degrees from Nadir or 25 degrees from horizontal is recommended.

For TV broadcast lighting shallower aiming angles may be acceptable depending on luminaire mounting locations and should be verified by a professional sports lighting engineer.



Mast Placement

Masts must always be situated outside the overrun area as shown below. We recommend a minimum of 5 m beyond the back-lines and 6 m behind the side-lines.

Side mast arrangement:

This method usually provides a more uniform lighting result and may be economically more feasible as pole height requirements are typically reduced. Four, six, or eight mast layouts are acceptable. A qualified lighting designer can determine the most advantageous arrangement based on the level of play and site conditions.

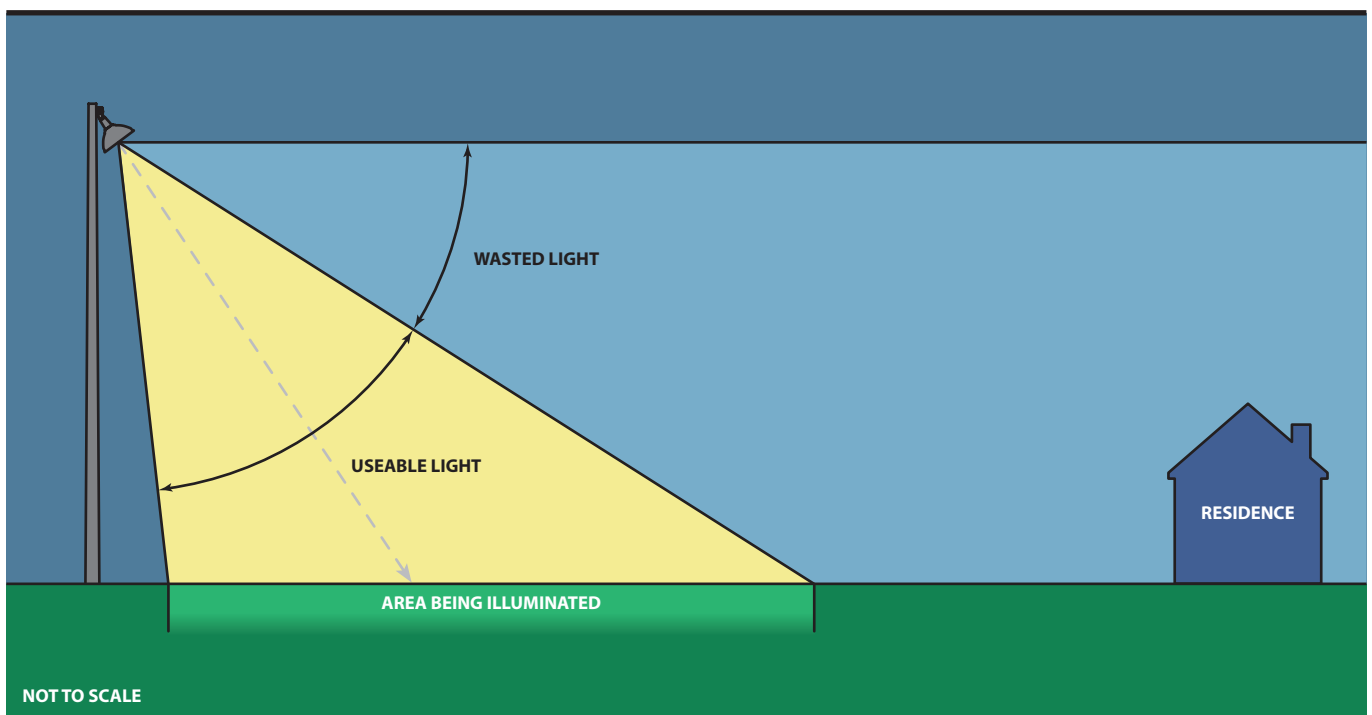
Corner mast arrangement:

A corner mast system can be utilised but, care should be taken that masts are situated so that there is sufficient vertical illuminance as this can sometimes prove difficult in the central area of side-lines. Heavy X shadowing from players is a drawback to this design as well as higher potential for glare. Positioning some lighting on the roof over spectator stands may help if of adequate height.

Light Control

Obtrusive light

This is wasted light that is directed up in to the sky or beyond the boundary of a sports facility. Reference should be made to CIE 150 (issued by the International Commission on Illumination) or local regulations. A good quality hockey lighting installation will achieve the lighting requirements and at the same time not impose on surrounding residents or services. FIH encourages all hockey pitch owners to be “good neighbours”. The lighting equipment supplier can assist in assessing this issue and provide drawings showing maximum lux at any points of concern on adjacent properties. Do not hesitate to investigate a supplier’s reputation, abilities and past experiences in working with local authorities and private property owners regarding glare and spill issues.



Commissioning

The luminaires must be aimed according to the lighting design and this should be followed by measurements to ensure that the installation meets the lighting design. Measurements should be carried out using a calibrated illuminance meter.

- For testing, a grid of maximum size 10m x 10m should be laid out with a point in the centre for lighting venues at non-televised events and 5m x 5m for lighting venues at televised events.
- Before measuring, the supply voltage should be checked.
- Lamps should have been used for a minimum of 10 hours to ensure consistency.
- After switching on the lighting, sufficient time should be allowed to ensure the lamps have warmed up. The required warm up time depends on the type of lamps used and can be obtained from the lamp manufacturer's specifications.
- Measurements should be undertaken from the highest switching mode working back down to the training mode.
- Infield measurements may vary from computer predicted results. On new installations this should be on the positive side of the average light levels required. For existing fields if the average light level is below computer predicted light level averages the light levels should be reviewed by a professional sports lighting engineer to determine if safety or broadcast ability is impacted.

A measurement record sheet should be used to record the results. An example is shown on the following page.



Project Name: _____

Project Number: _____

Field Identification: _____

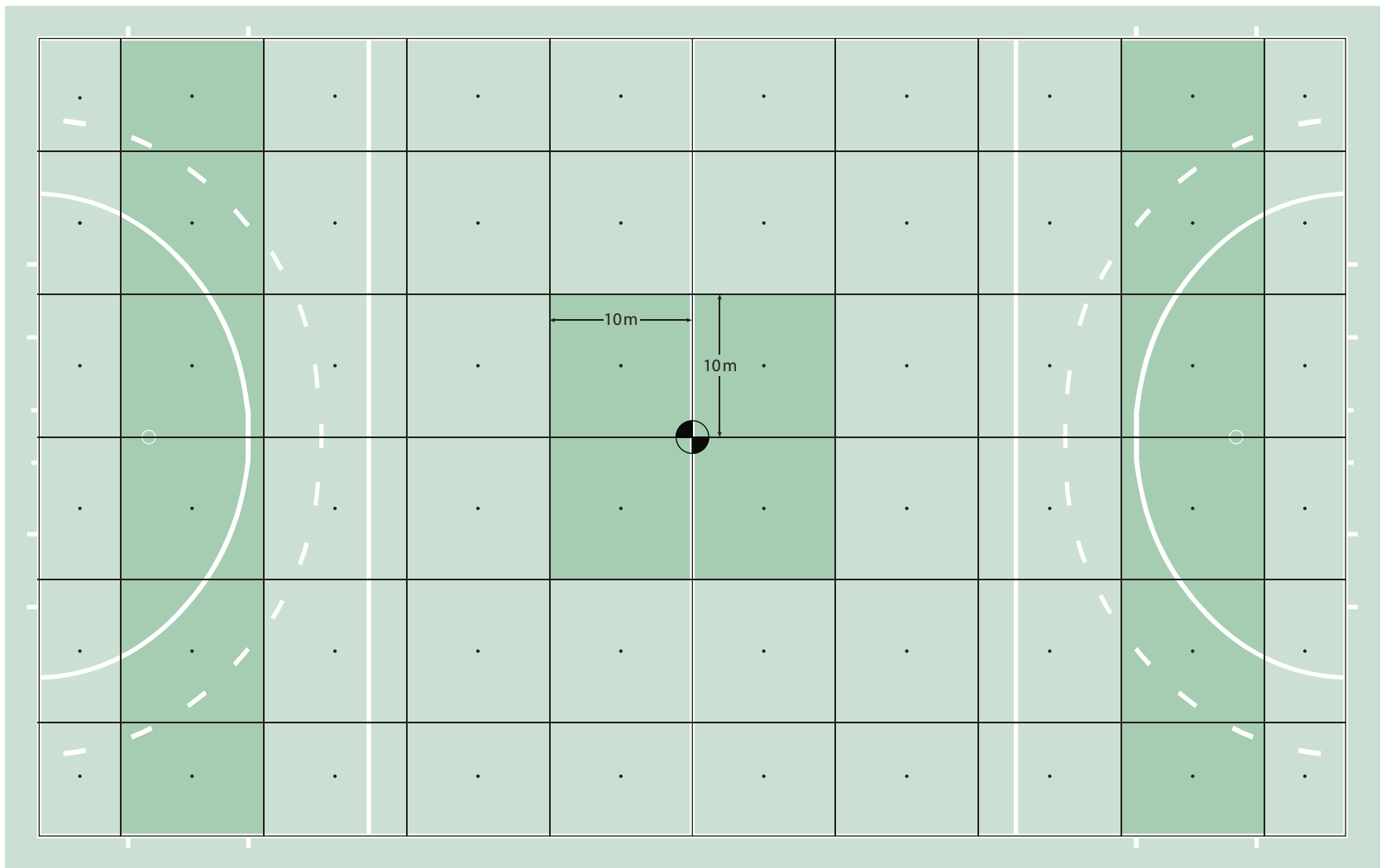
Date Readings Taken: _____

Technician: _____

Conditions: _____

Light Meter: _____

Last Calibration: _____



Average: _____ Min/Max: _____ CV: _____

Maximum: _____ Min/Avg: _____ Deviation: _____

Minimum: _____ Target Points: _____

Commissioning of a new lighting system should include readings at each location.

We recommend annual sampling of highlighted areas for comparison against previous readings to gauge playability for the season.

Broadcast requirements may entail more readings and professional evaluation.

Notes: _____



Key Terms in Sports Lighting

Here are some key terms you may want to understand:

Quantity of light required (illuminance)

This is the amount of light (measured in lux) that is required for the sport to be played.

Average maintained horizontal illuminance (E_h)

This is the average quantity of lux over the horizontal playing surface.

Average maintained vertical illuminance (E_v)

This is divided in to two principal types:

- Illuminance in the direction of a camera. This calculation is undertaken for fixed camera positions.
- The second is the quantity of light on a vertical plane and should be used for unrestricted camera positions.

In hockey the point of reference is 1.5 m above the playing surface.

Illuminance uniformity

Two measurements are normally undertaken:

- Minimum/Average: this is the ratio of the lowest to the average level of illuminance.
- Minimum/Maximum: this is the ratio of the minimum to the maximum level of illuminance.

Colour temperature (colour appearance)

The apparent colour of a light source and is measured in Degrees Kelvin. A consistent colour temperature should be utilised throughout an installation.

Colour rendering

Colour rendering is the ability of a light source to reproduce surface colours accurately. A colour rendering index is used to describe the performance of the lamp.

Glare

For outdoor hockey venues a Glare Rating (GR) is given based on a mathematical glare formula. This formula does not currently exist for indoor venues.

Switching Modes

Lighting should be designed to include different levels of light that are appropriate to the level of play. The following levels or 'switching modes' are commonly used:

- Training class III
- Competition class II
- High Grade Competition class I
- TV Broadcast (multiple level options for broadcast (see chart) but each venue would typically only have one broadcast switching level)



The International Hockey Federation provides information on various topics related to pitches and equipment on its web site.

The Rules of Hockey or the Rules of Indoor Hockey contain field, pitch and equipment specifications including:

- Field dimensions and markings (outdoor/field hockey)
- Pitch dimensions and markings (indoor hockey)
- Goals (outdoor/field hockey)
- Goals (indoor hockey)
- The stick (outdoor and indoor hockey)
- The ball (outdoor and indoor hockey)
- Goalkeepers' equipment (outdoor and indoor hockey)

Information is available about Synthetic Turf Fields including:

- Performance requirements
- Guidelines for care and maintenance
- Licensed manufacturers/suppliers of synthetic turf
- Licensed manufacturers of hockey balls
- Advice on the requirements and regulations for advertising around the field of play and on coloured over-runs

For further information, email info@fih.ch.



Notes:



International Hockey Federation
Rue du Valentin 61
1004 Lausanne
Switzerland

Tel: + 41 21 641 0606
Fax: + 41 21 641 0607

Email: info@fih.ch
Web: www.fih.ch

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