SUSTAINABLE ENERGY AUTHORITY OF IRELAND

Sports and Leisure

A GUIDE TO ENERGY EFFICIENT AND COST EFFECTIVE LIGHTING

This guide provides information on how to improve the quality, visual environment and cost effectiveness of lighting schemes in sports and leisure buildings through the use of energy efficient lighting technologies and techniques. By following this guidance you can reduce your electrical energy consumption by 30% to 50%, reduce maintenance costs and improve conditions for facility users.

ENERGY EFFICIENT AND COST EFFECTIVE LIGHTING

The quality of lighting in sports and leisure buildings has a key impact on its suitability for various sports. A well-lit sports building looks attractive to users and will deliver the correct illumination for a wide range of sporting activities. Lighting should be effective, energy efficient and require minimum maintenance. When these choices are integrated with good daylighting strategies electricity costs can be dramatically reduced. Use the appropriate lamps and luminaires (fittings) for each sports application.

LIGHTING OVERVIEW

To attain the best performance from the lighting scheme the following aspects of lighting technology and techniques should be addressed:

- colour appearance and colour rendering
- light distribution and lighting levels in the playing areas
- lamp and luminaire choice
- luminaire positions to avoid glare for players and spectators
- controls to adjust lighting levels and turn off lamps when not required
- use of daylight to supplement electric lighting
- maintenance and cleaning of luminaires
- lamp life, particularly for high level mounting positions

COLOUR APPEARANCE AND COLOUR RENDERING

Colour appearance as illustrated in Figure 1, defines a lamp's 'whiteness' and is measured on the Kelvin temperature scale (K). A colour temperature of less than 3,500 K is 'warm'; a colour temperature of 3,500 K is mid-white; and a colour temperature of 4,000 K and above is 'cooler'. 'Cooler' whites can provide better clarity in fast moving games such as squash, while 'warmer' whites can be used for sports which are less physically demanding.

Colour rendering is the ability of a light source to give good colour representation of the colour it is illuminating. It is measured on a scale of Ra 0-100 with Ra 100 representing the best, which is equivalent to that provided by daylight.

Ra 80 and above provides good colour rendering for a wide range of sports.

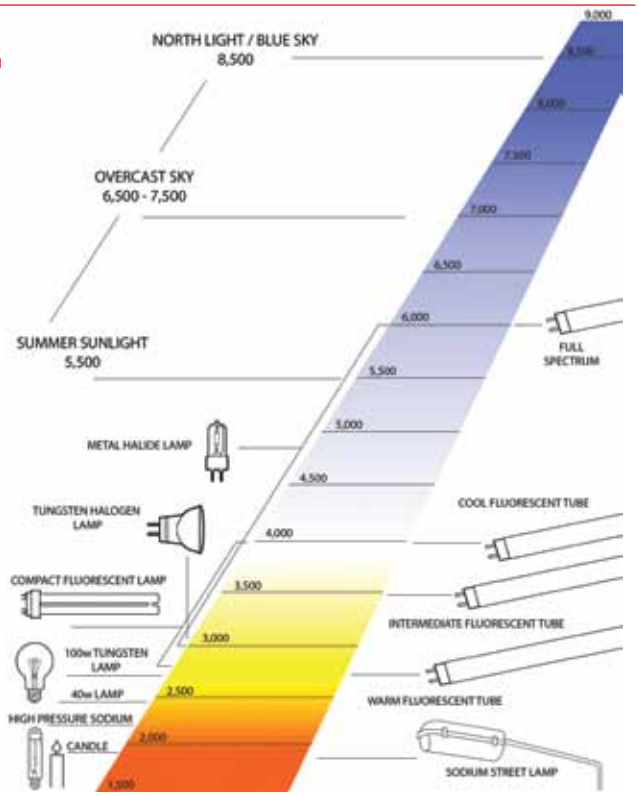

Fig.1 *Colour temperature (K) of various light sources.*

LIGHT DISTRIBUTION

It is important at the lighting design stage to have a clear understanding of the long term objectives of the sports areas and the range of uses. In large volume spaces such as sports and swimming pool halls, it is important to 'light what you see' particularly vertical surfaces.

- Wall colour should have a reflectance value of around 50% with darker backgrounds preferred for badminton and table tennis.
- Lighting levels of between 300 lux and 500 lux are suitable for most sports halls and swimming pools. 'lux' is a measure of the illuminance level and should be taken at the task level, i.e. on the table for table tennis and floor level for badminton. A lux reading can be obtained by using a light meter.
- Ensure that the correct illumination levels for the particular sport are uniform on vertical and horizontal surfaces.

APPLICATIONS IN SPORTS AND LEISURE FACILITIES

The following examples show applications within a sports facility listing some of the most appropriate energy efficient and effective lamps and luminaire types. For a full description of the different lamp types shown here, refer to the back page.

More detailed guidelines on lighting requirements for a wide range of sports are available from the National Standards Authority of Ireland's guide *I.S. EN12193:2007 Light and lighting-sports lighting.*

GENERAL SPORTS HALLS (300 lux)

For sports halls with low ceilings (below 6m)

- Electronic High Frequency T8 or T5 tubular fluorescents.

For larger sports halls with high ceilings (above 6m).

- T5 lamps in high bay fittings are suitable for most sports hall applications. They can be used for daylight dimming and presence detection.
- Otherwise consider high pressure sodium lamps (SON), or metal halide lamps if colour rendering is important, in high-bay luminaires with parabolic reflectors.

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FITNESS SUITES (250 lux – 400 lux)

- Use tubular fluorescents or CFLs for general background lighting with a 'cool white' colour (4,000 K and above) which gives the impression of a fresh and cool space for users.

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MULTI-PURPOSE POOL HALLS (300 lux – 500 lux)

Recreational/Club 300 lux and National 500 lux

- Metal halide are usually the most appropriate lamps when in enclosed (IP65 rated) luminaires as they provide good colour rendering and they are available in different colours of 'white' and have a long lamp life.
- Uplighting provides the least glare for swimmers and spectators and can be mounted more conveniently over pool surrounds for easier maintenance.

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RECEPTION, OFFICES (300 lux – 500 lux) AND CIRCULATION AREAS (150 lux)

- Use T8 (triphosphor) or T5 tubular fluorescents or CFLs for general lighting.
- Use infra-red coated (IRC) low voltage tungsten halogen dichroic lamps, appropriate LED versions or CFL lamps for accent lighting.
- Use CFLs or LEDs in task lights.

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CHANGING AREAS (200 lux – 300 lux)

- Use T8 or T5 tubular fluorescents or CFLs for general lighting.

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REFRESHMENT AND VIEWING AREAS (200 lux – 300 lux)

- Use CFLs for general background lighting.
- IRC tungsten halogen dichroic lamps and LEDs can be used to accentuate displays or create contrast.

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LUMINAIRES

The luminaire's light output ratio (LOR) is a measure of the proportion of the lamp light output that emerges from the luminaire. High efficiency luminaires of up to 93% are available. Manufacturers provide information on LORs and in general you should choose the highest LOR to minimise the number of fittings that are required to deliver the desired lighting effect. Use impact resistant luminaires in sports halls. Some rules of thumb for luminaire positioning:

- In large multi -purpose halls with fluorescent or discharge lighting it is usual to arrange the lighting in rows between courts (Figure 2).

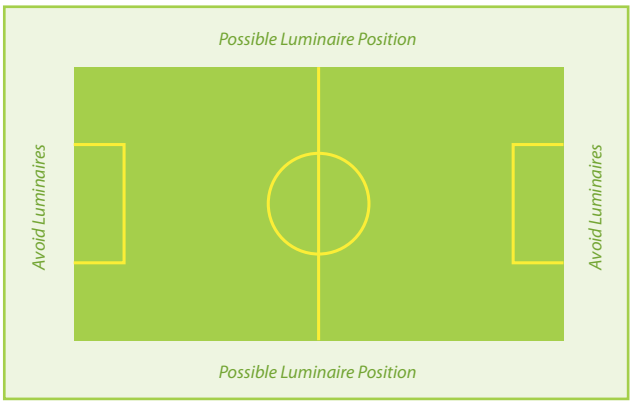


Fig.2 *Multi-Purpose Hall lighting layout*

- Luminaires should not be in the player's line of vision but vertical surfaces should be illuminated to allow easy viewing of balls, shuttlecocks etc.
- The intensity of the lamp should be relative to the height above playing areas, i.e. very bright light sources should be at higher mounting heights than those with less bright lamps.
- Use of indirect lighting is a good approach for swimming pool halls to give uniform, glare free illumination (Figure 3).

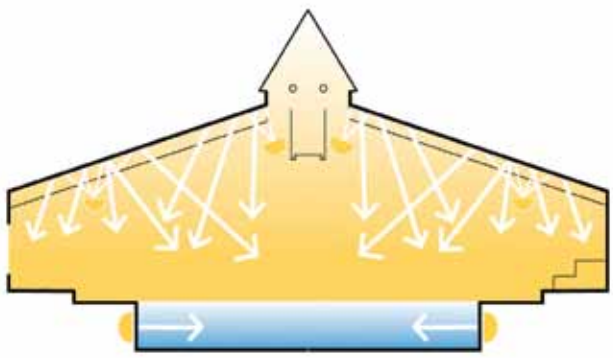


Fig.3 *Swimming pool hall lighting layout example. Access to luminaires from poolside and overhead gantry.*

CONTROLS

Effective lighting controls will maximise running costs savings.

- In sports halls with windows, zone controls could be linked to daylight sensors if good natural lighting is available.
- Presence detectors complete with daylight sensors are appropriate for cellular areas such as stores and changing areas and wherever variable occupancy occurs. Controls are available as infra-red (Figure 4) and ultra-sonic/microwave (Figure 5) with ranges between 5m to 60m for different applications.
- Daylight sensors can turn lights on/off and dim lights when sufficient daylight is available. Use in car-parks, circulation, office and reception areas.
- Light switches should be operated by staff using fish tail keys so that they are not tampered with.
- Controls should be set to ensure that fluorescent lamps are not switched on and off at too short an interval. Fluorescent tubes which have 'soft start' i.e. electronic starters or electronic high frequency ballast types, provide a less detrimental impact on the life cycle of lamps.

More information is available from a separate guidance document on controls in this series.

Fig.4 *Infra-red wall sensors with no neutral should only be used for the smaller sized room application i.e. stores and changing rooms.*

Fig.5 *Ultra-Sonic/Microwave for larger areas.*

DAYLIGHT

Natural lighting is a great way to reduce lighting costs.

- In sports halls, windows at high levels are preferred.
- Special 'daylight' blinds can channel light into building areas whilst reducing glare. Fit daylight sensors to artificial lighting to take advantage of the 'free' daylight.
- Investigate the use of light pipes, rooflights or other ways of getting more daylight into the building as part of refurbishment works.

MAINTENANCE AND LAMP REPLACEMENT

- Long life versions of lamp types should always be chosen as they will significantly reduce maintenance requirements.
- Keep lamps, luminaires, sensors and surfaces free from dust and dirt.
- Carry out group or bulk maintenance of lamps and fittings at suitable intervals.
- Luminaires should be easily accessible for lamp replacement.

Use the following guidance when deciding to replace existing inefficient lamps or fittings:

Existing Lamp Type	Replacement Lamp Type	Benefits
Mains Voltage Halogen Dichroic Reflector 35W 50W 	LED (GU10) (Also available in Low Voltage) 4W 8W 	90% energy saving Forty times the lamp life As the light distribution differs between these two lamp types lower light levels may be expected
Standard Metal Halide 	Ceramic Metal Halide (CMH) 	Equal efficiency Longer life
38mm diameter T12 or 26mm diameter T8 linear fluorescent lamps on electromagnetic control gear 	16mm T5 fluorescent lamp retrofit with electronic adaptor 	Use existing light fittings with retrofit adaptor 30% to 50% energy saving Twice the lamp life
Standard Metal Halide 	16mm diameter T5 fluorescent tube 	New light fittings required Dimmable and suitable for presence detection controls Better colour rendering No 'warm-up' or 'restrike' time required Twice the lamp life

Note: *Always use reputable suppliers and products that comply with all national and EU lighting regulations and standards. Trial newer products for their suitability before widescale upgrades. Refer to* ***www.seai.ie/aca*** *for energy efficient products.*

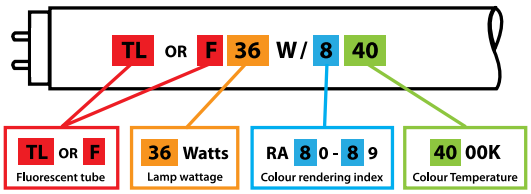
LIGHTING TECHNICAL DETAILS

1 Tubular or compact fluorescent lamps

The most common fluorescent tubes used in sports buildings are T8 (26mm), always specify triphosphor coated T8 models. T5 (16mm) and compact fluorescents are only available in triphosphor coated types. Always use electronic high frequency control gear to operate fluorescent lamps as this will maximise lamp life from a minimum of 12,000 hours to 60,000 hours (dependant on whether long life versions are used).

Ensure consistency in lamp colour temperature when replacing lamps by selecting the same lamp code. Always select luminaires that have high frequency electronic ballasts as they consume less energy and can provide interactive dimming or automatic signalling via an interface controls system.

When using compact fluorescents lamps, choose luminaries with electronic control gear as they are more energy efficient and provide for 50% more lamp life. Lamp code example: F36W/840.



- A good example of high efficiency lighting for sports halls would be to utilise 4 way 54W T5 or 4 way 55W compact fluorescent lamps within high output 'High Bay' type luminaires with cool white (4,000 K). These models are also available in 'dimming' versions for areas where there is daylight ingression.

2 High pressure sodium (SON) lamps

High pressure sodium discharge lamps combine high efficacy with long life and can be used in sports halls where colour rendering is less important. Lamps require a warm-up and re-strike period and are therefore not suitable for frequent switching.

3 Metal halide discharge lamps

Metal halide (HID) lamps have good efficiency and may be used to provide general lighting in large spaces, and for situations where good colour rendering and different colour appearances are required. Remember that if turned off during operation, metal halide lamps require a warm-up and restrike period of up to 15 minutes. A backup alternative lighting source is therefore required to provide light during restrike time. This is often achieved with fluorescent luminaires.

4 Low voltage (12v) IRC tungsten halogen dichroic lamps

Infra-red Coated (IRC) versions are brighter and more efficient than standard (12v) Tungsten Halogen Lamps and 300% brighter than GU10 mains voltage models.

5 Mains voltage GU10 LEDs

There are many LED replacements for replacing existing Mains Voltage GU10 lamps. They vary in wattage and distribution and can therefore be disappointing if the incorrect LED type is chosen. Always trial the prospective model to obtain the appropriate LED type for your application.

LAMP COMPARISON CHART

The best light sources for sports buildings are highlighted in yellow below.

Lamp Type	Efficacy (Lumens per watt)	Colour Temperature (K)	Colour Rendering (Ra)	Lamp Life (Hours)
Daylight		5,500 - 8,500	100	
Compact Fluorescent	45 - 90	2,700 - 4,000	85	8,000+
IRC Tungsten Halogen Low Voltage (12v)	22	3,000	100	5,000
T8 (26mm dia.) Halophosphor Fluorescent Tubes	37 - 68	2,700 - 4,000	58	6,000+
T8 (26mm dia.) Triphosphor Fluorescent Tubes	71 - 92	2,700 - 6,000	80	20,000 - 60,000
T5 (16mm dia.) High Efficiency Fluorescent Tubes	66 - 82	2,700 - 6,500	80	20,000
T5 (16mm dia.) High Output Fluorescent Tubes	62 - 76	2,700 - 6,500	80	20,000
Metal Halide (Standard)	71 - 83	3,000 - 6,000	65 - 85	8,000 - 20,000
Metal Halide (CDM)	87 - 95	3,000 - 6,000	65 - 85	12,000+
Mercury	31 - 57	3900 - 4200	36-49	12,000+
High Pressure Sodium	86 - 95	3,000 - 6,000	25	12,000 - 30,000
High Pressure Sodium H	80 - 89	2,000	25	8,000 - 20,000
LED*	50 - 100	3,000 - 6,000	70 - 80	35,000 - 50,000

** These types of lamps are continuously improving and should be investigated at periodic intervals*

Lamp life is the variance in lamp life indicated due to some lamp models having differing life hours available. When lumens fall to 80% of initial lumens, this is the rated 'life' and when the lamp should be replaced. One of the objectives of the lighting design should be to ensure that the lamps and fittings chosen will require the minimum amount of maintenance. Always seek to use long life versions to maximise savings in energy and maintenance costs.

Efficacy is the ratio of light emitted by a lamp to the power consumed by it, i.e. lumens per Watt. A lumen is a measure of the quantity of light emitted by a lamp.

A tax incentive is available through the accelerated capital allowance (ACA) scheme for approved lighting products. Further information and details of manufacturers and suppliers of eligible products are available from **www.seai.ie/aca**

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