LIGHTING DESIGN GUIDE

Designing a basic lighting scheme requires the consideration of many factors, not just the achievement of a desired lighting level. Basic objectives must first be established, such as:

- What sort of tasks will be performed in the area?
- What 'mood' needs to be created?
- What type of lighting will create a comfortable environment?

There are also standards and legislation that need to be complied with. For example:

- How energy efficient must the lighting be?
- How will Building Regulations affect the design?
- Is emergency lighting required?

When all of these objectives and requirements have been established, they can be expressed as a series of lighting criteria in order to facilitate a quality lighting design. Criteria that would normally be considered are:

- **Level of Illumination**
  Illumination levels for a wide variety of environments and tasks can be found in BSEN 12464-1: 2002 and the Society of Light and Lighting's Code for Lighting. The levels stated are maintained illuminance, which is the minimum average illumination level that should be achieved at the point of scheduled maintenance.

- **Uniformity & Ratios of Illuminance**
  The combination of luminaires selected should evenly illuminate the working plane and appropriately illuminate walls and ceiling in relation to the task illumination, so that a pleasant and comfortable environment is achieved. In specific areas, increased directional lighting may be required to create a defined or more intimate environment.

- **Glare**
  The acceptable level of glare should be established as appropriate for the application, using information in BSEN 12464 and the Code for Lighting.

- **Colour & Room Reflectance**
  The colour appearance of the lamps should be natural for the application and complement the interior colour scheme, which should be chosen with an appreciation of the reflectance values that will be achieved. Lamps should be selected with appropriate colour rendition properties, for colour discrimination and reduction of eye fatigue.

- **Energy Efficiency**
  Luminaires should be selected that meet the requirements of the Building Regulations. The distribution characteristics should also match the requirements of the criteria above.

- **Special Considerations**
  Certain applications require additional considerations, such as the addition of display lighting, the arduous nature of the environment or the use of Display Screen Equipment. Luminaires should be selected and the design completed with these elements in mind, where appropriate.

After these criteria have all been considered, a lighting scheme calculation can be undertaken. The most popular method of establishing the quantity of luminaires required, the illumination level achieved and the luminaire layout, is to use computer software created specifically for lighting design. It is important to remember that all the criteria above must still be considered prior to using computer software, if a satisfactory scheme is to be produced. Details of the Cooper Lighting Design System can be found on page 464.

Lighting Design can also be achieved using published photometric data, such as that included on the product pages of this catalogue. Average illumination via the lumen method of calculation can provide fast results that can then be assessed and facilitate more detailed design of the most appropriate option if required.

LUMEN METHOD CALCULATIONS

This method uses the utilisation factor tables created from photometric measurement of each luminaire. Firstly, the Room Index (K) of the space must be calculated, which is the relationship and measure of the proportions of the room:

$$K = \frac{L \times W}{(L + W) \times Hm}$$

Where:
L = length of room
W = width of room
Hm = height of luminaire above working plane

The result is used in conjunction with room reflectance values to obtain a specific utilisation factor for the surface illuminated from the tables. Example:

This can then be used as part of the calculation to determine the average illuminance level, using the following formula:

$$E = \frac{F \times n \times N \times MF \times UF}{A}$$

Where:
E = average illuminance
F = initial lamp lumens
N = number of luminaires
MF = maintenance factor
UF = utilisation factor
A = area

The maintenance factor is a multiple of factors and is determined as follows

MF = LLMF x LSF x LMF x RSMF

Where:
LLMF = lamp lumen maintenance factor - the reduction in lumen output after specific burning hours
LSF = lamp survival factor - the percentage of lamp failures after specific burning hours
LMF = luminaire maintenance factor - the reduction in light output due to dirt deposited on or in the luminaire
RSMF = room surface maintenance factor - the reduction in reflectance due to dirt deposition in the room surfaces

Guidance on calculating each of these factors is provided in the SLL Code for Lighting. Alternatively, contact our Technical Support and Application Department for advice.

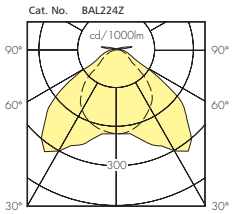
Finally, the luminaires must be spaced in the room such that acceptable uniformity is achieved. The maximum spacing to height ratio, SHRmax, provides the maximum spacing permissible between luminaires in both transverse and axial directions, in comparison to the mounting height and should not be exceeded if acceptable uniformity is to be achieved.

USING PHOTOMETRIC DATA

This catalogue includes a number of different formats of photometric data, to assist in lighting design.

Polar Intensity Curves

This illustrates the distribution of luminous intensity, in cd/1000 lm, for the transverse (solid line) and axial (dashed line) planes of the luminaire. The curve provides a visual guide to the type of distribution expected from the luminaire e.g. wide, narrow, direct, indirect etc, in addition to intensity.



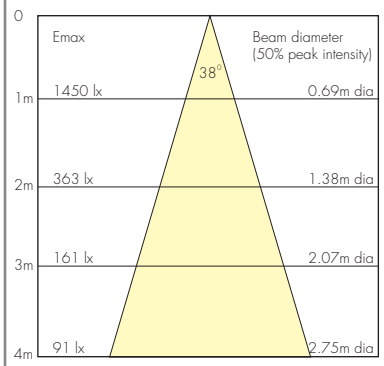
Utilisation factors / TM5

Reflectances			Room Index							
C	W	F	0.75	1.0	1.25	1.5	2.0	2.5	3.0	4.0	5.0
70	50	20	42	50	55	59	64	67	69	72	74
	30		37	45	50	54	60	63	66	69	72
	10		33	41	47	51	56	60	63	67	70
50	50	20	41	48	53	56	61	64	66	69	70
	30		36	44	49	53	58	61	63	66	68
	10		33	40	46	49	55	58	61	64	67
30	50	20	39	46	51	54	58	61	63	65	67
	30		35	43	48	51	56	59	61	64	65
	10		32	40	45	48	53	56	59	62	64
0	0	0	30	37	42	46	50	53	55	58	60
BZ-class			4	4	4	4	4	4	4	4	4

See page 438 for Design Guide

Illuminance Cone Diagrams

Usually used for spotlights or lamps with reflectors, the diagram indicates the maximum illuminance, Elux, at different distances, plus the beam angle of the lamp over which the luminous intensity drops to 50%. The beam diameter at 50% peak intensity, relative to distance away, is also shown.

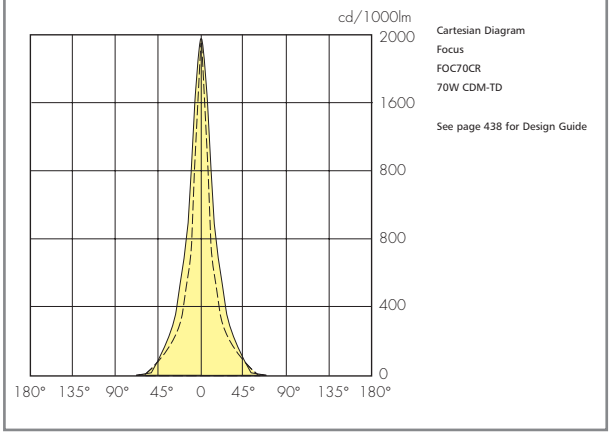


Cone Diagram
Coolstar Fixed
CSF50W
50W Dichroic

See page 438 for Design Guide

Cartesian Diagrams

Generally used for floodlights, this indicates the distribution of luminous intensity, in cd/1000 lm, for the horizontal (solid line) and vertical (dashed line) planes of the luminaire. The diagram provides a visual guide to the type of distribution expected from the luminaire e.g. narrow or wide beam etc, in addition to intensity. The associated data illustrates the beam angle to 10% peak intensity.

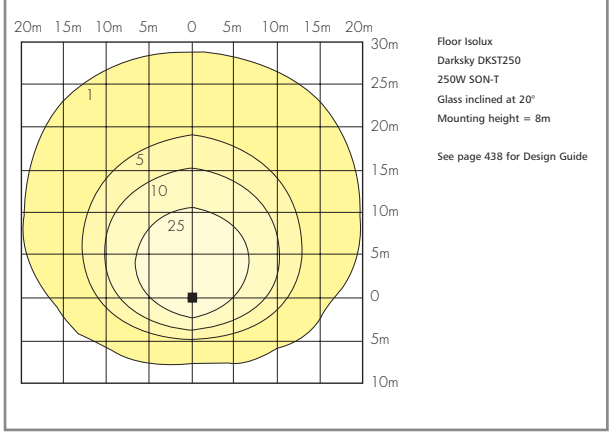


Cartesian Diagram
Focus
FOC70CR
70W CDM-TD

See page 438 for Design Guide

Isolux Diagrams

The contours provide the points of equal illuminance, in lux, on the floor or wall plane, from a specific stated mounting position. The diagram can be used to assess the distribution characteristics of the luminaire in addition to determining lighting levels.



Floor Isolux
Darksky DKST250
250W SON-T
Glass inclined at 20°
Mounting height = 8m

See page 438 for Design Guide

USEFUL WEBSITE ADDRESSES

www.cibse.org - The Society of Light and Lighting
www.bsi-global.com - British Standards