

There is a wide range of lighting application standards and guides available to aid the designer in creating a comfortable and efficient working space.

The recent updated edition of BS EN 12464-1:2011, which not only sets a standard for illumination levels for specific tasks but, also provides advice on how to achieve a lighting solution to meet the human need. Also the CIBSE Lighting Design Guides provides a very good source of guidance for the design of working spaces, and can be considered as best practice. Lighting Guide (LG) 7 is possibly the one most commonly referred to, but it is often misunderstood being used to specify luminaires rather than the total environment of the space.

LG7 was written to supersede the original LG3 which had very restrictive cut off criteria for the luminance of luminaires. With the development of improved and flatter VDT screens this could be relaxed, allowing for higher luminance values from the luminaire. The increase being 1000 cd/m<sup>2</sup> or 200 cd/m<sup>2</sup> if the screen type is unknown. This can be increased up to 1500 cd/m<sup>2</sup> and 500 cd/m<sup>2</sup> respectively if positive polarity software only is used. It also recommended values for the wall and ceiling illuminance which were based on a direct percentage of the working plane level. The intention being to alleviate the "cave like" appearance that the single use of the original Category 3 cut off luminaires produced. It must be stated that LG7 is often referred to as being, a guidance for luminaires but it was written as a complete guide for the lighting of the office environment, taking into account the total need of the occupants to create a pleasant working space. Within the guidance there are specific references to the recommended levels of wall and ceiling illuminances.

#### • Recommendation for wall and ceiling illuminance

The guide provides recommendations to address the dark and gloomy effect that can be created by 'categorised' louvres, including the sharp wall cut off and bright scalloping. To avoid this, walls and the ceiling should be lit as follows:

- The average wall illuminance above the working plane should be at least 50% of the average horizontal illuminance on the working plane, avoiding bright scallops or patches.
- The ceiling average illuminance should be at least 30% of the average horizontal illuminance on the working plane. In the case of large areas with unusually low ceilings, this may be difficult to achieve and so should be as high as practically possible.

The other misconception is that office lighting is all about creating a uniform lighting level across the whole space. What is needed is uniform lighting across each task area, which normally consists of relatively small areas on each desk. The lighting in the wider office space can, and indeed should, vary somewhat to create visual interest. Even the most dedicated office worker looks up from his or her work from time to time, and when they do they need to see an interestingly lit office space and, ideally, a more distant view out of a window.

If the building and the visual requirements of the users of an office space are understood and all possible lighting options are considered, a lit environment can be created for each office space that not only provides the required levels of lighting for each task but also provides an interesting and stimulating lit environment for people to work in.

This is a direct quote from the introduction of LG7 which goes on to discuss the whole design process. The overall intention of the guide has not been fully utilised by the majority of users and the reliance of a "single luminaire solution" has still been widely requested. The single luminaire approach when used in regular arrays to produce a high level of uniformity across the whole working space can be in contradiction to the original intent.

If designing to LG7 the certificate of conformity should be used to show the criteria of the design.

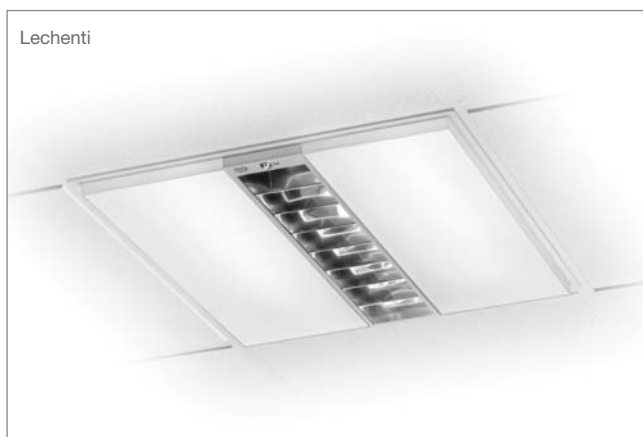
#### • Certificate of Conformity

The guide requires that the designer and installer of the installation complete and sign a Certificate of Conformity to demonstrate that all known visual and ergonomic criteria were fully considered during the design process and installed as specified.

Due to the regular development of these guides, Cooper Lighting and Safety recommends you visit CIBSE on [www.cibse.org](http://www.cibse.org) to ensure the latest guides are being referred to.

#### • EN12464-1:2011

The lighting design standards detailed in EN12464-1:2011 breaks the design process into a number of key elements to aid the design process. It however is not intended to provide specific solutions, nor restrict the designer from exploring new techniques or restricts the use of innovative equipment. The use of daylight as well as artificial light should also be fully utilised for both quality and to reduce energy.



- **EN12464-1:2011 (cont'd)**

- Luminous environment
- Luminance distribution
- Illuminance
- Glare
- Lighting in the interior space
- Colour aspects
- Flicker and stroboscopic effects
- Maintenance factor
- Energy efficiency
- Additional benefits of daylight
- Variability of light

- **Luminous Environment**

For good lighting it is essential that as well as the required illumination level is achieved it is important that the requirements of the occupant are considered. Lighting should meet the three basic human needs:

- Visual comfort
- Visual performance
- Safety

By meeting these basic requirements the lighting scheme will offer a feeling of wellbeing and allow all tasks to be safely and efficiently carried out.

- **Luminance Distribution**

The distribution of the source of illumination is important as this will have a direct effect on the individual and it is important to ensure that the level of adaption is balanced throughout the space.

This will increase visual acuity and contrast, as positive aspects, but good distribution will reduce the risk of excess levels of brightness which in turn can lead to glare which can lead to fatigue and poor performance. However a good level of contrast is important so as to create an interesting environment for people.

A well balanced luminous environment can only be achieved by taking into consideration the reflectances and illuminance of all surfaces. To avoid a gloomy environment and to raise the level of comfort in the building it is highly desirable to have bright interior surfaces particularly walls and ceilings. The recommendations are:

- Ceilings; 70-90%
- Walls; 50-80%
- Floor; 20-40%

Additionally the reflectance of any major items of fixed equipment or furniture should be in the range of 20-70%. The standard states the minimum levels of wall and ceiling illumination along with the maximum uniformity of these surfaces:

- Walls and major vertical surfaces:  $E_m > 50$  Lux
- Ceilings:  $E_m > 30$  Lux

*For offices these should be increased to:*

- Walls and major vertical surfaces:  $E_m > 75$  Lux
- Ceilings:  $E_m > 50$  Lux

- **Illuminance**

The recommendations for minimum illumination levels are detailed for specific task areas based on the following factors:

- Comfort and well being
- Actual task requirements
- Functional safety
- Economy

The standard is based on illuminating the task area and not the total space with references to areas referred to as "immediate surround" with a minimum band width of 0.5 meters, and "background area" with illumination ratios to the task and each other. The standard also details the uniformities of the respective areas in place of the whole work space.

Typically if the task is illuminated to 500 lux the immediate surround should be at least 300 lux, whilst the background should be illuminated to a 1/3 the value of the immediate surround.

- **Glare**

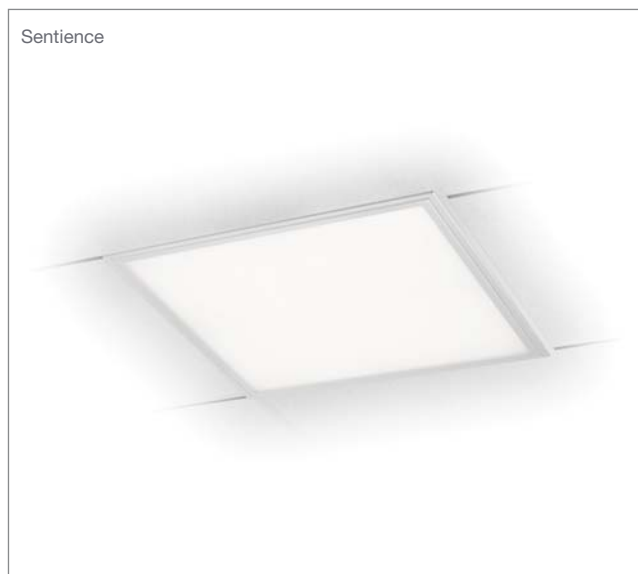
Glare must be limited to avoid errors, fatigue and accidents. Glare can be experienced as either:

- Discomfort Glare
- Disability Glare

If the limits of discomfort glare are met, disability glare is not usually a problem. The glare rating for a scheme should be calculated using the Unified Glare Rating (UGR) tabular method and must be below the rating listed for the application.

It should be noted that high brightness reflections in the visual task should be avoided and these can be prevented by correct arrangement of work spaces, choice of finishes, control of luminances and bright ceiling and wall surfaces.

Minimum shielding angles for bright light sources are also specified for a range of lamp luminances.



• **Lighting in the Interior Space**

It is important to ensure that illumination of the space fully considers the human need and ensures that the lighting solution provided has a good level of cylindrical illumination. This is important in environments where good inter-personal communication is required. Additionally the appearance of a space can be enhanced by providing a degree of modelling by controlled use of directional lighting. EN12464 offers good advice on achieving a balanced environment.

• **Colour Appearance and Colour Rendering**

The colour appearance of the lamps refers to the apparent colour (chromaticity) of the light emitted, and the colour used should suit what is deemed as natural for the application, e.g. relative to wall colours, furniture, climate etc.

For visual performance and a feeling of comfort and wellbeing lamps with a suitable colour rendering index should be selected. Lamps with a colour rendering index value of Ra 80 must be the minimum used where people work or stay for long periods. For special applications, colour rendering may be acceptable with a lower index, but for other areas such as health care and retail, a higher value may be appropriate.

• **Flicker and Stroboscopic Effects**

Lamp flicker and stroboscopic effects, which create discomfort and dangerous situations, should be avoided. This can be achieved by use of high frequency control gear in typical applications.

• **Energy Efficiency**

Lighting should be designed to meet the lighting requirements of a particular task or space in an energy efficient way; however it is important not to compromise the visual aspects of the lighting scheme just to reduce energy usage. The use of relevant lighting controls should be considered in any design to take account of daylight, occupancy patterns, and by using dimming control gear the benefit of maintained illuminance.

A procedure for estimating the energy requirements for a lighting installation is given in BS EN15193 Lighting Energy Numeric Indicator.

• **Energy Efficiency (cont'd)**

(LENI), as this is based on a complete building and as such it should only be used as guidance if used for single rooms

• **Additional Benefits of Daylight**

A good lighting design should also utilise any available daylight which can have a beneficial effect on the occupants. Creating variance in lighting level, direction and spectral composition throughout the day creates a feeling of wellbeing and comfort, it is however important to ensure that windows and skylights do not cause visual or thermal discomfort, or a loss of privacy. Additionally the use of natural daylight is beneficial in reducing the overall total lighting energy for the installation.

• **Variability of Light**

Light is important to health and wellbeing as it can affect the mood, emotions and general alertness, so it is important to create a lighting solution that is not just a design by “numbers”, but one which truly takes into account the person.

• **Practical Scheme Design**

In order to comply with the wide-ranging requirements of the CIBSE guides and BS EN 12464-1 (interior), each element briefly described should be carefully considered before choosing the luminaires to achieve the desired effect for the installation. It is unlikely that one luminaire type alone will meet the requirements in full and provide a satisfactory result. Each installation will also differ in design, as each application varies in terms of surface colours, furniture, ergonomics, task, limiting glare requirements, available daylight etc.

These documents aim to encourage the designer to look more closely at the working environment required and to create a comfortable and balanced lighting solution. It should take into consideration the factors listed, rather than reverting to a default luminaire or single light source suitable for all applications. It is therefore more likely that schemes that successfully achieve the standard and guidance documents whilst creating a feeling of wellbeing will consist of a combination of luminaire types.

The combination of luminaires can include:

- Recessed or surface direct downlight luminaires
- Semi-recessed or recessed direct/indirect luminaires
- Suspended direct/indirect luminaires
- Wall washer luminaires
- Wall mounted or floor standing uplighters

The resultant installation will provide efficient illumination of the task area, whilst walls and ceilings are evenly illuminated to provide a visually comfortable lit environment.

This catalogue provides data on lamp colour rendering and appearance properties. Further information and advice on the application of CIBSE lighting guides, BS EN 12464-1 (Light and lighting – lighting of the work place), BS EN 15193 (Energy performance of buildings-Energy requirements for lighting) and many other standards and guides is available from our Technical Support and Application Department. They are also able to offer guidance on selecting the appropriate luminaires for the application from the Cooper Lighting and Safety range of mains and emergency luminaires.

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