

## Lighting Guide 3: Addendum 2001 *The visual environment for display screen use* A new standard of performance

LG3:2001 is the latest development in a design guide that has been in use by the lighting industry for 12 years. It has evolved over the years to take into account increasing familiarity with the lighting techniques available for use in areas where display screens are in use. It has also been updated to take into account new screen types, new technology and changing national and international standards.

This latest update is to be read in conjunction with the existing version of LG3 *The visual environment for display screen use*, published in 1996. This update makes changes to the use of the fallback 'category' system of downlights and revises the recommendations given in LG3 relating to the maximum luminance of luminaires to align with new European standards.

### **A Withdrawal of the Category rating system**

In LG3: 1996 there is a small part of the guidance on the use of downlights that allows the designer or supplier to fall back on the use of a standard range of downlight types where there is no information on the types or disposition of the screens in a space or the designer or supplier lacks sufficient expertise to make the correct choice of luminance limit and limit angle.

Because of the high tendency amongst some in the industry to always specify 'Cat' fittings without any thought to the actual working environment into which they are to be installed **the Category system is withdrawn from the LG3 guidance**. In future, any specification for downlights for use in display screen areas will have to be specifically specified by the designer or selected by the supplier based on the data supplied to them by the client/user.

Specifically sub-section 8.3.2 of LG3 dealing with 'Unknown screen geometries' is modified to read as follows:

If we know that display screens are to be used in a space but we know little about them, then we can not tell at what angle of tilt or heights they will be used in. We have to assume that they will be used within the standard ergonomic limits as described in appendix 1. The designer needs to select luminaires with an appropriate luminance limit based on the type(s) of screens likely to be used in that space. This luminance limit will be applied at a standard 65° limit angle unless it is known that the likely screen tilts would require a lower limit angle.

**Considering only the luminaire's light distribution, however, does not guarantee a successful lighting installation. The designer needs to consider all aspects of the guidance in order to design an installation that complies with Lighting Guide 3.** The key to success is the avoidance of any very high luminance patches in a space and any abrupt change in luminance across a surface or between adjacent surfaces. It is therefore necessary for the designer to have some influence over the control of daylighting and the specification of the reflectance of ceiling, wall and other surfaces.

In addition the existing Appendix 2 of Lighting Guide 3 is withdrawn and the following text is substituted as a guide to selecting an appropriate lighting distribution for downlights.

#### **Appendix 2 Direct light luminance limit calculation**

Where the lighting designers **are unable to obtain** information about the display screens in use in an area, they will need to select a luminaire with a luminance limit of 200 cd/m<sup>2</sup> at 65° elevation, or 55° in special circumstances. This is referred to as the luminance limit angle. Section 2.1 below defines how the luminance has to be measured and quoted for a given luminaire. These

calculations will normally be carried out by the luminaire manufacturer and will be quoted in their catalogues. There may however be circumstances when a designer or user wishes to assess or check the luminance limit of a particular luminaire.

Where the designer is working with a known client and the parameters of the screen to be used in the space are known, then the luminaires selected can have luminance limits of 500 cd/m<sup>2</sup>, 1000 cd/m<sup>2</sup> or 1500 cd/m<sup>2</sup>, with the limit angle defined by the designer.

### A2.1 Luminance limit calculations

Photometric compliance is achieved by establishing that the calculated average luminance at any point above the specified luminance limit angle does not exceed the required luminance limit. The luminance limit is 200 cd/m<sup>2</sup> for areas where screens with no surface treatment are in use with software using a negative polarity presentation (light characters on a dark background). Higher limits are possible where screens with an anti-reflective surface treatment and/or use software with a positive polarity presentation (dark characters on a light background).

The manufacturers should check for compliance at each 15° angles of azimuth around the luminaire and at each 5° angle of elevation above the limit angle up to 85°. The information required for this calculation is the louvre/reflector luminous plan area, the luminous intensity above the limiting angle in elevation, for azimuth planes 0, 15, 30,...330 and 345°, and the lamp/ballast data (see Figure A2.1).

For preliminary manual check purposes only the luminance can be quickly checked by designers using the figures for the axial, transverse, 30° and 60° azimuth planes to see how close to compliance a particular luminaire is.

For recessed luminaires, or those with little or no emission of light from the sides of the luminaire, the following equation should be used to calculate the luminance of the luminaire at the luminance limit angle, and at every 5° angle of elevation above that to 85°, in each specified azimuth plane:

$$B_c = \frac{I_{c\gamma} \cdot N \cdot F \cdot K}{l \cdot w \cdot \cos \gamma \cdot 1000}$$

where:

$B_c$  = Luminance in azimuth plane C (cd/m<sup>2</sup>)

C = Azimuth plane angle 0°, 15°, 30° ... 345°

$\gamma$  = Angle of elevation from the downward vertical

$I_{c\gamma}$  = Intensity at angle  $\gamma$  in azimuth plane C (cd/1000 lm)

N = Number of lamps

F = Initial lumen output of lamp (lumens)

l = Sum of bottom plan length of louvre elements (meters)

w = Sum of bottom plan width of louvre elements (meters)

K = Factor to account for any fixed turn down ratio when regulated or dimmed ballasts are used, or factor to account for higher output from standard high frequency ballasts

For luminaires with significant emission of light from the sides of the luminaire the more complex equation within CIBSE TM10 should be used (this will be superseded by a section on the calculation of glare in the Society of Lighting *Code for Lighting 2002*).

The calculations for luminance limit should normally be carried out with the lamp (or lamps) normally used in the luminaire and with the standard luminaire ballast and taking the initial lumen output value. If the luminaire only meets a certain limit with a lower output lamp or different ballast then this **must** be stated in the luminaire data. If certain luminaire lengths, normally the longer lengths, do not meet the limit achieved for the rest of the range then this must also be stated in the luminaire data.

## A2.2 Use of materials

Manufacturers may use whatever materials and construction methods that they wish to achieve the criteria set out above in sections 2.1. However, other standards, relating to electrical, mechanical and fire safety, will limit the range of materials and construction techniques that can be employed.

## B Aligning luminance limits with new European standards

The luminance limits defined in LG3 are being revised to bring them in line with a new European Standard. This will avoid possible confusion and help in standardizing luminaire production in Europe.

Within the UK the old six part DSE ergonomics standard BS 7179 has now been replaced by the seventeen part BS EN ISO 29241, 'Ergonomic requirements for office work with visual display terminals'. The new Standard is referred to in guidance to the 1992 Health and Safety (Display Screen Equipment) Regulations.

When discussing compliance with this standard it should be remembered that the Health and Safety Executive's guidance to the 1992 Health and Safety (Display Screen Equipment) Regulations states: 'There is no requirement in the Display Screen Regulations to comply with this or any other standard'. However, it does then go on to say '...employers may find standards helpful as workplaces satisfying [BS EN ISO 29241] would meet and in most cases go beyond the minimum requirements in the Schedule to the Regulations'.

Within the guidance to the Health and safety (display screen equipment) Regulations 1992, there is reference to BS EN ISO 29241.

'While the CEN standard is not formally linked to the Display Screen Equipment directive, one of its aims is to establish appropriate levels of user health and safety and comfort'.

The 17 parts of the standard cover all ergonomic aspects of working with display screens from the way keyboards are laid-out to the way input dialogues spring-up on Windows®. This update covers the implications for LG3 of just part 6 of the standard, 'Guidance on the work environment', and part 7 'Display requirements with reflections'. Part 6 provides the standards required of luminaires to be used in an area where screens of a particular type are to be used. Part 7 provides a method of selecting display screens based on the amount of anti-reflective treatment needed to cope with the existing lighting within an area.

It should also be remembered that the Health & Safety Executive's guidance document to the *Health and safety (display screen equipment) Regulations 1992* refers readers onto LG3 for specific guidance on lighting issues.

(It is also likely within the next year to 18 months that prEN 12464 *Light and lighting. Lighting of indoor work places* will become a full European standard. The present final draft of this standard aligns with the luminance limits given here and stated in part 6 of BS EN ISO 29241.)

At the time the current edition of Lighting Guide 3 was being written in 1995/6, the work on parts 6 and 7 of the BS EN ISO 29241 was running in parallel. Although the standard was in draft, it was decided to adopt the standard's criteria for different luminaire luminance limits for screens with different types of anti-reflectance properties. As noted in section 5.6 of LG3, at the time of publication only two classes of screen anti-reflectance were proposed. Now that the standard is published there are three.

This means that the international standard has three classes of screen quality whereas LG3 has only two. The three ISO monitor classes are Class I for screens with good anti-reflective properties, Class II for moderate anti-reflective properties and Class III for screens with little or no anti-reflective properties. The two existing LG3 screen types are screens with 'poor surface treatment' and screens 'with anti-reflective treatment'. LG3 refers to the standard for the final definitions of these screen types.

## B1 The part 6 recommendations

The ISO recommends that the average luminance of luminaires and bright room surfaces should not exceed 1000 cd/m<sup>2</sup> for class I and class II screens and not exceed 200 cd/m<sup>2</sup> for class III screens. For this reason the recommended LG3 luminance limits have been adjusted in line with this.

The standard also notes that ‘When dark symbols are represented on a brighter background, the reflection of bright surfaces is found to have a less disturbing effect . . .’. Whilst no specific luminance recommendations are given in the standard, it has been decided that SLL should give specific recommendations for this mode of screen presentation. So for areas where only screens using dark symbols on a brighter background (positive polarity) are being used we have shown higher luminance limit recommendations.

## B2 Changes to LG3 recommendations

The following section outline the changes now implemented in the Society of Light and Lighting’s (CIBSE) LG3. All specification issued after 1 January 2002 should comply with the following amendments.

### B2.1 Recommendations for direct lighting

The International Standard acknowledges that the measurement of peak luminance on complex luminaires is difficult. For this reason the ‘Patch Test’ requirements are withdrawn. Specifically, table 8.2 on page 28 and the accompanying paragraph above it are withdrawn. Section A2.2.2 on page 45 is withdrawn. However, manufacturers should still design the optics of their luminaires to avoid, as far as is practicable, obvious bright patches.

However, part 6 of BS EN ISO 29241 does state that ‘It is . . . important that the luminance peaks diverge as little as possible from the average values’. Manufacturers should take this into account when designing optical systems for luminaires. It is particularly important to avoid any rapid ‘cut-off’ in luminous output. Such sharp ‘cut-offs’ can lead to sharp shadows on walls and cause annoyance to users sitting at a point where, if they move their head slightly, the luminaire above them goes from appearing bright to appearing dark.

To bring the screen types described in LG3 in line with the Standard the following changes are to be made:

The luminance limits laid-out in Table 8.1 on page 28 of LG3 and as discussed in section 8, are to be replaced by the values given in the table below. The limits for areas where some negative polarity software is in use align with the BS EN ISO 29241 values. Where only screens using positive polarity software will be affected by the lighting then the specifier can increase the luminaire’s luminance limit to the figures indicated below the table.

#### Replacement for table 8.1 of LG3:

Screen type	Maximum Luminance (cd/m <sup>2</sup> ) where some Negative polarity software used
Type I and II Good or moderate screen treatment	1000 cd/m <sup>2</sup>
Type III No screen treatment	200 cd/m <sup>2</sup>

Where positive polarity software **only** is being used on Type I and II screens the luminance limit can be increased to 1500 cd/m<sup>2</sup>.

Where positive polarity software **only** is being used on Type III screens the luminance limit can be increased to 500 cd/m<sup>2</sup>.

The notes and other conditions to the original table remain.

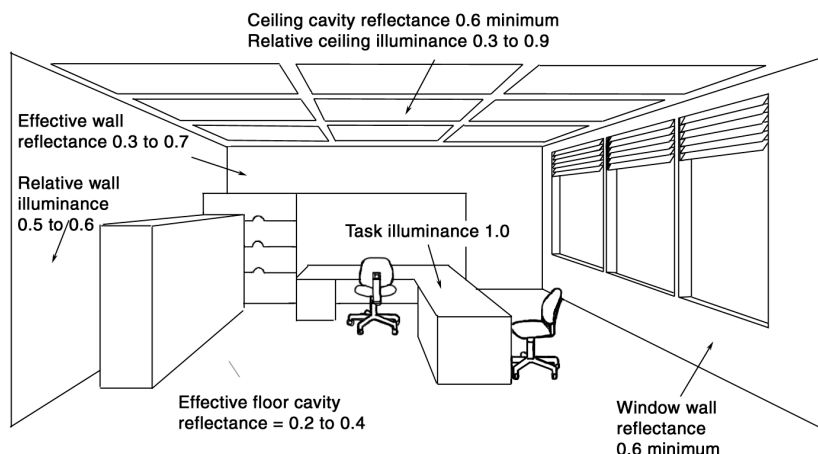
The present draft prEN 12464 'Light and Lighting, Lighting of indoor work places' recommends that the luminance limits are normally applied at a 65° angle of elevation where the screens in the area are not tilted back beyond 15° from the vertical. In special circumstances, where screens may be unusually sensitive to reflections, a 55° luminance limit angle is recommended. As it is likely that these recommendations will be contained in the final approved version of EN 12464 we are also recommending that the luminance values listed above in table 8.1 are applied at 65° for areas where screens are not tilted back beyond 15° to the vertical (or 55° where necessary).

An additional recommendation is introduced into LG3 as below.

The wall illuminance needs to be considered to ensure that the walls do not appear dark in relation to the working plane. With pure downlighting, there is a danger of the upper walls, especially, appearing dark. In certain spaces wall washing may be needed. To achieve a good luminance balance in a space, the average wall illuminance above the working plane, from both the direct and reflected components, should be at least 50% of the average horizontal illuminance on the working plane. Where these walls may be seen reflected in any display screens, then care must be taken to avoid bright scallops or patches appearing on the walls, i.e. gradual changes in illuminance will be necessary on these walls.

To avoid the ceiling appearing dark, the ceiling average illuminance from both the direct and reflected component should be at least 30% of the average horizontal illuminance. This could be from the sides of surface mounted downlights; from uplighting elements of suspended luminaires; from dropped elements of recessed downlights or from supplementary uplights. In large spaces with unusually low ceilings this may be difficult to achieve and in such circumstances the proportion of light on the ceiling should be as high as is practicable.

The following figure, reprinted from Fig 2.1 of the 1994 edition of the CIBSE *Code for interior lighting* (as amended in the reprint) indicates recommended surface characteristics.



## B2.2 Designing with indirect lighting

The recommendations contained in Lighting Guide 3 remain, i.e.

- The average luminance on the ceiling or other surfaces lit directly should not exceed 500 cd/m<sup>2</sup>
- The peak luminance should not exceed 1500 cd/m<sup>2</sup>
- The luminance should vary gradually across the surfaces being directly lit.

## B2.3 Designing with combined lighting

The recommendations contained in LG3 remain, i.e.

- The luminance of downlight elements in areas where Type III screens are in use can be allowed to rise to match the average ceiling luminance, i.e. up to 500 cd/m<sup>2</sup>.

## **C Certificate of conformity**

To ensure that designers and installers comply with all the criteria set out in LG3 and do not assume that the specification of a particular luminaire type will mean they comply we will be introducing a Certificate of Conformity to LG3.

The designers of an installation will complete this to demonstrate to the client/user of the space that all known ergonomic and visual criteria were considered in the formulation of the lighting design.

The installer also signs to confirm that they have installed the specified products, including lamp and control gear type, in the specified locations. Where the installation has had to deviate from that specified then the installer has to state this on the certificate.

The Society of Light and Lighting's Technical and Publications Committee is working on the new Certificate at present and this will be issued at a later date.

## **D Important points for consideration by designers and specifiers**

1 The introduction to LG3 states the following:

‘There has been a worrying emphasis amongst some designers and users of the previous guide on selecting luminaires purely on their ability to reduce screen reflections, without paying due attention to potential problems that this may cause to the general visual environment in the area. Because of this, greater emphasis has been given in this new guide to the overall visual environment. To highlight this and the widened scope to include all display screens the title of the guide has been changed from 'Areas with Visual Display Terminals' to 'The Visual Environment for Display Screen Use'.

2 The key points list from LG3 included a number of requirements that are still not being applied by some designers and specifiers leading to possible failure of lighting projects to meet the ‘good visual environment’ requirement contained in the Health and Safety (Display Screen) Regulations.

These points were:

(a) This guidance constitutes an assessment and design process. Compliance with this Lighting Guide can only be ensured by the application of the guidance as a whole and not just by the use of the sections on luminaire specification.

(b) Providing a suitable visual environment is key to the efficient use of DSE in an area, see section 3.

(c) The lighting for DSE tasks should not compromise the lighting for other tasks performed in that space nor degrade the overall visual environment of the space, see sections 2, 3 and 4.2.

(d) A full assessment of the risks to the users should be carried out before expensive, and possibly unnecessary, alterations to the existing lighting are carried out, see section 4.

(e) Reflections are always present in glass-fronted display screens. It is the elimination of distracting reflections that is important, see sections 4.3, 5.4 and Appendix 1.

(f) Disturbing reflections at a workstation can often be eliminated by suitable re-orientation of the screen and/or the workstation rather than by relighting the entire space, see sections 4.3, 5.4, 5.5 and Appendix 1.

(g) Windows and sunlit translucent window screening are likely to cause more problems with glare and screen reflections than electric lighting, see sections 4.3 and 6.

(h) The room decor and colours of furniture are very important in determining the overall appearance of the working space. Light in a space is inter-reflected and coloured by the surfaces in that space, see sections 5 and 7.7.

(i) Simple replacement of lighting equipment without the consideration of the decor and workstation use and orientation rarely leads to satisfactory interiors or compliance with LG3, see sections 4.3, 5 and Appendix 1.

*This update to LG3 was produced by Paul Ruffles on behalf of the Society of Light & Lighting's Technical & Publications Committee.*

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