GIL20

Please note:
The technical information in this publication is out of date. It remains available for information only.

Low energy domestic lighting

energy saving trust™

Lighting design and specification

Lighting has a major impact on a room's appearance, 'feel' and its suitability for purpose. When specified and installed correctly, it provides a pleasing environment conducive to carrying out a range of activities. Poor lighting design on the other hand (whether using tungsten or fluorescent lamps) can be bland, makes tasks difficult to carry out and is often the cause of complaints by occupants.

Many factors influence the adequacy and efficiency of lighting: this guide is intended to help designers, builders, and installers make the best use of energy efficient lighting and gain acceptance from occupants. If this happens, it is likely to remain in place for years and deliver continuing financial savings to the occupants while reducing carbon dioxide emissions to the environment. This publication is, however, only a summary – more information on best practice can be found in 'Energy efficient lighting – guidance for installers and specifiers' (CE61).

Energy efficient lighting is one of the most cost-effective energy efficiency measures!

Compact fluorescent lamps (CFLs)

Home energy use is responsible for 27 per cent of UK carbon dioxide emissions which contribute to climate change. By following the Energy Saving Trust's best practice standards, new build and refurbished housing will be more energy efficient – reducing these emissions and saving energy, money and the environment.

Increased insulation levels, especially in new homes, have driven down the energy needed for heating. This means that electricity for lighting is a growing proportion of energy used in the home. The high cost of electricity – and the emissions associated with it – makes lighting a prime candidate for action to improve energy efficiency.

Low energy lighting

This guide focuses on the use of tubular fluorescent lamps and pin-based compact fluorescent lamps (CFLs) with separate ballasts. However, many of the issues are also relevant to CFLs with integral ballasts. Pin-based lamps cannot be replaced with 'standard' tungsten filament general lighting service (GLS) lamps and this makes them preferable where continued energy efficiency is required.

Dedicated fittings (luminaires) are those that will only take low energy lamps. CFLs with integral ballasts are ideal for replacing GLS lamps in existing luminaires. Building regulations in parts of the UK now require a minimum number of dedicated fittings to be installed. A single product containing one or more lamp is one luminaire or fitting. Fittings which are wired together should be considered separately, e.g. a set of 10 recessed spotlights should be counted as 10 fittings.

General lighting design

The basis of all good lighting is the overall lighting design and there are many books on this subject. Traditional central light sources such as pendant lamps – which attempt to provide lighting for a variety of purposes including reading, dining, watching television, and entertaining – will generally result in a bland appearance and low occupant satisfaction. In comparison, good lighting design provides a mixture of light and shade.

Energy efficient lighting

Permanently installed lighting should provide enough background lighting for general movement. This can then be supplemented by an occupant's own task and accent lighting. In this way, luminaires and lamps can be chosen to provide the desired lighting for a specific purpose.

A number of factors affect the overall efficiency and effectiveness of lighting, including the compatibility of the luminaire and the lamp (see 'selecting lamps'), as well as the general lighting design. For the purposes of this publication 'energy efficient' means that the lamp has a luminous efficacy of at least 40 lumens/circuit watt. 'Circuit-watts' means the power consumed in the lighting circuit by the lamp and its associated control gear. Compact and tubular fluorescents both meet the 40l/W criteria but incandescent lamps such as tungsten filament and tungsten halogen lamps do not (Figure 1).

Installing energy efficient lighting

The best time to install energy efficient, or low energy, lighting is during construction. In parts of the UK, building regulations require new housing to incorporate a set amount of dedicated light fittings. The same applies to extensions and conversions ('material change of use'). The Energy Saving Trust best practice standard specifies that 75 per cent of permanent light fittings should only accept low energy lamps. See www.est.org.uk/housingbuildings/standards for further information.

In existing housing, luminaires can be replaced at any time but a key opportunity is whilst rewiring, especially where existing fittings are being replaced. This is particularly appropriate when the property is unoccupied during redevelopment work or at changes in occupancy.

Efficacy

Strictly speaking, the term 'efficiency' compares two quantities with the same units e.g. Watts output to Watts input. As light output is not normally measured in Watts (the wattage ratings on lamps are measures of the electrical input or consumption), the effectiveness of any lamp in transforming electricity into light (or luminous flux) is called efficacy.

A lamp's luminous efficacy is therefore the ratio of the lumens (light) emitted by the lamp compared to the power consumed, and is expressed as 'lumens per Watt' (l/W).

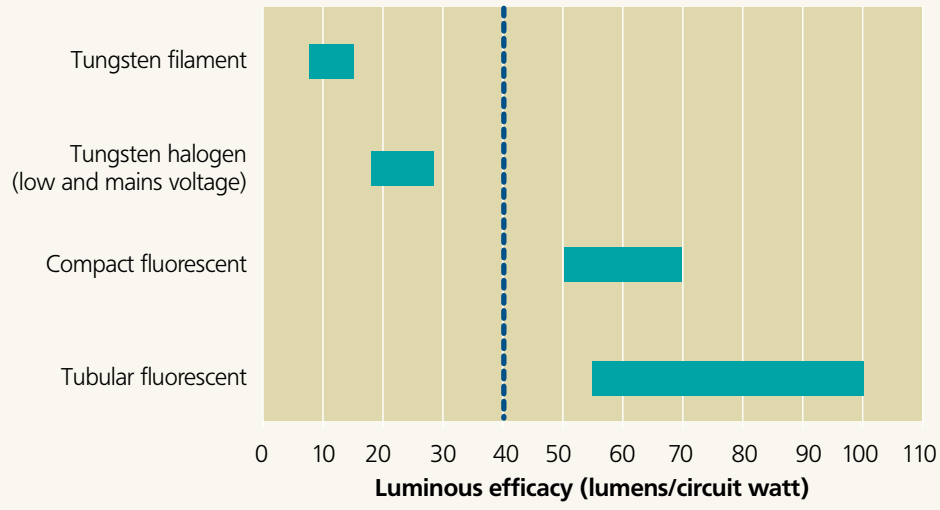

Figure 1 Luminous efficacy of a range of lamp types

Suitable rooms

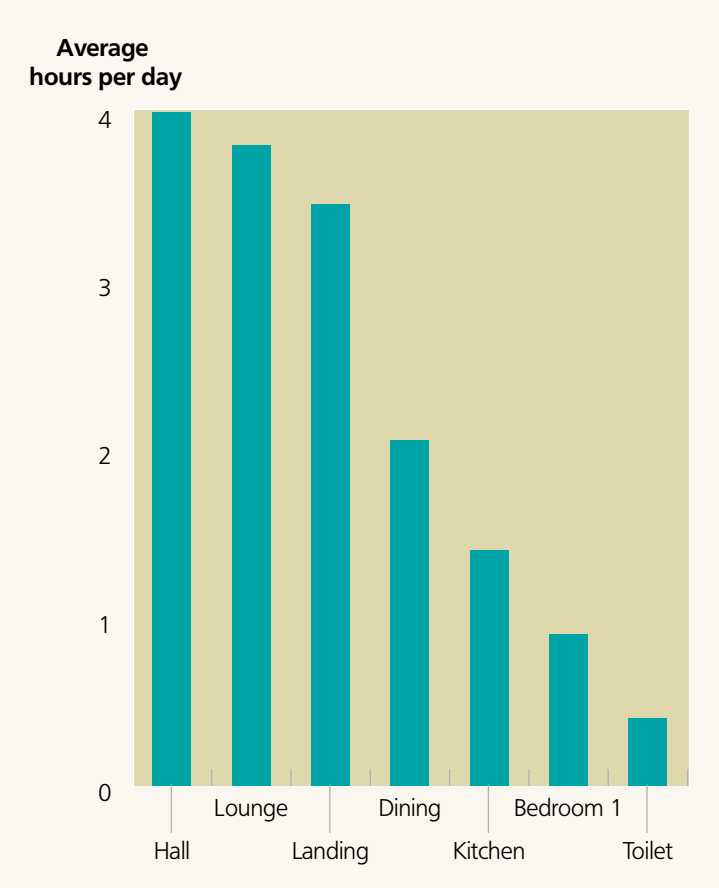

Figure 2 Average hours of lighting in different locations

Most rooms can benefit from energy efficient lighting; however, the greatest savings will be in rooms that are lit for longer periods and which have fittings that are likely to be retained by the occupants. Most-lit rooms vary with house layout and occupant lifestyle, but a study of 39 households showed that those lit for the longest periods were the hall, lounge and landing (Figure 2).

While luminaires may be selected by a developer, they may be replaced by new occupants unless they are acceptable to a wide range of tastes. Luminaires that do not make a strong style statement should therefore be fitted, particularly in lounges and dining rooms, where homebuyers are most likely to assert their own style.

Low energy luminaires might sometimes be more appropriate in rooms with lower lighting use (e.g. kitchens) where more discrete light sources can be used, for example in under-cabinet lighting, as these are unlikely to be changed by occupants. However, installing low energy fittings in cloakrooms, cupboards and storage areas will not produce appreciable savings.

Dedicated low energy luminaires for most applications and styles are widely available today. Many of these have energy saving recommended certification:

energy saving™
recommended
www.energysavingtrust.org.uk

A full list of energy saving recommended fittings is available at **www.est.org.uk/recommended**

Images of most of these are available at **www.lightingassociation.com**

Choosing lamps

Just as GLS lamps are available in a range of effects, such as clear, pearl, tinted, so there is also a range of options for fluorescent lamps which alter the lighting appearance and 'feel' of a room. These include colour rendering, colour temperature and lamp output.

Lamp shape

Most luminaires are designed to maximise the light output of particular lamp shapes or 'configurations'. Longer, two-finger 'sticks' are ideal in low profile luminaires designed to 'wash' surfaces. Four-finger models and 'hoops' are used where a more compact lamp is desired. Where the lamp is visible to occupants then 'look-alikes', (which have a casing around the fluorescent tube and resemble standard GLS lamps) are available.

Just as the diffuser of a luminaire reduces light output so too the casing may reduce the lamp efficacy slightly: however, there will be more even light distribution and this type of lamp is more acceptable to occupants. A selection of lamp shapes is shown on page 2.

Colour rendering

A colour rendering index is an indicator of how accurately different coloured surfaces appear under different lamps. Most fluorescent lamps are classified as either 'excellent' (Ra 90-100) or 'good' (Ra 80-89).

An Ra greater than 80 is suitable for domestic situations and wherever accurate colour judgements are necessary.

Colour temperature

The 'warmth' of a lamp is indicated by its colour temperature: the lower the temperature the 'warmer' the light. Early fluorescent lamps had a very cold appearance, but today a wide range of temperatures is available, including good equivalents for tungsten halogen lamps and standard tungsten filament lamps (Figure 3). Unless a specific effect is desired, lamps of different colour temperatures should not be used in the same room.

Fluorescent lamps of between 2700K and 3000K will generally be suitable for domestic settings except where the light needs to match daylight: in this case a cooler (higher) colour temperature of around 4000K may be required.

Lamp temperatures are shown in Figure 3. Some manufacturers supply dedicated luminaires complete with lamps. The colour temperature of the lamps should be checked as they are not always 2700K – although that by far the most common type.

Almost all CFLs with integral ballasts have a colour temperature of 2700K.

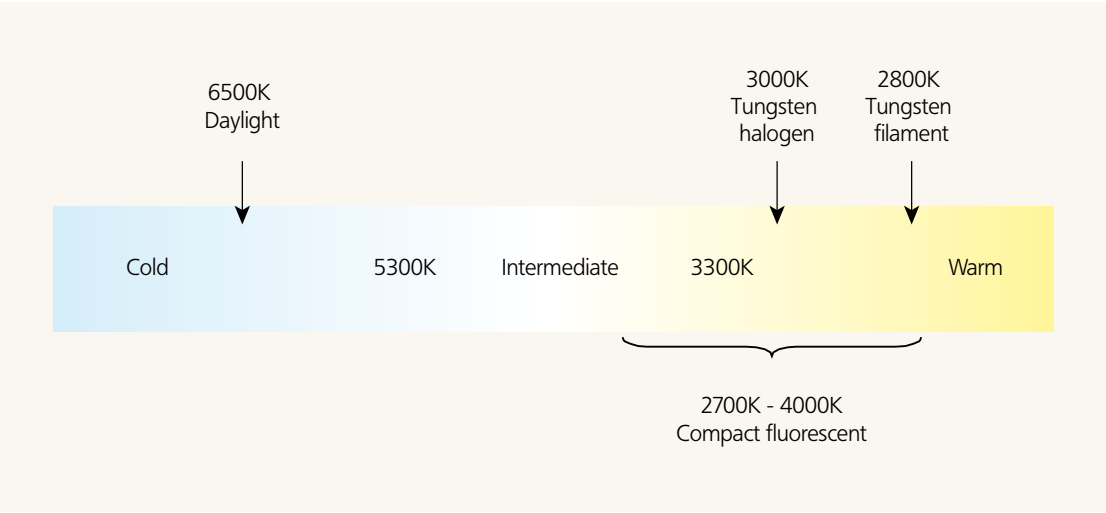

Figure 3 Colour temperature of different lamps

Lamp output

The output of a lamp is measured in lumens and can be found on the energy label printed on the packaging. The energy label allows different types of lamps to be compared, e.g. CFLs against standard tungsten GLS lamps. However, it may not be appropriate to make a choice on this basis alone. Although output may be identical, light distribution (or direction) will be different and so will the lighting effect.

Output also decreases with age, for all lamps. A higher wattage CFL and compatible ballast should therefore be specified if there is a need to maintain a minimum illuminance.

Manufacturers generally state the colour rendering and temperature of a lamp using a three-digit colour reference number, e.g. 827. The first digit (8) indicates the initial number of the colour rendering index and the second and third (27) indicate the initial numbers of the colour temperature (see Figure 4). The colour reference number is often preceded by the lamp wattage given in manufacturers' literature.

Ballasts

All fluorescent lamps require a ballast, also called 'control gear'. These may be electronic or conventional wire-wound types. All low energy pendant fittings use electronic ballasts. However, many other dedicated luminaires are still supplied with wire-wound ballasts, although many manufacturers give specifiers the option of upgrading.

Electronic ballasts have many benefits over wire-wound ballasts and should be specified wherever possible. These benefits include:

- Greater energy efficiency.
- Almost instant start up without flashing.
- Longer lamp life.
- No flicker in use.
- Silent operation.
- Possibility of dimming (four-pin lamps and specialist dimming equipment are required – generally only applicable to commercial applications. Conventional mains dimmers must not be used).
- Automatic switch off at the end of lamp life (eliminating any lamp flashing).

Most integral-ballast CFLs use electronic ballasts.

Internal lighting

Fluorescent lighting produces substantial energy savings. Its role has been recognised in both building regulations and the Energy Saving Trust's best practice standards. To maximise the savings, it is important to include energy efficient lamps in the lighting design. While using fluorescent lamps does require some thought at the specification and installation stage, when carefully considered it can produce lighting that is both attractive and energy efficient.

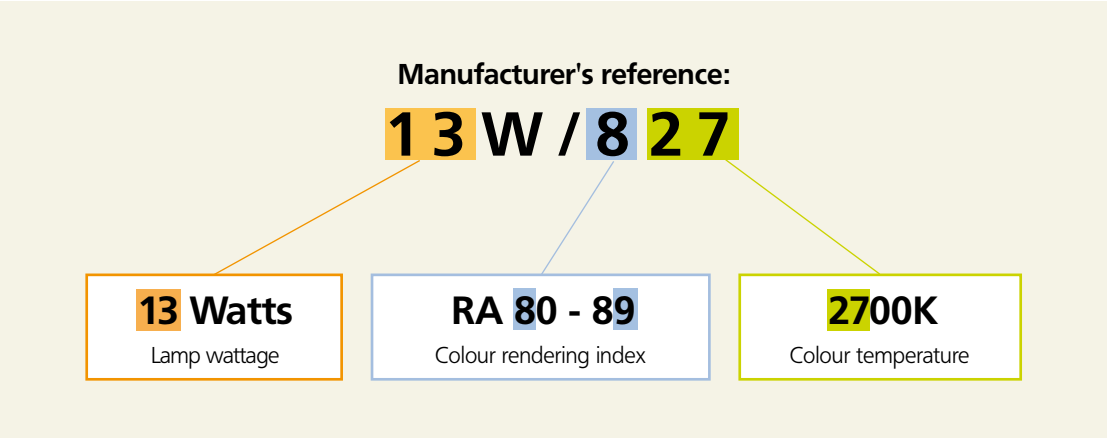

Figure 4 Derivation of manufacturer reference code

External lighting

The correct choice of energy efficient external lighting will depend upon the specific task. Where lighting is only required for short periods – for example in a passageway – the best approach is to use a conventional incandescent lamp controlled so that it will automatically switch off when there is enough daylight and when not required at night. A photocell combined with a passive infrared (PIR) detector will be sufficient. Floodlighting should be gauged for the task in hand. In domestic settings a 150W lamp is usually sufficient. If not, it is preferable to install two separately-controlled luminaires. These should illuminate the area better and are less likely to cause annoyance to passers-by and neighbours.

Lighting required at night for extended periods should ideally comprise luminaires which only accept pin-based fluorescent lamps. These should also be controlled so as to prevent use when not required, although care needs to be taken to ensure that controls such as photocells and timers are suitable for use with CFLs. PIRs can be used with CFLs for most external domestic situations but they should be avoided where frequent switching is likely to occur – in a communal entrance to flats for example. Where there are very long lighting periods, high-pressure discharge lights can be used: these have higher luminous efficacy than fluorescent lamps but a lower colour rendering index.

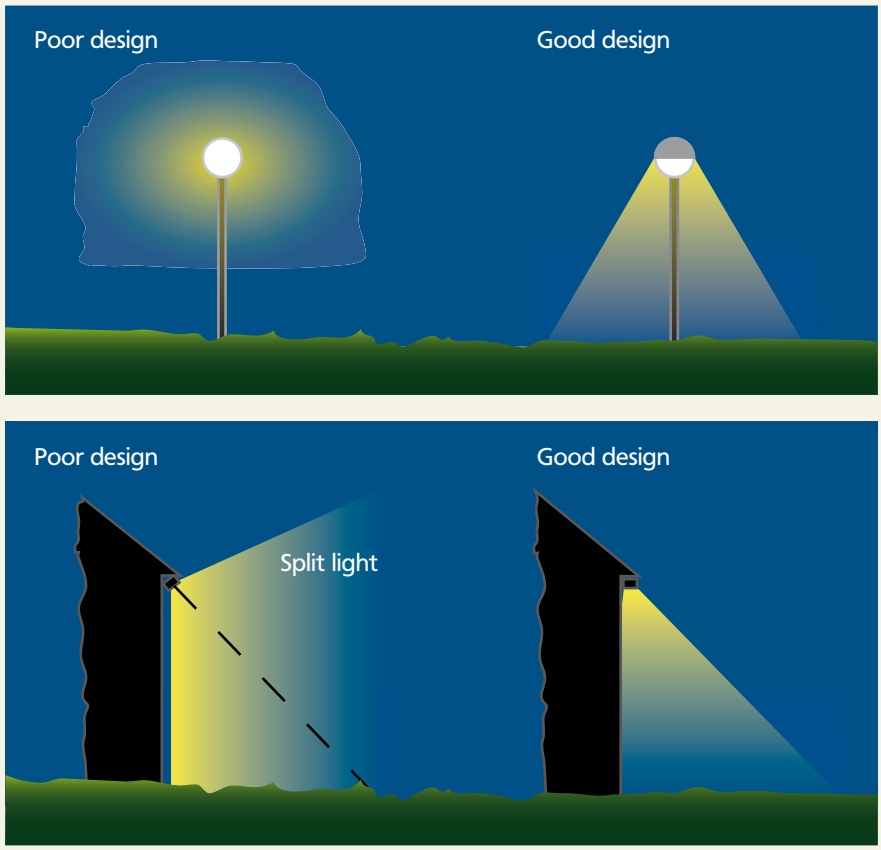

Figure 5 Light pollution and glare
External lighting that is badly selected and installed can result in light being directed into the sky. Not only is this wasteful in energy terms it also 'pollutes' the view of the sky. If lighting is misdirected it can also cause discomfort and visual impairment - possibly resulting in accidents.

Further reading

The Energy Saving Trust sets energy efficiency standards that go beyond building regulations for use in the design, construction and refurbishment of homes. These standards provide an integrated package of measures covering fabric, ventilation, heating, lighting and hot water systems for all aspects of new build and renovation. Free resources including best practice guides, training seminars, technical advice and online tools, are available to help meet these standards.

The following publications may also be of interest:

- Domestic lighting innovations (CE80/Adhoc 001)
- Energy efficient lighting – guidance for installers and specifiers (GPG199)
- Low energy domestic lighting – 'looking good for less': case studies (CE81/GPCS441)

To obtain these publications or for more information, call 0845 120 7799, email bestpractice@est.org.uk or visit www.est.org.uk/housingbuildings

Relevant organisations and websites

The Lighting Association
www.lightingassociation.com
Tel 01952 290905

BEAMA Installation Ltd
www.beamainstallation.org.uk
Tel 020 7793 3013

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