



## Lighting and the 2006 Building Regulations

On 6 April 2006 new editions of the Approved Documents on energy conservation in buildings (Part L of the Building Regulations) came into force in England and Wales. This Factfile explains the proposals. Information on regulations in force in Scotland and Northern Ireland is given at the end of the Factfile.

The view of The Society of Light and Lighting is that the new Approved Documents can be used as an opportunity to improve the quality of lighting. If luminaires with high light output ratios and high efficiency ballasts are chosen, there is plenty of scope to produce schemes considerably more efficient than the minimum requirements. This will require well designed equipment in well designed installations, and may increase initial costs, but the whole life costs will be reduced considerably.

Note that the minimum requirements in Approved Documents L2A and L2B are still considerably below those stipulated in DFES Building Bulletins for new and refurbished schools.

At the time of writing, it is not clear what will be the role of the suite of European Standards being prepared under a European Commission mandate in connection with the Energy Performance of Buildings Directive. That most relevant to lighting will be EN 15193-1 *Energy performance of buildings – Energy requirements for lighting – Part 1: Lighting energy estimation* although EN 15251 *Criteria for the indoor environment including thermal, indoor air-quality, light and noise* may also be relevant.

### Legal background

Building Regulations are made under the authority of the Building Act which is rarely changed, and defines both the scope of coverage of the Building Regulations and the legal framework for their implementation.

The Building Regulations themselves are brief. They are supplemented by Approved Documents which give options for complying with the Regulations. Note that it is theoretically possible (if

not always practical) to ignore the Approved Documents and prove compliance with the Regulations themselves. The Approved Documents themselves call up a wide range of documents from numerous sources.

### Building Regulations Part L

Sections of text in green type below are quoted direct from the Regulations and draft Approved Documents.

The Regulation under which Approved Documents covering energy efficiency are issued reads as follows:

#### Requirement

- L1 Reasonable provision shall be made for the conservation of fuel and power in buildings by:
- a. limiting heat gains and losses
    - i. through thermal elements and other parts of the building fabric;
    - ii. from pipes, ducts and vessels used for space heating, space cooling and hot water storage;
  - b. providing and commissioning energy efficient fixed building services with effective controls; and
  - c. providing to the owner sufficient information about the building, the fixed building services and their maintenance so that the building can be operated and maintained in such a manner as to use no more fuel and power than is reasonable in the circumstances.

Note that, although, clearly, Requirements *b* and *c* apply to lighting, Requirement *a* does not.

There are provisions in the Regulations themselves which will apply to all Approved Documents. Note that although they are quoted extensively for background information, much of the detailed text is unchanged. The most significant are as follows.

**Regulation 2** defines “fixed building services” as:

“fixed building services means/includes heating systems, hot water systems, fixed internal and

external lighting, cooling systems and mechanical ventilation systems”.

The draft Approved Documents defined “controlled service or fitting” as

“controlled service or fitting” means a service or fitting in relation to which Parts G, H, J, L or P of Schedule 1 imposes a requirement.

Unfortunately, although the term is still used, the definition appears to have been omitted from the final versions.

**Regulation 2** defines “renovation” as: the provision of a new layer in the thermal element or the replacement of an existing layer, but excludes decorative finishes, and ‘renovate’ shall be construed accordingly.

Clearly renovation does not apply to lighting.

**Regulation 3** defines the term “material alteration”:

32(2) An alteration is material for the purposes of these regulations if the work, or any part of it, would at any stage result

a. in a building or controlled service or fitting not complying with a relevant requirement where previously it did; or

b. in a building or controlled service or fitting which before the work commenced did not comply with a relevant requirement, being more unsatisfactory in relation to such a requirement.

32(3) In paragraph (2) ‘relevant requirement’ means any of the following applicable requirements of Schedule 1, namely:

a. Part A (structure)

b. Paragraph B1 (means of warning and escape)

c. Paragraph B3 (internal fire spread – structural)

d. Paragraph B4 (external fire spread)

e. Paragraph B5 (access and facilities for the fire service)

f. Part M (access to and use of buildings)

**Regulation 5** defines “material change of use”: There is a material change of use where there is a change in the purposes for which or the circumstances in which a building is used, so that after that change:

a. the building is used as a dwelling, where previously it was not;

b. the building contains a flat, where previously it did not;

c. the building is used as a hotel or a boarding house where previously it was not;

d. the building is used as an institution, where previously it was not;

e. the building is used as a public building, where previously it was not;

f. the building is not a building described in Classes 1 to VI in Schedule 2, where previously it was;

g. the building, which contains at least one dwelling, contains a greater or lesser number of dwellings than it did previously;

h. the building contains a room for residential purposes, where previously it did not;

i. the building, which contains at least one room for residential purposes, contains a greater or lesser number of such rooms than it did previously.

The final two paragraphs are new. Note that regulation 6 on requirements relating to material change to use has been updated to take account of changes to Part L.

New **Regulations 17A to 17E** implement Articles 3 and 4 of the Energy Performance of Buildings Directive and state that:

17A The Secretary of State shall approve a methodology of calculation of the energy performance of buildings.

17B The Secretary of State shall approve minimum energy performance requirements for new buildings in the form of target CO<sub>2</sub> emission rates, which shall be based upon the methodology approved pursuant to regulation 17A.

17C Where a building is erected, it shall not exceed the target CO<sub>2</sub> emission rate for the building that has been approved pursuant to regulation 17B.

17D – (1) Paragraph (2) applies to an existing building with a total useful floor area over 1000 m<sup>2</sup> where the proposed building work consists of or includes:

a. an extension;

b. the initial provision of any fixed building services; or

c. an increase to the installed capacity of any fixed building services.

(2) Subject to paragraph (3), where this regulation applies, such work, if any, shall be carried out as is necessary to ensure that the building complies with the requirements of Part L of Schedule 1.

(3) Nothing in paragraph (2) requires work to be carried out that is not technically, functionally and economically feasible.

17E In this Part ‘building’ means the building as a whole or parts of it that have been designed or altered to be used separately.

Initially, this is being achieved for nondomestic

buildings by means of the Simplified Building Energy Method (SBEM) and for dwellings by a revision of the Standard Application Procedure (SAP) rating system. There are, in the process of preparation, European Standards which will in due course supplement and may replace the SBEM and SAP rating methods. However, suggestions that application of the full European standards, rather than the SAP and SBEM procedures, will become mandatory appear to be unfounded.

**Regulation 20** includes provisions on commissioning (see box on page 9):

20C – (1) This regulation applies to building work in relation to which paragraph L1(b) of Schedule 1 imposes a requirement, but does not apply where the work consists only of work described in Schedule 2B.

(2) Where this regulation applies the person carrying out the work shall, for the purpose of ensuring compliance with paragraph L1(b) of Schedule 1, provide to the local authority a notice confirming that all fixed building services have been properly commissioned in accordance with a procedure approved by the Secretary of State.

(3) The notice shall be given to the local authority:

- a. not later than the date on which the notice required by regulation 15(4) or regulation 16A(3) is given; or
- b. where that regulation does not apply, no more than 30 days after completion of the work.

## Definitions used

**Daylit space** means any space:

- a. within 6 m of a window wall, provided that the glazing area is at least 20% of the internal area of the window wall.
- b. below rooflights and similar provided that the glazing area is at least 10% of the floor area. The normal light transmittance of the glazing should be at least 70%, or, if the light transmittance is reduced below 70%, the glazing area could be increased proportionately.

**Display lighting** means lighting intended to highlight displays of exhibits or merchandise, or lighting used in spaces for public leisure and entertainment such as dance halls, auditoria, conference halls, restaurants and cinemas.

**Dwelling** means a self-contained unit designed to accommodate a single household.

**Dwellings emission rate** is the predicted rate of CO<sub>2</sub> emissions from the dwelling.

**Emergency escape lighting** means that part of emergency lighting that provides illumination for the safety of people leaving an area or attempting to terminate a dangerous process before leaving an area.

**Fit-out work** means that work needed to complete the partitioning and building services within the external fabric of the building (the shell) to meet the specific needs of in-coming occupiers. Fit-out work can be carried out in whole or in parts:

- a. in the same project and time frame as the construction of the building shell; or
- b. at some time after the shell has been completed.

**Fixed building services** means any part of, or controls associated with:

- a. fixed internal or external lighting systems, but does not include emergency escape lighting or specialist process lighting; or
- b. fixed systems for heating, hot water service, air conditioning or mechanical ventilation.

**Specialist process lighting** means lighting intended to illuminate specialist tasks within a space, rather than the space itself. It could include theatre spotlights, projection equipment, lighting in TV and photographic studios, medical lighting in operating theatres and doctors' and dentists' surgeries, illuminated signs, coloured or stroboscopic lighting, and art objects with integral lighting such as sculptures, decorative fountains and chandeliers.

**Target emission rate:** this is defined helpfully as the target CO<sub>2</sub> emission rate!

**Thermal element:** means a wall, floor or roof (but does not include windows, doors, roof windows or roof-lights) which separates a thermally conditioned part of the building (the 'conditioned space') from:

- a. the external environment (including the ground); or
- b. in the case of floors and walls, another part of the building which is:
  - i. unconditioned;
  - ii. an extension falling within class VII of Schedule 2; or
  - iii. where this paragraph applies, conditioned to a different temperature.

This evidently does not include lighting.

### Historic buildings

There are the usual exclusions for historic buildings; English Heritage and Historic Scotland are currently revising their guidance; CIBSE has been asked to provide input.

# Part L1A: New dwellings

This Part covers dwellings except that those buildings containing *rooms for residential purposes* such as nursing homes, student accommodation and similar are not considered as dwellings and, in such cases, Approved Document L2A would apply. The presence of (e.g.) a small manager's flat in a large non-domestic building would not result in the whole building being treated as a dwelling.

There are five criteria to be considered, not all of which are relevant to the lighting. However, it is not possible to consider the lighting in isolation.

1: the predicted rate of carbon dioxide emissions from the dwelling (the Dwellings Emission Rate *DER*) is not greater than the Target Emissions Rate (*TER*); and

2: the performance of the building fabric and the *fixed building services* (for definition see page 3) should be no worse than the design limits set out in paragraphs 32 to 45; and

3: the dwelling has appropriate passive control measures to limit the effect of solar gains on indoor temperatures in summer; and

4: the performance of the *dwelling* (for definition see page 3), as built, is consistent with the *DER*, and

5: the necessary provisions for energy efficient operation of the dwelling are put in place.

The *TER* must be calculated using the following approved calculation tools:

a. for individual dwellings no greater than 450 m<sup>2</sup> total floor area, the 2005 edition of the Government's Standard Assessment Procedure (*SAP*).

b. for individual dwellings larger than the above threshold, the Simplified Building Energy Model (*SBEM*).

The calculation tool will report the CO<sub>2</sub> emissions arising from:

i. the provision of heating and hot water,  $C_H$  (which includes the energy used by pumps and fans) and

ii. the use of internal fixed lighting  $C_L$ .

Note that the *TER* does not give any credit for low energy lighting.

Where a building contains more than one dwelling (such as in a terrace of houses or in a block of flats), an overall *TER* can be calculated for all the dwellings in the building.

In all cases the *DER* should be calculated using a fixed assumption of 30% low energy lighting.

Is this 30% of light output or 30% of installed load? It is not clear. There is a note stating that low energy lighting provision is therefore non-tradable. The minimum amount is as given below but the designer can include a greater level of provision. There is also a note permitting calculation of average *DER* for blocks of flats and terraces of houses, though it is still necessary to provide the data for each dwelling.

## *Fixed internal lighting*

A way of showing compliance would be to provide lighting fittings (including lamp, control gear and an appropriate housing, reflector, shade or diffuser or other device for controlling the output light) that only take lamps having a luminous efficacy greater than 40 lumens per circuit-watt. Circuit-watts means the power consumed in lighting circuits by lamps and their associated control gear and power factor correction equipment.

*Fluorescent and most compact fluorescent luminaires would meet this standard. Luminaires for GLS tungsten lamps, or tungsten halogen lamps would not.*

Reasonable provision would be to install fixed energy efficient light fittings in the most frequented locations in the dwelling to a number not less than the greater of:

a. one per 25 m<sup>2</sup> of dwelling floor area (excluding garages) or part thereof; or

b. one per four fixed light fittings.

A light fitting may contain one or more lamps.

It is noted that installing mains-frequency fluorescent lighting in garages may cause dangers through stroboscopic interaction with vehicle engine parts or machine tools. High-frequency electronic ballasted fluorescent lamps substantially reduce this risk. The same applies to other areas such as workshops. Note, though, that garages will normally be excluded from the areas where energy efficient lighting can count towards the total since they are not heated!

Lighting fittings in less frequented areas like cupboards and other storage areas would not count. GIL 20 gives guidance on identifying suitable locations. (GIL20: *Low energy domestic lighting*, Energy Saving Trust, 2006).

## *Fixed external lighting*

Fixed external lighting means lighting fixed to an external surface of the dwelling supplied from the dwelling occupier's electrical system. It excludes the lighting in common areas in blocks of flats and other access-way lighting provided communally.

Reasonable provision would be to enable effective control and/or the use of efficient lamps such that:

- a. either: Lamp capacity does not exceed 150 W per light fitting and the lighting automatically switches off:
  - i. When there is enough daylight and
  - ii. When it is not required at night
- b. or: the lighting fittings have sockets that can only be used with lamps having an efficacy greater than 40 lumens per circuit watt.

Compact fluorescent lamps would meet the standard in (b). GLS tungsten lamps with bayonet cap or Edison screw bases, or tungsten halogen lamps would not.

The above is pretty self-explanatory, though in fact not all compact fluorescent lamps give 40 lm/W. Note that, from April 2006, fixed external lighting will also come within the scope of the Clean Neighbourhoods and Environment Act 2005 with regard to light pollution as lighting is being included in factors which can be a "statutory nuisance".

## Part L1B: Existing dwellings

This gives guidance relating to:

- a. extensions;
- b. when creating a new dwelling or part of a dwelling through a *material change of use* (see definition on page 2);
- c. material alterations to existing dwellings;
- d. the provision of a controlled fitting;
- e. the provision or extension of a *controlled service* (see definition on page 3); and
- f. the provision or renovation of a *thermal element* (see definition on page 3).

In most circumstances reasonable provision would be to limit the area of windows, roof windows and doors in extensions so that it does not exceed the sum of

- a. 25% of the floor area of the extension plus
- b. the area of any windows or doors which, as a result of the extension works, no longer exist or are no longer exposed.

In some cases different approaches may be adopted by agreement with the building control body in order to achieve a satisfactory level of daylighting. BS 8206-2 *Code of practice for daylighting* gives guidance on this.

Note that BS 8602-2 is overdue for revision. It is hoped that work will begin shortly.

### *Fixed internal lighting*

The requirements kick in when

- a. a dwelling is extended, or
- b. a new dwelling is created from a material change of use, or
- c. an existing lighting system is being replaced as part of re-wiring works.

The requirements are the same as for new dwellings.

### *Fixed external lighting*

As for new dwellings.

# Part L2A: New buildings other than dwellings

This Approved Document deals with the construction of new buildings other than dwellings; the first *fit-out works* (see definition on page 3) in buildings that were built to comply with Part L as amended in 2006 (if the fit-out was deferred); and the construction of extensions to existing buildings where the gross floor area of the extension is greater than 100 m<sup>2</sup> and greater than 25% of the gross floor area of the existing building.

When a building contains dwellings, account should also be taken of Approved Document L1A

Again there are a number of criteria set:

- 1: the predicted rate of carbon dioxide emissions from the building (the *BER*) is not greater than the target rate (the *TER*); and
- 2: the performance of the building fabric and the heating, hot water and fixed lighting systems should be no worse than the design limits; and
- 3: those parts of the building that are not provided with comfort cooling systems have appropriate passive control measures to limit solar gains; and
- 4: the performance of the building, as built, is consistent with the prediction made in the *BER*; and
- 5: the necessary provisions for enabling energy efficient operation of the building are put in place.

## Target carbon dioxide Emission Rate (*TER*)

The Target CO<sub>2</sub> Emission Rate (*TER*) represents the minimum energy performance requirement specified in Regulation 17B, and is expressed in terms of the mass of CO<sub>2</sub>, in units of kg per m<sup>2</sup> of floor area per year that should be emitted as a result of the provision of heating, hot water, ventilation, cooling and lighting for the appropriate selection from a set of standardised activities when assessed by an approved calculation tool.

The *TER* must be calculated using one of the following tools:

- a. Simplified Building Energy Model (SBEM) for those buildings whose design features are capable of being adequately modelled by SBEM, or
- b. Other approved software such as dynamic

simulation models; if used, such a tool must be capable of adequately modelling the design features in the proposed building. As part of the submission to building control body, the applicant must justify that the tool used is appropriate to the application.

The *TER* is calculated as follows.

An approved calculation tool is used to calculate the CO<sub>2</sub> emissions rate ( $C_{notional}$ ) from a notional building with specified properties.

The CO<sub>2</sub> emissions rate is adjusted by an improvement factor which depends on the building (eg whether it is air-conditioned).

The notional building is the same size and shape as the proposed building and complies with the energy performance values set out in the ODPM Non-domestic calculation methodologies in respect of both the building fabric and the *fixed building services*.

The notional building must have the same area of *display windows* as the actual building.

The notional building has the same activity areas and class of building services as proposed for the actual building. The activity areas with their associated class of building services must be selected from predefined standard activity areas.

The notional building has the occupancy times and environmental conditions (temperatures, illuminance, ventilation rate etc) in each activity area as defined by the standard data associated with the reference schedules, and is subject to the climate defined by the appropriate CIBSE Test Reference Year.

Grid mains electricity should be assumed as the motive power for all building services other than heating.

The calculation excludes any service not covered by Part L (such as *emergency escape lighting*, *specialist process lighting* and vertical transport systems).

**The AD gives fall-back criteria as follows for the lighting. Note, however, that if a building is designed using all the available fall-back criteria, it is very unlikely to meet the overall carbon emissions requirements. Those designing lighting should therefore aim for standards considerably better than the minima acceptable. This is not difficult, as the latter part of this Factfile demonstrates.**

*General lighting efficacy in office, industrial and storage areas in all building types*

Office areas include those spaces that involve

predominantly desk-based tasks, including classrooms, seminar rooms and conference rooms, including those in schools. (Note that schools are no longer exempt from the Building Regulations.)

Approved Document L2A states that: Reasonable provision would be to provide lighting with an average initial efficacy of not less than 45 luminaire-lumens/circuit-watt as averaged over the whole area of these types of space in the building.

The average luminaire-lumens/circuit-watt is calculated by:

(Lamp lumens x LOR) summed for all luminaires in the relevant areas of the building, divided by the total circuit-watts for all the luminaires where:

Lamp lumens = the sum of the average initial (100 hour) lumen output of all the lamp(s) in the luminaire and

LOR = the light output ratio of the luminaire, i.e. the ratio of the total light output under stated practical conditions to that of the lamp or lamps contained in the luminaire under reference conditions.

This is similar to the provision in the 2002 edition except for the increased efficiency requirement from 40 to 45 lm/W and the removal of the Luminaire control factor.

#### *General lighting efficacy in all other types of space*

The Approved Document recognises that, for lighting systems serving other types of space, it may be appropriate to provide luminaires for which photometric data are not available and/or are lower powered and use less efficient lamps.

For such spaces, the requirement would be met if the installed lighting has an average initial (100 hour) lamp plus ballast efficacy of not less than 50 lamp lumens per circuit-watt.

This is again a similar approach to the 2002 edition.

#### *Lighting controls for general lighting in all types of spaces*

Lighting controls should be provided so as to avoid unnecessary lighting during the times when daylight levels are adequate or when spaces are unoccupied.

**For safety reasons automatically switched lighting systems should be subjected to risk assessment.**

Reasonable provision would be local switches in easily accessible positions within each work-

ing area or at boundaries between working areas and general circulation routes that are manually operated by the deliberate action of the occupants.

Manual switches include rocker switches, push buttons and pull cords and remote switching devices such as wireless transmitters and telephone handsets.

'Switches' includes dimmer switches and 'switching' includes dimming.

It would usually be reasonable for dimming to be effected by reducing rather than diverting the energy supply.

The distance on plan from any local switch to any luminaire it controls should generally be not more than six metres, or twice the height of the luminaire above the floor if this is greater. Where a space is a *daylit space* served by side windows, it would be reasonable for the perimeter row of luminaires to be separately switched.

Occupant control of local switching can be supplemented by other controls such as automatic systems which

- a switch the lighting off when they sense the absence of occupants or
- b either dim or switch off the lighting when there is sufficient daylight.

When installed in appropriate locations, such control systems can make a useful contribution towards reducing the BER.

An alternative way of meeting the requirement would be to follow the recommendations in BRE Digest 478 *Selecting lighting controls*, 2006.

The main differences from the 2002 edition are that the maximum distance from manual switches to the luminaires they control has been reduced and that there is no control factor. However, the latter is reputedly taken into account in the SBEM calculation.

#### *Display lighting in all types of space*

Reasonable provision for *display lighting* (see definitions on page 3) would be to demonstrate that the installed display lighting has an average initial (100 hour) efficacy of not less than 15 lamp-lumens per circuit-watt. In calculating this efficacy, the power consumed by any transformers or ballasts should be taken into account.

This will rule out GLS lamps but allow most types of tungsten-halogen lamp.

Spaces where display lighting is present would normally be expected to also have general lighting used for circulation and for purposes of cleaning and restocking outside public access hours. The above paragraphs apply in this case.

Note that the 500 W uncontrolled allowance

has been removed, apparently at the request of the lighting industry.

#### *Controls for display lighting in all types of space*

A way of meeting the requirement would be to connect display lighting in dedicated circuits that can be switched off at times when people will not be inspecting exhibits or merchandise or attending entertainment events. In a retail store, for example, this could include timers that switch the display lighting off outside store opening hours, except for displays designed to be viewed from outside the building through *display windows*.

#### *Systems not covered by Part L*

*Emergency escape lighting, specialist process lighting* (see definitions on page 3) and *vertical transportation systems* are not subject to the requirements of Part L.

#### *Commissioning*

There is now a stricter requirement for commissioning, including lighting. See page 9.

#### *Building log-book*

In accordance with Requirement L1(c), the owner of the building must be provided with a building logbook. A way of showing compliance would be to follow the guidance in CIBSE TM31 *Building logbook toolkit*. The data used to calculate the *TER* and the *BER* should be included.

## Part L2B: Work in existing buildings that are not dwellings

There are exclusions to what counts as an existing building, eg where the proposed extension has a total floor area that is both:

- a greater than 100 m<sup>2</sup> and
- b greater than 25% of the floor area of the existing building

then the work should be regarded as in a new building and Approved Document L2A should be followed.

Where there is a material change of use, the building or part of a building should comply with the applicable requirements of various Parts of Schedule 1, including Part L. Specific requirements apply to the provision or extension of controlled services.

Regulation 17 requires "consequential improvements" to improve the energy efficiency of the whole building when there is an extension or alteration of over 100 m<sup>2</sup>. For lighting, it is considered that reasonable provision for consequential improvements would be, for any general lighting system serving an area greater than 100 m<sup>2</sup> and which has an average lamp efficacy of less than 40 lamp-lumens per circuit-watt (ie below the standard in the 2002 edition of Approved Document L2), to upgrade it by the provision of new luminaires or improved controls.

There is however a proviso that work should be economically feasible and there are limits on total expenditure.

#### *General lighting*

The efficiency criteria are generally the same as the "fall-back" criteria for new buildings, ie 45

**Table 1. Luminaire control factors (applicable only to Approved Document L2B)**

Control function	Control factor
(a) The luminaire is in a daylit space and its light output is controlled By photoelectric switching or dimming control, with or without manual override	0.90
(b) The luminaire is in a space that is likely to be unoccupied for a significant proportion of working hours and where a sensor switches off the lighting in the absence of occupants but switching on is done manually, except where this would be unsafe	0.90
(c) Circumstances (a) and (b) combined	0.85
(d) None of the above	1.00

luminaire-lumens per circuit-watt for offices, industrial and storage areas, 50 lamp lumens per circuit-watt in other types of space, and 15 lamp lumens per circuit-watt for display lighting along with requirements for controls, with the additions of a control factor (see below).

The average luminaire-lumens/circuit-watt is calculated by:

(Lamp lumens x LOR) summed for all luminaires in the relevant areas of the building, divided by the total (circuit-watts x control factor) for all the luminaires where

**Lamp lumens** = the sum of the average initial (100 hour) lumen output of all the lamp(s) in the luminaire and

**LOR** = the light output ratio of the luminaire, which means the ratio of the total light output of a luminaire under stated practical conditions to that of the lamp or lamps contained in the luminaire under reference conditions.

*Control factor* (see Table 1)

Unlike the provisions for new buildings, those in Approved Document L2B still include a controls factor defined as the factor applicable when automatic controls substantially reduce the power consumption of the luminaire when electric light is not required. The controls factor is stated to have been included in Approved Document L2B to allow greater flexibility and to encourage better controls.

To provide more design flexibility, an accredited whole building calculation model can be used to demonstrate that the energy efficiency standard of the building as it will become is no worse than if the building had been improved following the guidance set out in the first part of the Approved Document.

## Choosing lamps, luminaires and control gear to provide efficient lighting

Tables on pages 11 to 13 provide generic information on lamp types which can be used, in conjunction with suitable control gear and luminaires, to meet or exceed the efficiency requirements of Approved Documents L2A and L2B.

Lamp lumen outputs quoted are nominal, and the figures for the actual lamp considered should be checked as there are considerable variations both between manufacturers and between different lamp ranges from the same manufacturer, for apparently similar lamps.

Control gear power consumption is based on the CELMA publication which has been adopted by the EU as follows:

There are seven classes of efficiency. The classes have no direct correlation to a specific technology; every class is defined by a limiting value of total input power related to the corresponding ballast lumen factor.

Every class is defined by a limiting value of total input power when referenced with a BLF of 1.00 for high-frequency operated ballasts and 0.95 for magnetic ballasts. The Energy Efficiency Index (EEI) is compared to the corresponding table to obtain the relevant energy class of the ballast-lamp combination.

class D: magnetic ballasts with very high losses  
class C: magnetic ballasts with moderate losses

## Lighting Industry Commissioning Scheme

At the instigation of The Society of Light and Lighting, in conjunction with the Electrical Contractors' Association and the National Inspection Council for Electrical Installation Contracting, and with the approval of the Office of the Deputy Prime Minister, this scheme is being developed to provide a way for individuals to demonstrate competence in commissioning of lighting schemes.

Short courses will be run by the two contracting organisations, ending with a test and the issuing of a certificate to those who pass. It will not be necessary to be a member of any of the three organisations to obtain a certificate, and there will be a means for those with the relevant expertise to obtain a certificate without taking the course. The syllabus for the course, and the content of the test, will be based on CIBSE Commissioning Code L: *Lighting*.

For more details contact one of the three organisations or search the web for "lighting industry commissioning scheme".

Note that, although membership of the Scheme is a means of demonstrating competence, it is not mandatory; it is possible to demonstrate competence in other ways.

class B2: magnetic ballasts with low losses  
class B1: magnetic ballasts with very low losses  
class A3: electronic ballasts  
class A2: electronic ballasts with reduced losses  
class A1: dimmable electronic ballasts

**Ballasts in classes C and D are no longer available.**

Dimmable ballasts are classified A1 if they fulfil the following requirements:

at 100% light output setting the ballast fulfils at least the demands belonging to A3;

at 25% light output setting the total input power is equal to or less than 50% of the power at the 100% light output setting;

the ballast must be able to reduce the light output to 10% or less of the maximum light output.

A conventional magnetic ballast, conforming to CELMA energy efficiency scheme class C, limits a system total input power to 70 W when operating a 58 W fluorescent lamp.

Magnetic ballasts conforming to CELMA energy efficiency scheme classes B1 and B2 have a thicker copper wire and an iron core subject to less power dissipation. This development reduces internal losses. A class B2 ballast operating a 58 W fluorescent lamp, has a total input power of 67 W.

Electronic ballasts (conforming to CELMA energy efficiency scheme classes A1, A2 and A3) are major power savers. They even reduce the power consumption of ballast/lamp circuits to less than the rated power of the lamp at 50 Hz. This is caused by the increased lamp efficiency at high frequencies (>20 kHz), leading to about 10% less lamp power and a decrease of the ballast losses.

The light output ratio figures used are nominal: 50%, 60%, 70% and 80%. There will be luminaires with LORs outside these ranges; indeed LORs of up to 96% are quoted by manufacturers. Manufacturers' information should be obtained for the specific luminaire under consideration as LOR is strongly effected by material choice, optical design and manufacturing quality.

## Using the tables

In the tables, a figure in **red** does not meet the minimum requirements, while a figure in **green** meets your chosen criteria by a margin of at least 15%. Figures in **blue** indicate performance more than 30% above the requirement.

Once you have selected a lamp, luminaire and control gear, the Tables 2-5 will show you how

well the chosen combination will perform. Tables 2-5 give you the option of aiming for the minimum circuit efficacy of 45 luminaire lumens per circuit watt, or to opt for 50 or 55 lm/W.

It can be seen that there is a considerable benefit in choosing efficient luminaires and ballasts. Indeed, unless you use a luminaire with a very high LOR you can rarely achieve the required circuit efficiency if you use a class B2 ballast. However, if you choose a class A2 ballast and a T5 lamp you have a good deal of choice. Bear in mind, however, that class B2 ballasts may disappear from the market in the future.

For situations where the luminaire LOR is not known, Tables 6-9 should be used. Apart from compact fluorescent lamps, most sources listed give you plenty of scope to achieve a much better standard than the minimum permitted.

Unfortunately, because there is no rating system for ballasts for high pressure discharge lamps, it is not possible to provide similar tables for these sources.

## Examples

### Example 1

Assume that you wish to use a 28 W T5 high efficiency lamp with a luminaire with an LOR of 70%. This lamp has a nominal light output of 2600 lm. Referring to Table 3, it can be seen that 45 luminaire lumens per circuit watt is exceeded by more than 15% for any type of ballast and 50 luminaire lumens per circuit watt is achieved for any ballast type. If one wished to achieve 55 luminaire lumens per circuit watt would one have to avoid using a class A3 ballast.

### Example 2

On the other hand, if one wished to use a 36 W T8 fluorescent lamp, the luminaire would have to have a minimum LOR of 60% and that would entail using a class A2 ballast to achieve even 45 luminaire lumens per circuit watt. If one could instead use a luminaire with an LOR of 70%, the choice of ballast would be open, and a class A2 ballast would give performance more than 15% above the minimum to achieve 50 luminaire lumens per circuit watt.

### Example 3

If the luminaire is for a compact fluorescent lamp and of a type which does not have LOR data and is to be used in a building which does not

*Continued on page 13*

**Table 2: Minimum light outputs (in lumens) to meet the requirements of Part L2A: T8 fluorescent lamps**

Rating (W)	Light output (lm)*	Desired circuit efficacy (lm/W)	Ballast class A2				Desired Ballast class A3				Desired circuit watts	Ballast class B2					
			circuit watts	LOR =	LOR =	LOR =	LOR =	circuit watts	LOR =	LOR =		LOR =	LOR =	LOR =	LOR =	LOR =	LOR =
				50%	60%	70%	80%		50%	60%		70%	80%		50%	60%	70%
58	4000 to 5200	45	55	4950	4125	3536	3094	59	5310	4425	3793	3319	67	6030	5025	4037	3769
		50		5500	4583	3929	3438		5900	4917	4212	3688		6700	5583	4786	4188
		55		6050	5042	4321	3781		6490	5408	4636	4056		7370	6642	5264	4606
36	2500 to 3350	45	36	3240	2700	2314	2025	38	3420	2850	2443	2138	43	4050	3225	2764	2419
		50		3600	3000	2571	2250		3800	3167	2714	2375		4300	3583	3071	2688
		55		3960	3300	2829	2475		4180	3483	2986	2613		4730	3942	3379	2956
18	1050 to 1350	45	19	1710	1425	1221	1069	21	1890	1575	1350	1181	26	2340	1950	1671	1463
		50		1900	1583	1357	1188		2100	1750	1500	1312		2600	2167	1857	1625
		55		2090	1742	1493	1306		2310	1925	1650	1444		2860	2383	2043	1788

\* Taken as the mean lumen output for the rating; for other lamps compare actual output with table

**Table 3: Minimum light outputs (in lumens) to meet the requirements of Part L2A: T5 high efficiency fluorescent lamps**

Rating (W)	Light output (lm)*	Desired circuit efficacy (lm/W)	Ballast class A2				Desired Ballast class A3				Desired circuit watts	Ballast class B2					
			circuit watts	LOR =	LOR =	LOR =	LOR =	circuit watts	LOR =	LOR =		LOR =	LOR =	LOR =	LOR =	LOR =	LOR =
				50%	60%	70%	80%		50%	60%		70%	80%		50%	60%	70%
35	3300	45	39	3510	2925	2507	2194	42	3780	3150	2700	2363	n/a	n/a	n/a	n/a	
		50		3900	3250	2786	2438		4200	3500	3000	2625		n/a	n/a	n/a	n/a
		55		4290	3575	3064	2681		4620	3850	3300	2888		n/a	n/a	n/a	n/a
28	2600	45	32	2880	2400	2057	1800	34	3060	2550	2186	1913	n/a	n/a	n/a	n/a	
		50		3200	2667	2286	2000		3400	2833	2429	2125		n/a	n/a	n/a	n/a
		55		3520	2933	2514	2200		3740	3740	2671	2338		n/a	n/a	n/a	n/a
21	1900	45	24	2160	1800	1543	1350	26	2340	1950	1671	1463	n/a	n/a	n/a	n/a	
		50		2400	2000	1714	1500		2600	2167	1857	1625		n/a	n/a	n/a	n/a
		55		2640	2200	1886	1650		2860	2383	2043	1788		n/a	n/a	n/a	n/a
14	1200	45	17	1530	1275	1093	956	19	1710	1425	1221	1069	n/a	n/a	n/a	n/a	
		50		1700	1417	1214	1063		1900	1583	1357	1188		n/a	n/a	n/a	n/a
		55		1870	1558	1336	1169		2090	1742	1493	1306		n/a	n/a	n/a	n/a

**Table 4 Minimum light outputs (in lumens) to meet the requirements of Part L2A: T5 high output fluorescent lamps**

Rating (W)	Light output (lm)*	Desired circuit efficacy (lm/W)	Ballast class A2				Desired Ballast class A3				Desired circuit watts	Ballast class B2					
			circuit watts	LOR =	LOR =	LOR =	LOR =	circuit watts	LOR =	LOR =		LOR =	LOR =	LOR =	LOR =	LOR =	LOR =
				50%	60%	70%	80%		50%	60%		70%	80%		50%	60%	70%
80	6150	45	88	7920	6600	5657	4950	92	8280	6900	5914	5175	n/a	n/a	n/a	n/a	
		50		8800	7333	6286	5500		9200	7667	6571	5750		n/a	n/a	n/a	n/a
		55		9680	8067	6914	6050		10120	8433	7229	6325		n/a	n/a	n/a	n/a
54	4450	45	60	5400	4500	3857	3375	63	5670	4725	4050	3544	n/a	n/a	n/a	n/a	
		50		6000	5000	4286	3750		6300	5250	4500	3938		n/a	n/a	n/a	n/a
		55		6600	5500	4714	4125		6930	5775	4950	4332		n/a	n/a	n/a	n/a
49	4300	45	55	4950	4125	3536	3094	58	5220	4350	3729	3263	n/a	n/a	n/a	n/a	
		50		5500	4583	3929	3438		5800	4833	4143	3625		n/a	n/a	n/a	n/a
		55		6050	5042	4321	3781		6380	5317	4557	3988		n/a	n/a	n/a	n/a
39	3100	45	43	3870	3225	2764	2419	46	4140	3450	2957	2588	n/a	n/a	n/a	n/a	
		50		4300	3583	3071	2688		4600	3833	3286	2875		n/a	n/a	n/a	n/a
		55		4730	3942	3379	2956		5060	4217	3614	3163		n/a	n/a	n/a	n/a
24	1750	45	26	2340	1950	1671	1463	28	2520	2100	1800	1575	n/a	n/a	n/a	n/a	
		50		2600	2167	1857	1625		2800	2333	2000	1750		n/a	n/a	n/a	n/a
		55		2860	2383	2043	1788		3080	2567	2200	1925		n/a	n/a	n/a	n/a

**Table 5 Minimum light outputs (in lumens) to meet the requirements of Part L2A: compact fluorescent lamps**

Rating (W)	Type	Light output (lm)*	Desired circuit efficacy (lm/W)	Ballast class A2				Ballast class A3				Ballast class B2						
				Circuit	LOR	LOR	LOR	Circuit	LOR	LOR	LOR	Circuit	LOR	LOR	LOR			
																watts	=	=
				50%	60%	70%	80%	50%	60%	70%	80%	50%	60%	70%	80%			
10	TC-D, TC-DE	600	45	11	990	825	707	619	13	1170	975	836	731	16	1440	1200	1029	900
			50		1100	917	786	688		1300	1083	929	813		1600	1333	1143	1000
			55		1210	1008	864	756		1430	1192	1021	894		1760	1467	1257	1100
13		900	45	14	1260	1050	900	788	16	1440	1200	1029	900	19	1710	1425	1221	1069
			50		1400	1167	1000	875		1600	1333	1143	1000		1900	1583	1357	1188
			55		1540	1283	1100	963		1760	1467	1257	1100		2090	1742	1493	1306
18	TC-D, TC-DE, TC-T	1200	45	19	1710	1425	1221	1069	21	1890	1575	1350	1181	26	2340	1950	1671	1463
			50		1900	1583	1357	1188		2100	1750	1500	1313		2600	2167	1857	1625
			55		2090	1742	1493	1306		2310	1925	1650	1444		2860	2383	2043	1788
24	TC-TE, TC-LE	1800	45	25	2250	1875	1607	1406	27	2430	2025	1736	1519	32	2880	2400	2057	1800
			50		2500	2083	1786	1563		2700	2250	1929	1688		3200	2667	2286	2000
			55		2750	2292	1964	1719		2970	2475	2121	1856		3520	2933	2514	2200
26		1800	45	27	2430	2025	1736	1519	29	2610	2175	1864	1631	34	3060	2550	2186	1913
			50		2700	2250	1929	1688		2900	2417	2071	1813		3400	2833	2429	2125
			55		2970	2475	2121	1856		3190	2658	2279	1994		3740	3167	2671	2338
32		2400	45	36	3240	2700	2314	2025	39	3510	2925	2507	2194	n/a	n/a	n/a	n/a	
			50		3600	3000	2571	2250		3900	3250	2786	2438		n/a	n/a	n/a	n/a
			55		3960	3300	2829	2475		4290	3575	3064	2681		n/a	n/a	n/a	n/a
42		3200	45	47	4230	3525	3021	2644	50	4500	3750	3214	2813	n/a	n/a	n/a	n/a	
			50		4700	3917	3357	2936		5000	4167	3571	3215		n/a	n/a	n/a	n/a
			55		5170	4308	3693	3231		5500	4583	3929	3438		n/a	n/a	n/a	n/a
5	TC	250	45	7	630	525	450	394	8	720	600	514	450	12	1080	900	771	675
			50		700	583	500	438		800	667	571	500		1200	1000	857	750
			55		770	642	550	481		880	733	629	550		1320	1100	943	825
7		400	45	9	810	675	579	506	10	900	750	642	563	14	1260	1050	900	788
			50		900	750	643	563		1000	833	714	625		1400	1167	1000	875
			55		990	825	707	619		1100	917	786	688		1540	1283	1100	963
9		600	45	11	990	825	707	619	12	1080	900	771	675	16	1440	1200	1029	900
			50		1100	917	786	688		1200	1000	857	750		1600	1333	1143	1000
			55		1210	1008	864	756		1320	1100	943	825		1760	1467	1257	1100
11		900	45	14	1260	1050	900	788	15	1350	1125	964	844	18	1710	1425	1221	1069
			50		1400	1167	1000	875		1500	1250	1071	938		1900	1583	1357	1188
			55		1540	1283	1100	963		1650	1375	1179	1031		2090	1742	1493	1306
36	TC-L, TC-LE	2900	45	36	3240	2700	2314	2025	38	3420	2850	2443	2138	43	3870	3225	2764	2419
			50		3600	3000	2571	2250		3800	3167	2714	2375		4300	3583	3071	2688
			55		3960	3300	2829	2475		4180	3483	2986	2613		4730	3942	3379	2956
40		3500	45	45	4050	3375	2893	2532	48	4320	3600	3086	2700	n/a	n/a	n/a	n/a	
			50		4500	3750	3214	2813		4800	4000	3429	3000		n/a	n/a	n/a	n/a
			55		4950	4125	3576	3094		5280	4400	3771	3300		n/a	n/a	n/a	n/a
55		4800	45	61	5490	4575	3921	3431	65	5850	4875	4179	3656	n/a	n/a	n/a	n/a	
			50		6100	5083	4357	3813		6500	5417	4643	4063		n/a	n/a	n/a	n/a
			55		6710	5592	4793	4194		7150	5958	5107	4469		n/a	n/a	n/a	n/a
80		6000	45	88	7920	6600	5657	4950	92	8280	6900	5914	5175	n/a	n/a	n/a	n/a	
			50		8800	7333	6286	5610		9200	7667	6571	5750		n/a	n/a	n/a	n/a
			55		9680	8067	6914	6050		10120	8433	7228	6325		n/a	n/a	n/a	n/a
10	2D	650	45	11	990	825	707	619	13	1170	975	836	731	16	1440	1200	1029	900
			50		1100	917	786	688		1300	1083	929	813		1600	1333	1143	1000
			55		1210	1008	864	756		1430	1192	1021	894		1760	1467	1257	1100
16		1050	45	17	1530	1275	1093	956	19	1710	1425	1221	1069	23	2070	1725	1479	1294
			50		1700	1417	1214	1063		1900	1583	1357	1188		2300	1917	1643	1438
			55		1870	1558	1336	1169		2090	1742	1493	1306		2530	2108	1807	1581
28		1350	45	29	2610	2175	1864	1631	31	2790	2325	1993	1744	36	3240	2700	2314	2025
			50		2900	2417	2071	1813		3100	2583	2214	1938		3600	3000	2571	2250
			55		3190	2658	2279	1994		3410	2842	2436	2131		3960	3300	2829	2475
38		2850*	45	38	3420	2850	2443	2138	40	3600	3000	2571	2250	45	4050	3375	2893	2532
			50		3800	3167	2714	2375		4000	3333	2857	2500		4950	4125	3576	3094
			55		4180	3843	2986	2613		4400	3667	3143	2750		4950	4125	3576	3094
55		4000	45	61	5490	4575	3921	3431	65	5850	4875	4179	3656	n/a	n/a	n/a	n/a	
			50		6100	5083	4357	3813		6500	5417	4643	4063		n/a	n/a	n/a	n/a
			55		6710	5592	4793	4194		7150	5958	5107	4469		n/a	n/a	n/a	n/a

\* Figure based on only data available and may apply to US lamps

**Table 6 Efficacies of T8 fluorescent lamps for luminaires without LOR data, in lumens per watt (requirement 50 lm/W)**

Rating (W)	Light output (lm)	Ballast class A2	Ballast class A3	Ballast class B2
58	4000	72.72	68.00	59.70
	4600	83.64	77.97	68.66
	5000	90.91	84.75	74.63
	5200	94.55	88.14	77.62
50	5000	90.91	84.75	75.63
36	2500	83.33	78.95	69.77
	2850	79.17	75.00	66.28
	3000	83.33	78.95	69.77
	3200	88.89	84.21	74.42
	3350	93.06	88.16	77.91
32	3200	88.89	84.21	74.42
18	1050	55.26	50.00	40.39
	1150	60.53	54.76	44.23
	1200	63.16	57.14	46.15
	1300	68.42	61.90	50.00
	1350	71.05	64.29	51.92
16	1400	73.68	66.67	53.85

**Table 7 Efficacies of T5 high efficiency fluorescent lamps for luminaires without LOR data, in lumens per circuit watt (requirement 50 lm/W)**

Rating (W)	Light output (lm)	Ballast class A2	Ballast class A3
35	3300	84.62	78.57
28	2600	81.25	76.47
21	1900	79.17	73.08
14	1200	70.59	63.16

**Table 8 Efficacies of T5 high output fluorescent lamps for luminaires without LOR data, in lumens per circuit watt (requirement 50 lm/W)**

Rating (W)	Light output (lm)	Ballast class A2	Ballast class A3
80	6150	69.89	66.84
54	4450	74.17	70.63
49	4300	78.18	74.14
39	3100	72.09	67.39
24	1750	67.31	62.60
54 de luxe	3450	62.73	59.48
49 de luxe	3450	57.50	54.76
24 de luxe	1300	50.00	46.43

**Table 9 Efficacies of compact fluorescent lamps for luminaires without LOR data, in lumens per watt (requirement 50 lm/W)**

Rating (W)	Type	Version	Light output (lm)	Ballast class A2	Ballast class A3	Ballast class B2		
10	TC-D	2-pin	600	54.55	46.15	21.31		
13			900	64.29	56.25	25.77		
18	TC-D,	TC-T	1200	63.16	57.14	22.02		
26			1800	66.67	62.01	26.42		
18	TC-T	4-pin	1200	63.16	57.14	28.04		
26			1800	66.67	62.01	31.03		
32			2400	58.57	64.86	33.19		
42			3200	68.09	64	n/a		
5	TC2-pin,	4-pin	250	35.71	31.25	13.66		
7			400	44.44	40	18		
9			600	54.55	50	22.9		
11			900	64.29	60	29.03		
18	TC-L	4-pin	1200	63.16	57.14	25.13		
24			1800	72	66.67	29.05		
36			2900	80.56	76.32	32.54		
40			3500	77.78	72.92	n/a		
55			4800	78.69	73.85	n/a		
80			6000	68.19	65.22	n/a		
10			2D		650	59.09	50	40.63
16					1050	61.76	55.26	47.72
28	1350	46.55			43.55	37.50		
38	2850*	75			71.25	63.33		
55	4000	na/			n/a	n/a		

*Examples, continued from page 10*

count as offices, industrial and storage areas, you will have to achieve 50 lamp lumens per circuit watt. Table 9 shows that you will have to use a ballast of class A3 or better and if using such a ballast your choice of lamp will be limited. However, using a class A2 ballast will permit you to use any compact fluorescent lamp except 5 and 7 W types and the 28 W 2D lamp.

**Example 4**

For an industrial lighting scheme you wish to use a high bay reflector luminaire with an aluminium housing which uses a 250W metal halide lamp with a colour rendering index of at least 80. Assume that the luminaire has an LOR of 82%. Then, since the light output is 23 500 lm and the total power consumption is 260.4 W, the luminaire lumens per circuit watt comes out as 74.

# Examples of luminaires offering performance to meet the requirements of Part L of the Building Regulations



Slim pendant luminaire with parabolic louvre for 2 x 28W T5 lamps and CDELMA class 2 ballast, LOR: 86%  
Luminaire lumens per circuit watt: 72



Recessed luminaire for DSE environments with decorative feature using 40 or 55 W compact fluorescent lamps; LOR: 80%  
Luminaire lumens per circuit watt (40 W lamp and class A2 ballast): 62.2



Recessed luminaire for DSE environments with glass feature giving a small upward light component using 40 or 55 W compact fluorescent lamp; LOR: 75.8%  
Luminaire lumens per circuit watt (40 W lamp and class A2 ballast): 59



Luminaire with prismatic controller for one or two linear 28 or 35 W T5 high efficiency lamps; LOR 95% for single lamp version and 86% for twin lamp version  
Luminaire lumens per circuit watt (single 28 W lamp, class A2 ballast): 77.2  
Luminaire lumens per circuit watt (twin 28 W lamps, class A3 ballast): 65.8



Individually suspended direct/indirect luminaire for two 28 or 35 W T5 lamps high efficiency lamps, maximum surface luminance below 1500 cd/m<sup>2</sup>; LOR: 91%  
Luminaire lumens per circuit watt (35 W lamp, class A2 ballast): 77  
Luminaire lumens per circuit watt (28 W lamp, class A3 ballast): 69.6



Recessed luminaire for DSE environments with increased upward light component using 40 or 55 W compact fluorescent lamp; LOR: 77.6%  
Luminaire lumens per circuit watt (55 W lamp and class A2 ballast): 59.8



Recessed downlight with faceted low luminance reflector for two 26 W TC-D compact fluorescent lamps; LOR: 72%

Luminaire lumens per circuit watt (class A1 ballast): 44.7 (based on full light output and class A3 ballast power consumption, see description of CELMA ballast classes)



Recessed downlight with metallised reflector for two 26 W TC-D compact fluorescent lamps; LOR: 70%

Luminaire lumens per circuit watt (class A1 ballast): 43.4 (based on full light output and class A3 ballast power consumption, see description of CELMA ballast classes)



High bay reflector luminaire with aluminium housing for 250W HSE lamp, LOR: 82%

Luminaire lumens per circuit watt: 74

Note that since the CELMA ballast rating scheme does not cover high pressure discharge lamps it is necessary to obtain ballast power consumption for each case. The efficiency figure quoted above assumes an initial (100 hour) light output of 23 500 lm and lamp and ballast power consumption of 260.4 W.

## Other jurisdictions

The Building Regulations described above cover only England and Wales. Scotland and Northern Ireland have their own legislation.

In Scotland it is The Building (Scotland) Act 2003; two Technical Handbooks covering Domestic and Nondomestic buildings have been issued by the Scottish Building Standards Agency and came into force on 1 May 2005. In each case there are six sections covering: General, Structure; Fire; Environment; Safety; Noise; Energy; plus three appendices covering: Definitions and explanations; Standards and other publications; and Cross-referencing between the previous and new documents. Section 6: Energy covers the same general ground as Part L of the England and Wales regulations. The general requirement is that "Every building must be designed and constructed in such a way that provision is made for energy conservation in accordance with the Building Standards Circular on Energy, 2004." These standards are intended to provide a level transposition from the 6th Amendment to the 1990 Building Standards Regulations and therefore the Circular is fixed at the level achieved by the 6th Amendment. This is a 25% improvement on the energy performance of buildings as required under the 5th Amendment. Scotland still offers the options of the elemental method, the heat loss method or the carbon emissions calculation method.

For artificial and display lighting the general requirements is that, "In order to comply with standard 6.1 every building must be designed and constructed in such a way that artificial or display lighting must operate and be capable of being controlled to achieve optimum energy efficiency". It does not apply to domestic buildings.

There are three approaches: where at least 95% of light sources chosen from those listed in a table; where the installed lighting capacity

comprises luminaires with lamps having an average initial (100 hour) efficacy of not less than 65 lumens per circuit watt; and where the design has been completed in accordance with the advice and guidance given in the Society of Light and Lighting (CIBSE) Code for Lighting 2002. Provisions for display lighting and controls are generally similar to those in England and Wales.

For Northern Ireland the provisions are within the Building Regulations (Northern Ireland) 2000 (Statutory Rule 2000 no 389) as amended by Building (Amendment) Regulations (Northern Ireland) 2005 (Statutory Rule 2005 no 295); Technical Booklet F covers energy issues but has not been updated since 1998. As in Scotland, there are the three options for calculating overall building performance (the energy use method is not applicable to domestic buildings but SAP ratings are mandatory).

For lighting there are two options of choosing lamps from a table or incorporating lamps with an average initial (100 hour) efficacy of not less than 50 lumens per circuit watt. Provisions on display lighting and controls are similar to those in England and Wales.

The Northern Ireland Department of Finance and Personnel is reviewing the provisions; the main elements of the amendment to Part F, which will come into operation in June 2006, are to: Introduce a "whole building approach" based on the calculated energy performance of buildings using defined national calculation methodologies; Set energy performance requirements that achieve a reduction in carbon emissions of up to 40% on current standards; Introduce a requirement to consider the installation of alternative energy sources such as CHP and renewable energy systems in large buildings (over 1000m<sup>2</sup>); Require the upgrading of energy performance in large existing buildings (over 1000 m<sup>2</sup>) undergoing major refurbishment; and Require the production of an Energy Performance Certificate (EPC) for all new buildings.

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