

The Building Regulations 2010

**Conservation of
fuel and power**

APPROVED DOCUMENT

L1A

**L1A Conservation of fuel and power
in new dwellings**

Main changes in the 2010 edition

This 2010 edition, incorporating further 2010 amendments, reflects the changes made as a result of the Building Regulations 2010 and Building (Approved Inspectors etc) Regulations 2010. The changes mainly reflect regulation number changes as a result of re-ordering. There have been no amendments to the substantive requirements in Schedule 1 (i.e. Parts A to P) of the Building Regulations. Please note the simplification of the definition of 'room for residential purposes' in regulation 2 of the Building Regulations 2010. Please also note that L1(c) has now become regulation 40.

Main changes made by the 2016 amendments

Changes reflect alterations to the regulations, principally withdrawal of Regulations 29 to 33 of the Building Regulations 2010 and their replacement by Regulation 7A of the Energy Performance of Buildings (England and Wales) Regulations 2012 and changes in wording of Regulations 24, 25, 26, 26A, 27 and 27A of the Building Regulations 2010. There are no technical changes.

* This approved document gives guidance for compliance with the Building Regulations for building work carried out in England. It also applies to building work carried out on exempted energy buildings in Wales as defined in the Welsh Ministers (Transfer of Functions) (No.2) Order 2009. This approved document also gives guidance applying to buildings of statutory undertakers and of the Crown or carried out by Crown authorities in both England and Wales in respect of regulations 25, 25A, 25B and 26.

The approved documents

What is an approved document?

The Secretary of State has approved a series of documents that give practical guidance about how to meet the requirements of the Building Regulations 2010 for England. Approved documents give guidance on each of the technical parts of the regulations and on regulation 7 (see the back of this document).

Approved documents set out what, in ordinary circumstances, may be accepted as reasonable provision for compliance with the relevant requirements of the Building Regulations to which they refer. If you follow the guidance in an approved document, there will be a presumption of compliance with the requirements covered by the guidance. However, compliance is not guaranteed; for example, 'normal' guidance may not apply if the particular case is unusual in some way.

Note that there may be other ways to comply with the requirements – *there is no obligation to adopt any particular solution contained in an approved document*. If you prefer to meet a relevant requirement in some other way than described in an approved document, you should discuss this with the relevant building control body.

In addition to guidance, some approved documents include provisions that must be followed exactly, as required by regulations or where methods of test or calculation have been prescribed by the Secretary of State.

Each approved document relates only to the particular requirements of the Building Regulations that the document addresses. However, building work must also comply with any other applicable requirements of the Building Regulations.

How to use this approved document

This document uses the following conventions.

- a. **Text against a green background** is an extract from the Building Regulations 2010 or the Building (Approved Inspectors etc.) Regulations 2010 (both as amended). These extracts set out the legal requirements of the regulations.
- b. **Key terms, printed in green**, are defined in Appendix A.
- c. When this approved document refers to a named standard or other document, the relevant version are listed in Appendix D (documents referred to) and Appendix E (standards referred to) respectively. However, if the issuing body has revised or updated the listed version of the standard, you may use the new version as guidance if it continues to address the relevant requirements of the Building Regulations.
- d. Additional *commentary in italic* text appears after some numbered paragraphs. This commentary is intended to assist understanding of the immediately preceding paragraph or sub-paragraph, or to direct readers to sources of additional information, but is not part of the technical guidance itself.

NOTE: *Standards and technical approvals may also address aspects of performance or matters that are not covered by the Building Regulations, or they may recommend higher standards than required by the Building Regulations.*

Where you can get further help

If you do not understand the technical guidance or other information in this approved document or the additional detailed technical references to which it directs you, you can seek further help through a number of routes, some of which are listed below:

- a. The Government website: www.gov.uk.
- b. *If you are the person undertaking the building work:* either from your local authority building control service or from an approved inspector.
- c. *If you are registered with a competent person scheme:* from the scheme operator.
- d. *If your query is highly technical:* from a specialist or an industry technical body for the relevant subject.

The Building Regulations

The following is a high level summary of the Building Regulations relevant to most types of building work. Where there is any doubt you should consult the full text of the regulations, available at www.legislation.gov.uk.

Building work

Regulation 3 of the Building Regulations defines ‘building work’. Building work includes:

- a. the erection or extension of a building
- b. the provision or extension of a controlled service or fitting
- c. the material alteration of a building or a controlled service or fitting.

Regulation 4 states that building work should be carried out in such a way that, when work is complete:

- a. for new buildings or work on a building that complied with the applicable requirements of the Building Regulations: the work and the building comply with the applicable requirements of the Building Regulations.
- b. for work on an existing building that did not comply with the applicable requirements of the Building Regulations:
 - (i) the work itself must comply with the applicable requirements of the Building Regulations
 - (ii) the building must be no more unsatisfactory in relation to the requirements than before the work was carried out.

Material change of use

Regulation 5 defines a ‘material change of use’ in which a building or part of a building that was previously used for one purpose will be used for another.

The Building Regulations set out requirements that must be met before a building can be used for a new purpose. To meet the requirements, the building may need to be upgraded in some way.

Materials and workmanship

In accordance with regulation 7, building work must be carried out in a workmanlike manner using adequate and proper materials. Guidance on materials and workmanship is given in Approved Document 7.

Energy efficiency requirements

Part 6 of the Building Regulations imposes additional specific requirements for energy efficiency.

If a building is extended or renovated, the energy efficiency of the existing building or part of it may need to be upgraded.

Notification of work

Most building work and material changes of use must be notified to a building control body unless one of the following applies.

- a. It is work that will be self-certified by a registered competent person or certified by a registered third party.
- b. It is work exempted from the need to notify by regulation 12(6A) of, or schedule 4 to, the Building Regulations.

Responsibility for compliance

People who are responsible for building work (for example the agent, designer, builder or installer) must ensure that the work complies with all applicable requirements of the Building Regulations. The building owner may also be responsible for ensuring that work complies with the Building Regulations. If building work does not comply with the Building Regulations, the building owner may be served with an enforcement notice.

Contents

The approved documents	Page i
The Building Regulations	iii
Approved Document L1A: Conservation of fuel and power in new dwellings	1
Summary	1
Energy performance certificates	2
Section 1: The requirements	3
Part L of Schedule 1: Conservation of fuel and power	3
Demonstrating compliance	4
Section 2: Design standards	5
Regulations 35, 24 and 25	5
Target CO ₂ Emission Rate (TER) and Target Fabric Energy Efficiency (TFEE) rate	5
Buildings containing multiple dwellings	7
Criterion 1 – Achieving the TER and TFEE rate	7
Calculating the CO ₂ emissions from and fabric energy efficiency performance of the actual dwelling	7
CO ₂ emission rate and fabric energy efficiency rate calculations	8
Secondary heating	10
Internal lighting	10
Buildings containing multiple dwellings	10
Achieving the TER and TFEE rate	11
Consideration of high-efficiency alternative systems	12
Special considerations	13
Criterion 2 – Limits on design flexibility	14
Limiting fabric standards	14
Limiting system efficiencies	15
Criterion 3 – Limiting the effects of heat gains in summer	16
Limiting the effects of solar gains in summer	16
Heat losses and gains from circulation pipes	16

Section 3: Quality of construction and commissioning	17
Criterion 4 – Building performance consistent with DER and DFEE rate	17
Party walls and other thermal bypasses	17
Thermal bridges	19
Air permeability and pressure testing	20
Alternative to pressure testing on small developments	21
Commissioning of heating and hot water systems	21
Section 4: Providing information	24
Criterion 5 – Provisions for energy-efficient operation of the dwelling	24
Section 5: Model designs	25
Appendix A: Key terms and abbreviations	27
Appendix B: Types of work covered by this approved document	29
Appendix C: Reporting evidence of compliance	30
Appendix D: Documents referred to	32
Appendix E: Standards referred to	33
Index	34

Approved Document L1A: Conservation of fuel and power in new dwellings

Summary

0.1 This approved document is one of four approved documents that give guidance on how to comply with the [energy efficiency requirements](#) of the Building Regulations:

Approved Document L1A: Conservation of fuel and power in new dwellings

Approved Document L1B: Conservation of fuel and power in existing dwellings

Approved Document L2A: Conservation of fuel and power in new buildings other than dwellings

Approved Document L2B: Conservation of fuel and power in existing buildings other than dwellings

The approved documents are supported by the:

Domestic Building Services Compliance Guide

Non-Domestic Building Services Compliance Guide

0.2 This approved document contains the following sections:

Section 1 sets out the relevant legal requirements and provides an overview of the steps to demonstrate compliance.

Section 2 sets out the considerations that apply to demonstrating that the design of the building will meet the [energy efficiency requirements](#).

Section 3 sets out the considerations that apply when demonstrating that the design has been appropriately translated into actual construction performance.

Section 4 describes the information that should be provided to occupiers to help them achieve reasonable standards of energy efficiency in practice.

Section 5 provides a pointer to some useful information on different design approaches to meeting the [energy efficiency requirements](#)

Appendix A: Key terms and abbreviations

Appendix B: Guidance on the types of building work covered by this approved document

Appendix C: Reporting evidence of compliance

Appendix D: Documents referred to

Appendix E: Standards referred to

Energy performance certificates

- 0.3** Regulation 7A of the Energy Performance of Buildings (England and Wales) Regulations 2012 requires that when a **dwelling** is erected the person carrying out the work must give an **energy performance certificate** to the owner of the building and a notice to the building control body (BCB) that a certificate has been given including the reference number under which the certificate has been registered. See also the Energy Performance of Buildings (England and Wales) Regulations 2012 (SI 2012/3118) at www.legislation.gov.uk and detailed guidance on **energy performance certificates** at www.gov.uk

Section 1: The requirements

- 1.1 This approved document, which takes effect on 6 April 2014, deals with the **energy efficiency requirements** in the Building Regulations 2010. Regulation 2(1) of the Building Regulations defines the **energy efficiency requirements** as the requirements of regulations 23, 25A, 25B, 26, 26A, 28 and 40 and Part L of Schedule 1. The **energy efficiency requirements** relevant to this approved document, which deals with new **dwellings**, are those in regulations 25A, 26, 26A and 40 and Part L of Schedule 1, and are set out below.

NOTE: Regulation 25B 'Nearly zero-energy requirements for new buildings' will not come into force until 2019 at the earliest. Statutory guidance on how to comply with regulation 25B is not included within this approved document and will be provided nearer to the time that regulation 25B comes into force.

- 1.2 Relevant extracts from the Building Regulations 2010 or the Building (Approved Inspectors etc.) Regulations 2010 (both as amended) are set out using **text against a green background** in this approved document. Where there is any doubt you should consult the full text of the regulations, available at www.legislation.gov.uk

Part L of Schedule 1: Conservation of fuel and power

<i>Requirement</i>	<i>Limits on application</i>
Schedule 1 – Part L Conservation of fuel and power	
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; and	
(ii) from pipes, ducts and vessels used for space heating, space cooling and hot water services;	
(b) providing fixed building services which–	
(i) are energy efficient;	
(ii) have effective controls; and	
(iii) are commissioned by testing and adjusting as necessary to ensure they use no more fuel and power than is reasonable in the circumstances.	

Demonstrating compliance

1.3 In the Secretary of State's view, compliance with the **energy efficiency requirements** could be demonstrated by meeting the five separate criteria set out in the following paragraphs. Compliance software should produce an output report to assist **BCBs** check that compliance has been achieved.

NOTE: *The output report can benefit both developers and BCBs during the design and construction stages as well as at completion.*

1.4 Criterion 1: in accordance with regulation 26, the calculated rate of CO₂ emissions from the **dwelling** (the Dwelling CO₂ Emission Rate, **DER**) must not be greater than the Target CO₂ Emission Rate (**TER**). Additionally, and in accordance with regulation 26A, the calculated Dwelling Fabric Energy Efficiency (**DFEE**) rate must not be greater than the Target Fabric Energy Efficiency (**TFEE**) rate. The **TER/DER** and **TFEE/DFEE** rate calculations are determined using the procedures set out in paragraphs 2.8 to 2.30.

NOTE: *Criterion 1 is a regulation and is therefore mandatory, whereas the limits for design flexibility for Criteria 2 are statutory guidance. The calculations required as part of the procedure to show compliance with this criterion can also provide information for the **energy performance certificate** required by the Energy Performance of Buildings (England and Wales) Regulations 2012 (SI 2012/3118).*

1.5 Criterion 2: the performance of the individual fabric elements and the **fixed building services** of the building should achieve reasonable overall standards of energy efficiency, following the procedure set out in paragraphs 2.31 to 2.37.

NOTE: *Criterion 2 is intended to limit design flexibility, to discourage excessive and inappropriate trade-offs. For example, individual building fabric elements with poor insulation standards being offset by renewable energy systems with uncertain service lives.*

1.6 Criterion 3: the **dwelling** should have appropriate passive control measures to limit the effect of heat gains on indoor temperatures in summer, irrespective of whether the **dwelling** has mechanical cooling. The guidance given in paragraphs 2.38 to 2.42 of this approved document provides a way of demonstrating reasonable provision.

NOTE: *The purpose is to limit solar gains and heat gains from circulation pipes to reasonable levels during the summer period, in order to reduce the need for, or the installed capacity of, air-conditioning systems. Criterion 3 should be satisfied even if the **dwelling** is air-conditioned.*

1.7 Criterion 4: the performance of the **dwelling**, as built, should be consistent with the **DER** and **DFEE** rate. Use the guidance in Section 3 to demonstrate that this criterion has been met.

1.8 Criterion 5: the necessary provisions for enabling energy-efficient operation of the **dwelling** should be put in place. One way to achieve this is to follow the guidance in Section 4.

Section 2: Design standards

Regulations 35, 24 and 25

2.1 Regulations 35, 24 and 25 state that:

Interpretation

35(1). 'Energy performance of a building' means the calculated or measured amount of energy needed to meet the energy demand associated with a typical use of the building, which includes, inter alia, energy used for heating, cooling, ventilation, hot water and lighting.

Methodology of calculation of the energy performance of buildings

24. (1) The Secretary of State shall approve—

- (a) a methodology of calculation of the energy performance of buildings, including methods for calculating asset ratings and operational ratings of buildings; and
- (b) ways in which the energy performance of buildings, as calculated in accordance with the methodology, shall be expressed.

(2) In this regulation—

'asset rating' means an energy performance indicator determined from the amount of energy estimated to meet the different needs associated with a standardised use of the building; and

'operational rating' means an energy performance indicator determined from the amount of energy consumed during the occupation of a building over a period of time and the energy demand associated with a typical use of the building over that period.

Minimum energy performance requirements for buildings

25. Minimum energy performance requirements shall be set by the Secretary of State calculated and expressed in accordance with the methodology approved pursuant to regulation 24, for—

- (a) new buildings (which shall include new dwellings), in the form of target CO₂ emission rates; and
- (b) new dwellings, in the form of target fabric efficiency rates.

Target CO₂ Emission Rate (TER) and Target Fabric Energy Efficiency (TFEE) rate

2.2 The Target CO₂ Emission Rate (TER) and Target Fabric Energy Efficiency (TFEE) rate are the minimum energy performance requirements for a new dwelling approved by the Secretary of State in accordance with regulation 25. The TER is expressed as the mass of CO₂ emitted in kilograms per square metre of floor area per year. The TFEE rate is expressed as the amount of energy demand in units of kilowatt-hours per square metre of floor area per year. The results are based on the provision and standardised use of specified fixed building services when assessed using approved calculation tools.

2.3 In line with the methodology approved by the Secretary of State in the *Notice of Approval*, the TER and TFEE rate for individual dwellings must be calculated using SAP 2012.

NOTE: A summary of the Part L 2013 notional dwelling is published at Table 4 in this approved document with the full detail in SAP 2012 Appendix R. If the actual dwelling is constructed entirely to the notional dwelling specifications it will meet the CO₂ and fabric energy efficiency targets and the limiting values for individual fabric elements and buildings services. Developers are, however, free to vary the specification, provided the same overall level of CO₂ emissions and fabric energy efficiency performance is achieved or bettered.

2.4 The TER is calculated in two stages:

- a. First calculate the CO₂ emissions from a notional dwelling of the same size and shape as the actual dwelling and which is constructed according to the reference values set out in Appendix R of SAP 2012 (and summarised at Table 4). No values may be varied from these reference values when establishing the TER. The calculation tool will report the CO₂ emissions (based on SAP 2012 CO₂ emission factors) arising from:
 - i. The provision of space heating and hot water, C_H
 - ii. The use of pumps and fans, C_{PF}
 - iii. The use of internal lighting, C_L
- b. Second, calculate the TER using the following formula:

$$TER_{2013} = C_H \times FF + C_{PF} + C_L$$

Where FF is the fuel factor taken from Table 1 in accordance with the guidance in paragraph 2.5.

2.5 The fuel to be used when determining the fuel factor from Table 1 is one of the fuels used to provide heating and hot water to the actual dwelling, as follows:

- a. If all the space heating and domestic hot water heating appliances are served by the same fuel, select that fuel.
- b. If the dwelling has more than one appliance for space heating and/or domestic hot water and these are served by different fuels, select:
 - i. mains gas if used to fire any of the appliances; or
 - ii. otherwise the fuel used for the main space heating system.
- c. Where the dwelling is served by a community heating scheme, select:
 - i. mains gas if used for any purpose in the community scheme; or
 - ii. otherwise the fuel that provides the most heat for the community scheme.

Table 1 Fuel factor

	Fuel factor ¹
Mains gas	1.00
LPG	1.06
Oil	1.17
B30K	1.00
Grid electricity for direct acting and storage systems	1.55
Grid electricity for heat pumps	1.55
Solid mineral fuel ²	1.35
Any fuel with a CO ₂ emission factor less than that of mains gas	1.00
Solid multi-fuel ²	1.00

Notes:

1. The fuel factors in this table will be reviewed as progress is made towards the zero carbon target.
2. For those appliances that can only burn one particular fuel, use the specific fuel factor. For an appliance that is classed as multi-fuel and that is not in a dwelling in a smoke control area, use the multi-fuel factor. For a multi-fuel appliance in a dwelling within a smoke control area, use the solid mineral fuel figure unless the specific appliance type is approved for use within smoke control areas, in which case use the multi-fuel factor.

- 2.6 The TFE rate is calculated by determining the fabric energy efficiency from a notional dwelling of the same size and shape as the actual dwelling and which is constructed according to the reference values as summarised in Table 4. This fabric energy efficiency is then multiplied by 1.15 to give the TFE rate.

Buildings containing multiple dwellings

- 2.7 For a building that contains more than one dwelling (such as a terrace of houses or an apartment block), an average TER and/or TFE rate can be calculated. The average TER and/or TFE rate is the floor-area-weighted average of the TERs and/or TFE rates for all the dwellings in the building, calculated according to the following formula:

$$\frac{\{(TER_1 \times \text{Floor area}_1) + (TER_2 \times \text{Floor area}_2) + (TER_3 \times \text{Floor area}_3) + \dots\}}{(\text{Floor area}_1 + \text{Floor area}_2 + \text{Floor area}_3 + \dots)}$$

The average TFE rate is calculated according to an identical formula, replacing TER with TFE rate.

An average TER and/or TFE rate can be calculated across multiple dwellings in the same building but **cannot** be calculated across separate multiple buildings on the same site.

Criterion 1 – Achieving the TER and TFE rate

- 2.8 Regulations 26 and 26A state that:

CO₂ emission rates for new buildings

26. Where a building is erected, it shall not exceed the target CO₂ emission rate for the building that has been approved pursuant to regulation 25 applying the methodology of calculation and expression of the energy performance of buildings approved pursuant to regulation 24.

Fabric energy efficiency rates

26A. Where a dwelling is erected, it shall not exceed the target fabric energy efficiency rate for the dwelling that has been approved pursuant to regulation 25, applying the methodology of calculation and expression of the energy performance of buildings approved pursuant to regulation 24.

Calculating the CO₂ emissions from and fabric energy efficiency performance of the actual dwelling

- 2.9 To comply with regulations 26 and 26A, the Dwelling CO₂ Emission Rate (DER) and the Dwelling Fabric Energy Efficiency (DFEE) rate must be no worse than the TER and TFE rate calculated as set out in paragraphs 2.2 to 2.7. The final DER and DFEE rate calculation produced in accordance with regulations 27 and 27A (see paragraph 2.13 below) must be based on the building as constructed, incorporating:
- a. any changes to the list of specifications that have been made during construction; and
 - b. the assessed air permeability. The assessed air permeability is determined as follows:
 - i. where the dwelling has been pressure tested, the assessed air permeability is the measured air permeability;
 - ii. where the dwelling has not been pressure tested, the assessed air permeability is the average test result obtained from other dwellings of the same dwelling type on the development, increased by +2.0 m³/(h·m²) at 50 Pa;

- iii. on small developments (see paragraph 3.22) where the builder has opted to avoid testing, the assessed air permeability is $15 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ at 50 Pa.

NOTE: The safety margin in sub-paragraph ii is approximately one standard deviation, derived from analysing a large sample of data from post-2006 dwellings. For dwellings that will not be pressure tested, the design air permeability should be a maximum of $8.0 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ at 50 Pa, so that the assessed air permeability (the average of other test results, plus $2.0 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ at 50 Pa) is less than the limiting value of $10 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ at 50 Pa.

If the design of a dwelling aims to achieve a low design air permeability but the dwelling is not pressure tested, the margin added under sub-paragraph ii will have a significant impact on the calculated DER and DFEE rate. In such cases, the builder should consider testing the dwelling so that the measured permeability can be included in the calculation.

CO₂ emission rate and fabric energy efficiency rate calculations

2.10 Regulation 27 states that:

CO₂ emission rate calculations

27. (1) This regulation applies where a building is erected and regulation 26 applies.
- (2) Not later than the day before the work starts, the person carrying out the work shall give the local authority a notice which specifies—
- the target CO₂ emission rate for the building calculated and expressed in accordance with the methodology approved pursuant to regulation 24,
 - the CO₂ emission rate for the building as designed, calculated and expressed in accordance with the methodology approved pursuant to regulation 24, and
 - a list of specifications to which the building is to be constructed.
- (3) Not later than five days after the work has been completed, the person carrying out the work shall give the local authority—
- a notice which specifies—
 - the target CO₂ emission rate for the building calculated and expressed in accordance with the methodology approved pursuant to regulation 24,
 - the CO₂ emission rate for the building as constructed, calculated and expressed in accordance with the methodology approved pursuant to regulation 24, and
 - whether the building has been constructed in accordance with the list of specifications referred to in paragraph (2)(c), and if not a list of any changes to those specifications; or
 - a certificate of the sort referred to in paragraph (4) accompanied by the information referred to in sub-paragraph (a).
- (4) A local authority is authorised to accept, as evidence that the requirements of regulation 26 have been satisfied, a certificate to that effect by an energy assessor who is accredited to produce energy performance certificates for that category of building.
- (5) In this regulation, ‘specifications’ means specifications used for the calculation of the CO₂ emission rate.

NOTE: Where the BCB is an approved inspector see regulation 20 of the Building (Approved Inspectors etc.) Regulations 2010 (as amended).

2.11 Regulation 27A of the Building Regulations states that:

Fabric energy efficiency rate calculations

27A. (1) This regulation applies where a dwelling is erected and regulation 26A applies.

(2) Not later than the day before the work starts, the person carrying out the work shall give the local authority a notice which specifies—

- (a) the target fabric energy efficiency rate for the dwelling calculated and expressed in accordance with the methodology approved pursuant to regulation 24;
- (b) the fabric energy efficiency rate for the dwelling as designed, calculated and expressed in accordance with the methodology approved pursuant to regulation 24; and
- (c) a list of specifications to which the dwelling is to be constructed.

(3) Not later than five days after the work has been completed, the person carrying out the work shall give the local authority—

- (a) a notice which specifies—
 - (i) the target fabric energy efficiency rate for the dwelling calculated and expressed in accordance with the methodology approved pursuant to regulation 24;
 - (ii) the fabric energy efficiency rate for the dwelling as constructed, calculated and expressed in accordance with the methodology approved pursuant to regulation 24; and
 - (iii) whether the dwelling has been constructed in accordance with the list of specifications referred to in paragraph (2)(c), and if not a list of any changes to those specifications; or
- (b) a certificate of the sort referred to in paragraph (4) accompanied by the information referred to in subparagraph (a).

(4) A local authority is authorised to accept, as evidence that the requirements of regulation 26A have been satisfied, a certificate to that effect by an energy assessor who is accredited to produce energy performance certificates for that category of building.

(5) In this Regulation, ‘specifications’ means specifications used for the calculation of the fabric energy efficiency rate.

NOTE: Where the BCB is an approved inspector see regulation 20 of the Building (Approved Inspectors etc.) Regulations 2010 (as amended).

CO₂ emission and fabric energy efficiency rate calculations before work commences

2.12 Regulations 26 and 26A and 27 and 27A require that, before work starts, the builder must calculate the DER and the DFEE rate of the dwelling as designed, to demonstrate that the DER and the DFEE rate are not greater than the TER and the TFEE rate. The builder must give this design-based calculation to the BCB, along with a list of specifications used in calculating the DER and DFEE rate.

NOTE: This design-stage calculation and list of specifications will help the BCB to confirm that the dwelling as designed aligns with the claimed performance. As set out at Appendix C, it is expected that the builder will use software implementations of SAP 2012 to produce the list of specifications and highlight those features of the design that are critical to achieving compliance. These ‘key features’ can be used to prioritise the risk-based inspection of the dwelling as part of confirming compliance with regulations 26 and 26A. If a provisional energy rating is calculated and an interim recommendations report is therefore available, the developer should review the recommendations to see whether further measures may be incorporated in a cost-effective manner.

CO₂ emission and fabric energy efficiency rate calculation when work is complete

2.13 When work is complete, the builder must notify the BCB of the TER and DER, the DFEE rate and TFEE rate, and whether the building was constructed in accordance with the list of specifications

submitted to the BCB before work started. A list of any changes to the design-stage list of specifications must be given to the BCB. BCBs are authorised to accept a certificate of compliance to this effect signed by a suitably accredited energy assessor.

NOTE: *It is useful to provide additional information to support the values used in the DER and DFEE rate calculation and the list of specifications. For example, U-values may have been determined from a specific calculation, in which case the details should be provided, or from an accredited source, in which case a reference to that source is sufficient. For example, for a boiler, details of the model reference and fuel type is sufficient evidence to allow the claimed performance to be checked against the Products Characteristics Database. Evidence that demonstrates that the dwelling as designed satisfies the requirements of criteria 2 and 3 is also useful.*

Secondary heating

2.14 A secondary heating appliance may meet part of the demand for space heating. When calculating the DER, the fraction provided by the secondary heating system must be as defined by SAP 2012 for the particular combination of main heating system and secondary heating appliance. Refer to the following when calculating the DER:

- a. Where a secondary heating appliance is fitted, the efficiency of the actual appliance with its appropriate fuel must be used in the calculation of the DER.
- b. Where a chimney or flue is provided but no appliance is installed, the presence of the following appliances must be assumed when calculating the DER:
 - i. if a gas point is located adjacent to the hearth, a decorative fuel-effect gas fire open to the chimney or flue with an efficiency of 20 per cent;
 - ii. if there is no gas point, an open fire in grate for burning multi-fuel with an efficiency of 37 per cent, unless the dwelling is in a smoke control area, when the fuel should be taken as smokeless solid mineral fuel.
- c. Otherwise it must be assumed that the secondary heating system has the same efficiency as the main heating system and is served by the same fuel – i.e. the equivalent of having no secondary heating system.

Internal lighting

2.15 In all cases, when calculating the DER, allow for the proportion of low-energy lamps installed in the fixed lighting locations.

NOTE: *Low-energy lighting provision is therefore tradable. The minimum amount that would be reasonable provision in the actual dwelling is given in the Domestic Building Services Compliance Guide.*

Buildings containing multiple dwellings

2.16 A building that contains more than one dwelling (such as a terrace of houses or an apartment block) complies with regulation 26 if:

- a. **either** every individual dwelling has a DER that is no greater than the individual dwelling's corresponding TER;
- b. **or** the average DER for the whole building is no greater than the average TER.

The average DER is the floor-area-weighted average of the individual DERs for all the dwellings in the building, and is calculated in the same way as the average TER (see paragraph 2.7).

An average DER **cannot** be calculated across separate multiple buildings on a site.

NOTE: When an average DER is calculated, it is still necessary to provide information for each individual dwelling, as required by regulation 27.

- 2.17** A building that contains more than one dwelling (such as a terrace of houses or an apartment block) complies with regulation 26A if:
- either** every individual dwelling has a DFEE rate that is no greater than the individual dwelling's corresponding TFEE rate;
 - or** the average DFEE rate for the whole building is no greater than the average TFEE rate;

The average DFEE rate is the floor-area-weighted average of the individual DFEE rates for all the dwellings in the building, and is calculated in the same way as the average TFEE rate (see paragraph 2.7).

An average DFEE rate **cannot** be calculated across separate multiple buildings on a site.

NOTE: When an average DFEE rate is calculated, it is still necessary to provide information for each individual dwelling, as required by regulation 27A.

Achieving the TER and TFEE rate

- 2.18** Provided the dwelling satisfies the limits on design flexibility set out in Criterion 2, the designer can achieve the TER by using fabric energy efficiency, system measures and integrating low and zero carbon technologies in whatever mix is appropriate.
- 2.19** Similarly, provided the dwelling satisfies the limits on design flexibility set out in Criterion 2, the designer can achieve the TFEE rate by using fabric energy efficiency measures in whatever mix is appropriate.
- 2.20** The approved compliance tools include algorithms that enable the designer to assess the role that low and zero carbon technologies (including local renewable and low carbon energy sources driven by the *National Planning Policy Framework*) can play in achieving the TER.
- 2.21** Where a dwelling is connected to a community energy system, the annual percentage heat supplied from each heat source should be the same for each newly connected dwelling. The submission should demonstrate that the capacity of the community scheme is sufficient to provide the percentage that is assumed. The predicted effect of all dwellings proposed to be newly connected to the system in the first 12 months of operation of the system can be considered in the calculation of the percentage of heat supplied so that the increased operation of any marginal plant (e.g. gas boilers) is properly accounted for.
- 2.22** In order to facilitate incorporation of improvements in system efficiencies and the integration with low and zero carbon technologies, the designer should:
- consider heating system designs that use low distribution temperatures; and
 - where multiple systems serve the same end use, organise the control strategies such that priority is given to the least carbon-intensive option; and

NOTE: For example, where a solar hot water system is available, use controls that make best use of the available solar energy.

- consider making the dwelling easily adaptable by facilitating the integration of additional low and zero carbon technologies at a later date. Providing appropriate facilities at the construction stage can make subsequent enhancements much easier and cheaper, e.g. providing capped off connections that can link into a planned community heating scheme.

Consideration of high-efficiency alternative systems

2.23 Regulation 25A states that:

Consideration of high-efficiency alternative systems for new buildings

- 25A.** (1) Before construction of a new building starts, the person who is to carry out the work must analyse and take into account the technical, environmental and economic feasibility of using high-efficiency alternative systems (such as the following systems) in the construction, if available—
- (a) decentralised energy supply systems based on energy from renewable sources;
 - (b) cogeneration;
 - (c) district or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources; and
 - (d) heat pumps.
- (2) The person carrying out the work must—
- (a) not later than the beginning of the day before the day on which the work starts, give the local authority a notice which states that the analysis referred to in paragraph (1)—
 - (i) has been undertaken;
 - (ii) is documented; and
 - (iii) the documentation is available to the authority for verification purposes; and
 - (b) ensure that a copy of the analysis is available for inspection at all reasonable times upon request by an officer of the local authority.
- (3) An authorised officer of the local authority may require production of the documentation in order to verify that this regulation has been complied with.
- (4) The analysis referred to in paragraph (1)—
- (a) may be carried out for individual buildings or for groups of similar buildings or for common typologies of buildings in the same area; and
 - (b) in so far as it relates to collective heating and cooling systems, may be carried out for all buildings connected to the system in the same area.
- (5) In this regulation—
- (a) ‘cogeneration’ means simultaneous generation in one process of thermal energy and one or both of the following—
 - (i) electrical energy;
 - (ii) mechanical energy;
 - (b) ‘district or block heating or cooling’ means the distribution of thermal energy in the form of steam, hot water or chilled liquids, from a central source of production through a network of multiple buildings or sites, for the use of space or process heating or cooling;
 - (c) ‘energy from renewable sources’ means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases; and
 - (d) ‘heat pump’ means a machine, a device or installation that transfers heat from natural surroundings such as air, water or ground to buildings or industrial applications by reversing the natural flow of heat such that it flows from a lower to a higher temperature. (For reversible heat pumps, it may also move heat from the building to the natural surroundings.)

NOTE: Where the BCB is an approved inspector see regulation 20 of the Building (Approved Inspectors etc.) Regulations 2010 (as amended).

- 2.24** Regulation 25A requires that, before work starts, the person undertaking the work must carry out an analysis that considers and takes into account the technical, environmental and economic feasibility of using high-efficiency alternative systems in the **dwelling** design. The following high-efficiency alternative systems may be considered if available, but other low and zero carbon systems may also be considered if available:
- decentralised energy supply systems based on energy from renewable sources;
 - cogeneration;
 - district or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources;
 - heat pumps.

The analysis should state whether high-efficiency alternative systems have or have not been included in the building design. The requirement relates to considering, taking into account, documenting and making available for verification purposes the analysis of high-efficiency alternative systems.

NOTE: *The Building Regulations are technology neutral and do not require that high-efficiency alternative systems or other low and zero carbon systems are installed.*

- 2.25** The analysis of the feasibility of using high-efficiency alternative systems may be carried out for individual **dwellings**, groups of similar **dwellings** or for common types of **dwelling** in the same area. Where a number of **dwellings** are connected to a community energy system, a single analysis may be carried out for all the **dwellings** connected to the system in the same area as the building to be constructed.
- 2.26** Before work starts, the person undertaking the work must give the **BCB** a notice which states that the analysis of the feasibility of using high-efficiency alternative systems has been undertaken and documented and is available for verification purposes. The documented results of the analysis must be retained for inspection by the **BCB** upon request.

Although the analysis of high-efficiency alternative systems is not an explicit requirement of the CO₂ emission rate calculation, a facility within calculation software output reporting (the design-stage BRUKL report) may be available to the builder to declare that the analysis has been carried out and documented, and where it is available for verification purposes.

Special considerations

- 2.27** The following paragraphs describe some ‘special areas’ that fall outside the normal five criteria, and give guidance on how to demonstrate reasonable provision for the conservation of fuel and power.

Common areas in buildings with multiple dwellings

- 2.28** The common areas of buildings containing more than one **dwelling** are not classified as **dwellings** and therefore fall outside the scope of the five criteria outlined above. For such areas, reasonable provision is:
- if they are heated, to follow the guidance in Approved Document L2A; or
 - if they are unheated, to provide individual fabric elements that meet the fabric standards set out in paragraphs 2.33 to 2.35.

Conservatories and porches

2.29 Where conservatories and porches are installed at the same time as the construction of a new **dwelling**, and adequate thermal separation (see Tables 2 and 4) is provided between the **dwelling** and the conservatory or porch, and the **dwelling's** heating system is not extended into the conservatory or porch, follow the guidance in Approved Document L1B. Where conservatories and porches are installed at the same time as the construction of a new **dwelling**, and no, or inadequate, thermal separation is included between the **dwelling** and the conservatory or porch, or the **dwelling's** heating system is extended into the conservatory or porch, follow the guidance in this approved document including **TER/DER** and **TFFEE/DFEE** rate calculations.

Swimming pool basins

2.30 In terms of Criterion 1, the **dwelling** should be assessed as if the pool basin were not there, although the pool hall should be included. The area covered by the pool should be replaced with the equivalent area of floor with the same U-value as the pool surround.

Criterion 2 – Limits on design flexibility

2.31 While the approach to complying with Criterion 1 allows design flexibility, paragraph L1(a)(i) of Schedule 1 to the Building Regulations requires that reasonable provision be made to limit heat gains and losses through the fabric of the building, and paragraphs L1(b)(i) and (ii) require that energy-efficient **fixed building services** with effective controls be provided.

2.32 One way of showing that the Part L requirement is satisfied is to demonstrate that the fabric elements and the **fixed building services** all meet the minimum energy efficiency standards specified in the following paragraphs.

NOTE: Note that, in order to satisfy the **TER** and the **TFFEE** rate, the building specification needs to be considerably better than the stated limiting values in many aspects of the design.

NOTE: Achieving the **TFFEE** rate could be dependent on very good performance of one specific feature of the fabric design with poorer fabric performance elsewhere. If this key element of fabric design was to fail, or perform less well than expected, this would have a significant impact on performance. Continuing to have limiting fabric standards in Criterion 2 reduces such an impact.

Limiting fabric standards

2.33 Table 2 sets out the limiting standards for the properties of the fabric elements of the building. Each stated value represents the area-weighted average for all elements of that type. In general, to achieve the **TER** and the **TFFEE** rate, a significantly better fabric performance than that set out in Table 2 is likely to be required.

2.34 U-values shall be calculated using the methods and conventions set out in BR 443 *Conventions for U-value calculations*, and should be based on the whole element or unit (e.g. in the case of a window, the combined performance of the glazing and the frame).

In the case of windows, the U-value can be taken as that for:

- the smaller of the two standard windows defined in BS EN 14351-1; or
- the standard configuration set out in BR 443; or
- the specific size and configuration of the actual window.

The U-value of the door can be calculated for:

- a. the standard size as laid out in BS EN 14351-1; or
- b. the specific size and configuration of the actual door.

NOTE: For domestic-type construction, SAP 2012 Table 6e gives values for different window configurations, which can be used if there are no test data or calculated values.

2.35 The U-values for roof windows and roof-lights given in this approved document are based on the U-value having been assessed with the roof window or roof-light in the vertical position. If a particular unit has been assessed in a plane other than the vertical, the standards given in this approved document, should be modified by making an adjustment that is dependent on the slope of the unit, following the guidance given in BR 443.

Table 2 Limiting fabric parameters

Roof	0.20 W/(m ² ·K)
Wall	0.30 W/(m ² ·K)
Floor	0.25 W/(m ² ·K)
Party wall	0.20 W/(m ² ·K)
Swimming pool basin ¹	0.25 W/(m ² ·K)
Windows, roof windows, glazed roof-lights ² , curtain walling and pedestrian doors	2.00 W/(m ² ·K)
Air permeability	10.0 m ³ /(h·m ²) at 50 Pa

Notes:

1. Where a swimming pool is constructed as part of a new building, reasonable provision should be made to limit heat loss from the pool basin by achieving a U-value no worse than 0.25 W/(m²·K) as calculated according to BS EN ISO 13370.
2. For the purposes of checking compliance with the limiting fabric values for roof-lights, the true U-value based on aperture area can be converted to the U-value based on the developed area of the roof-light. Further guidance on evaluating the U-value of out-of-plane roof-lights is given in *Assessment of thermal performance of out-of-plane rooflights*, NARM Technical Document NTD 2 (2010).

Note: Approved Document C gives limiting values for individual elements to minimise the risk of condensation.

Limiting system efficiencies

2.36 Each fixed building service should be at least as efficient as the minimum acceptable value for the particular type of service, as set out in the *Domestic Building Services Compliance Guide*. If a type of service is not covered by the Guide, then reasonable provision is to demonstrate that the proposed service is not less efficient than a comparable service that is covered by the Guide.

NOTE: To not inhibit innovation.

2.37 The efficiency claimed for the fixed building service should be based on the appropriate test standard set out in the *Domestic Building Services Compliance Guide*, and the test data should be certified by a notified body. It is reasonable for BCBs to accept such data at face value. In the absence of quality-assured data, the BCB should satisfy itself that the claimed performance is justified.

Criterion 3 – Limiting the effects of heat gains in summer

2.38 This section sets out the approach to limiting heat gains as required by paragraph L1(a)(i) and L1(a)(ii) of Schedule 1 to the Building Regulations.

Limiting the effects of solar gains in summer

2.39 Solar gains are beneficial in winter to offset demand for heating, but can contribute to overheating in the summer. The effects of solar gain in summer can be limited by an appropriate combination of window size and orientation, solar protection through shading and other solar control measures, ventilation (day and night) and high thermal capacity. If ventilation is provided using a balanced mechanical system, consider providing a summer bypass function to use during warm weather (or allow the dwelling to operate via natural ventilation) so that the ventilation is more effective in reducing overheating.

2.40 SAP 2012 Appendix P contains a procedure enabling designers to check whether solar gains are excessive. Reasonable provision is achieved if the SAP assessment indicates that the dwelling does not have a high risk of high internal temperatures. This assessment should be done regardless of whether or not the dwelling has mechanical cooling. If the dwelling has mechanical cooling, the assessment should be based on the design without the cooling system operating, but with an appropriate assumption about effective air-change rate through openable windows.

NOTE: *Designers may want to exceed the requirements in the current Building Regulations to consider the impacts of future global warming on the risks of higher internal temperatures occurring more often. CIBSE TM 36 Climate change and the indoor environment gives guidance on this issue.*

2.41 When seeking to limit solar gains, consideration should be given to the provision of adequate levels of daylight. BS 8206-2 *Code of practice for daylighting* gives guidance on maintaining adequate levels of daylight.

NOTE: *The Building Regulations do not specify minimum daylight requirements. Reducing the window area has conflicting impacts on the predicted CO₂ emissions: reduced solar gain but increased use of electric lighting. As a general guide, if the area of glazing is much less than 20 per cent of the total floor area, some parts of the dwelling may experience poor levels of daylight, resulting in increased use of electric lighting.*

Heat losses and gains from circulation pipes

2.42 Reasonable provision should be made to limit heat losses from pipes as set out in the *Domestic Building Services Compliance Guide*. This includes insulating primary circulation pipes for domestic hot water services throughout their length.

NOTE: *In the case of apartment blocks, insulating primary circulation pipes for space heating as well as for domestic hot water services within communal spaces can help to limit potentially unwanted heat gains and overheating of the space.*

Section 3: Quality of construction and commissioning

Criterion 4 – Building performance consistent with DER and DFEE rate

3.1 Dwellings should be constructed and equipped so that performance is consistent with the calculated DER and DFEE rate. As indicated in paragraph 2.13, a final calculation of the DER and DFEE rate is required to take account of any changes in performance between design and construction, and to demonstrate that the building, as constructed, meets the TER and TFEE rate as required by regulations 26 and 26A. The following paragraphs in this section set out what in normal circumstances is reasonable provision to ensure that the performance of the building is consistent with the DER and DFEE rate.

NOTE: *The information referred to in paragraph 2.12 will help BCBs check that the key features of the design are included during the construction process.*

3.2 In accordance with Part L and regulation 7, the building fabric should be constructed to a reasonable standard so that:

- the insulation is reasonably continuous over the whole building envelope; and
- the air permeability is within reasonable limits.

Party walls and other thermal bypasses

3.3 Contrary to previous assumptions, party cavity walls may not be zero heat loss walls; this is because air flow in the cavity provides a heat-loss mechanism.

NOTE: *Where outside air flows into the party wall cavity, a cold zone is created which causes heat loss through the wall sections on either side. The extent of air flow and heat changes depends on external conditions such as wind and temperature, and also on the effect caused by the warmed air rising in the cavity to be replaced by cooler air drawn in from outside. The air movements involved can be significant and, if no steps are taken to restrict flows, the resulting heat losses can be large.*

3.4 Heat loss can be reduced by restricting air movement through the cavity, which can be achieved by fully filling the cavity and/or by effective sealing around the perimeter. Further guidance is available at www.buildingcontrolalliance.org

The extent to which heat loss can be reduced depends on the detailed design and the quality of construction. In the absence of any specific independent scientific field evidence, reasonable provision is to adopt the guidance on U-values in paragraph 3.5.

NOTE: *Fully filling the cavity may affect sound transmission through party walls. Developers who plan to fill a party wall cavity must satisfy the BCB that the requirements of Part E (Sound) of Schedule 1 to the Building Regulations will be satisfied, either by adopting a full-fill detail accredited under the Robust Details scheme or through specific site testing.*

- 3.5** When calculating the DER and DFEE rate for a dwelling, a party wall U-value for the type of construction adopted, as set out in Table 3, should be applied.
- 3.6** When applying the U-values in Table 3, it is important that if edge sealing is adopted, either on its own or in conjunction with a fully filled cavity, the seal is effective in restricting air flow and is aligned with the thermal envelope. Although effective sealing may be part of a cavity barrier provided in order to comply with Part B (Fire) of Schedule 1 to the Building Regulations, a cavity barrier on its own may not be effective in restricting air flow. In order to claim a reduced U-value (0.2 or 0.0), it is necessary to demonstrate that the design adopted is likely to be robust under normal site conditions.

It is also important that the sealing system is applied in such a way as to be in line with the thermal envelope. Any solution to reducing party wall heat loss must take into account all the requirements in Schedule 1 to the Building Regulations, but particular attention should be given to the requirements of Part E.

NOTE: For example, in a room-in-roof design, the insulation layer may follow the sloping roof sections to a horizontal ceiling then continue at ceiling level. In such a case it is important that the party wall cavity seal follows the line of the insulation in the slope and horizontal ceiling sections (although for the purposes of Part B (Fire), it may be necessary to ensure that the fire cavity barrier follows the slope to the ridge). In the case of flats, the sealing system should follow the line of party floors and other party structures as well as the main thermal envelope.

- 3.7** In considering heat losses via party walls, it is important to remember that wherever the wall penetrates an insulation layer, such as when the blockwork of a masonry party wall penetrates insulation at ceiling level, a thermal bridge is likely to exist – even when the party wall U-value is zero. Any bridging at the party wall should be evaluated and then taken into account, along with other thermal bridges. It is important also to be satisfied that any solution to the party wall bypass does not contravene other parts of the regulations, in particular Part E (Sound).

Table 3 U-values for party walls

Party wall construction	U-value W/(m ² K)
Solid	0.0
Unfilled cavity with no effective edge sealing	0.5
Unfilled cavity with effective sealing around all exposed edges and in line with insulation layers in abutting elements	0.2
A fully filled cavity with effective sealing at all exposed edges and in line with insulation layers in abutting elements	0.0

- 3.8** The party wall is a particular case of the more general thermal bypass problem that occurs if the air barrier and the insulation layer are not contiguous and the cavity between them is subject to air movement. To avoid the consequent reduction in thermal performance, either the insulation layer should be contiguous with the air barrier at all points in the building envelope, or the space between the air barrier and insulation layer should be filled with solid material, such as in a masonry wall.

Thermal bridges

3.9 The building fabric should be constructed so that there are no reasonably avoidable thermal bridges in the insulation layers caused by gaps within the various elements, at the joints between elements, and at the edges of elements, such as those around window and door openings.

3.10 Reasonable provision would be to:

- a. Adopt approved design details as set out in DCLG Approved Construction Details or those that are formally recognised by DCLG. The calculated linear thermal transmittance values can be used directly in the DER and DFEE rate calculations; or
- b. Use construction joint details that have been calculated by a person with suitable expertise and experience following the guidance set out in BRE Report BR 497 *Conventions for calculating linear thermal transmittance and temperature factors*. The linear thermal transmittance values can be used directly in the DER and DFEE rate calculations. Reasonable provision for the temperature factors is that they should achieve a performance no worse than that set out in BRE Information Paper IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings*; or

NOTE: Evidence of suitable expertise and experience for calculating linear thermal transmittance would be to demonstrate that the person has been trained in the software used to carry out the calculation, has applied that model to the example calculations set out in BR 497 and has achieved results that are within the stated tolerances.

- c. Use the linear thermal transmittance values in the 'default' column of Table K1 in SAP 2012 directly in the DER and DFEE rate calculations; or
- d. Use a conservative default ψ -value of $0.15 \text{ W}/(\text{m}^2\text{K})$, rather than linear transmittance values for each construction joint, in the DER and DFEE rate calculation.

3.11 The alternative approaches for using linear transmittance values in paragraphs 3.10 (a), (b) and (c) are not mutually exclusive. For example, a builder could use approved design details for the majority of the junctions, but use a calculated bespoke detail for the window head. Furthermore, where design details via paragraph 3.10 (a) or (b) are adopted for some junctions but not for all junctions, the linear thermal transmittance values in the 'default' column of Table K1 in SAP 2012 should be used for the other junctions.

NOTE: The effect of using linear transmittance values that are poorer than those in the notional dwelling specification at SAP 2012 Appendix R should be compensated for by improved standards elsewhere in the dwelling design. When default linear transmittance values from Table K1 in SAP 2012 are used for the majority of the construction joints in a dwelling, or when the conservative default ψ -value of $0.15 \text{ W}/(\text{m}^2\text{K})$ is used, the builder would need to significantly improve upon the notional dwelling values elsewhere in the design to meet the TER and TFEE rate.

3.12 When adopting the approaches in paragraphs 3.10 (a) and (b), the builder should demonstrate to the BCB that an appropriate system of site inspection is in place to give confidence that the construction procedures achieve the required standard of consistency.

Air permeability and pressure testing

3.13 In order to demonstrate that an acceptable **air permeability** has been achieved, Regulation 43 states:

Pressure testing

- 43.** (1) This regulation applies to the erection of a building in relation to which paragraph L1(a)(i) of Schedule 1 imposes a requirement.
- (2) Where this regulation applies, the person carrying out the work shall, for the purpose of ensuring compliance with regulation 26 and paragraph L1(a)(i) of Schedule 1:
- (a) ensure that:
- (i) pressure testing is carried out in such circumstances as are approved by the Secretary of State; and
 - (ii) the testing is carried out in accordance with a procedure approved by the Secretary of State; and
- (b) subject to paragraph (5), give notice of the results of the testing to the local authority.
- (3) The notice referred to in paragraph (2)(b) shall:
- (a) record the results and the data upon which they are based in a manner approved by the Secretary of State; and
 - (b) be given to the local authority not later than seven days after the final test is carried out.
- (4) A local authority is authorised to accept, as evidence that the requirements of paragraph (2)(a)(ii) have been satisfied, a certificate to that effect by a person who is registered by the Independent Air Tightness Testing Scheme Limited or the Air Tightness and Testing and Measuring Association in respect of pressure testing for the air tightness of buildings.
- (5) Where such a certificate contains the information required by paragraph (3)(a), paragraph (2)(b) does not apply.

NOTE: Where the **BCB** is an approved inspector see regulation 20 of the Building (Approved Inspectors etc.) Regulations 2010 (as amended).

3.14 The approved procedure for pressure testing is given in the Air Tightness Testing and Measurement Association (ATTMA) publication *Measuring air permeability of building envelopes (dwellings)* and, specifically, the method that tests the envelope area. The preferred test method is that trickle ventilators should be temporarily sealed rather than just closed. **BCBs** should be provided with evidence that test equipment has been calibrated within the previous 12 months using a UKAS-accredited facility. The manner approved for recording the results and the data on which they are based is given in Section 4 of that document.

3.15 **BCBs** are authorised to accept, as evidence of compliance, a certificate offered under regulation 43(4). It should be confirmed to the **BCB** that the person who completed the testing has received appropriate training and is registered to test the specific class of building concerned. See <http://www.iats-uk.org/iats-member-list/> and https://attma.org/join-attma/registered_members/

3.16 The approved circumstances under which the Secretary of State requires pressure testing to be carried out are set out in paragraphs 3.17 to 3.22.

3.17 On each development, an air pressure test should be carried out on three units of each **dwelling type** or 50 per cent of all instances of that **dwelling type**, whichever is the less. For the purposes of this approved document, a block of flats should be treated as a separate development, irrespective of the number of blocks on the site. The **dwelling(s)** to be tested should be taken from the first completed batch of units of each **dwelling type**.

NOTE: Most larger developments include many **dwelling types**. Multiple units of each type should be tested to confirm the robustness of the designs and the construction procedures.

3.18 The specific dwellings making up the test sample should be selected by the BCB in consultation with the pressure tester. Dwellings should be selected so that about half of the scheduled tests for each dwelling type are carried out during construction of the first 25 per cent of each dwelling type. The results of all tests on dwellings in the sample should be reported to the BCB, including any test failures (see paragraphs 3.19 to 3.21).

NOTE: *The aim is to enable lessons to be learned and adjustments to the design and/or site procedures to be made before the majority of the dwellings are built.*

Showing compliance with regulation 43, and the consequences of failing a pressure test

3.19 The dwelling is shown to comply with the requirements if:

- a. the measured air permeability is not worse than the limit value of $10 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ at 50 Pa; and
- b. the DER and the DFEE rate calculated using the measured air permeability are not worse than the TER and the TFEE rate.

NOTE: *If a low (i.e. better) design air permeability is used in order to achieve a performance that is better than the TER and the TFEE rate, the design will not fail to comply with the energy efficiency requirements if the pressure test achieves the limit value and the TER and the TFEE rate are achieved.*

3.20 If satisfactory performance is not achieved, then remedial measures should be carried out on the dwelling and new tests carried out until the dwelling achieves the criteria set out in paragraph 3.19. In addition, a further dwelling of the same dwelling type should be tested, thereby increasing the overall sample size.

3.21 When a dwelling fails the initial pressure test, other dwellings of the same dwelling type that have not been tested should be examined and, where appropriate, remedial measures applied.

Alternative to pressure testing on small developments

3.22 On development sites where no more than two dwellings are to be erected, reasonable provision is to:

- a. demonstrate that during the preceding 12-month period, a dwelling of the same dwelling type constructed by the same builder was pressure tested according to the procedures given in paragraphs 3.13 to 3.18 and achieved the design air permeability; or
- b. use a value of $15 \text{ m}^3/(\text{h}\cdot\text{m}^2)$ at 50 Pa for the air permeability when calculating the DER and the DFEE rate, which then avoids the need for pressure testing.

NOTE: *The effect of using this cautious value in option b should be compensated for by improved standards elsewhere in the dwelling design.*

Commissioning of heating and hot water systems

3.23 Paragraph L1(b)(iii) of Schedule 1 to the Building Regulations requires fixed building services to be commissioned by testing and adjustment as necessary to ensure that they use no more fuel and power than is reasonable in the circumstances. In order to demonstrate that the heating and hot water systems have been adequately commissioned, regulation 44 states:

Commissioning

44. (1) This regulation applies to building work in relation to which paragraph F1(2) of Schedule 1 imposes a requirement, but does not apply to the provision or extension of any fixed system for mechanical ventilation or any associated controls where testing and adjustment is not possible.
- (2) This regulation applies to building work in relation to which paragraph L1(b) of Schedule 1 imposes a requirement, but does not apply to the provision or extension of any fixed building service where testing and adjustment is not possible or would not affect the energy efficiency of that fixed building service.
- (3) Where this regulation applies the person carrying out the work shall, for the purpose of ensuring compliance with paragraph F1(2) or L1(b) of Schedule 1, give to the local authority a notice confirming that the fixed building services have been commissioned in accordance with a procedure approved by the Secretary of State.
- (4) The notice shall be given to the local authority—
- not later than the date on which the notice required by regulation 16(4) is required to be given; or
 - where that regulation does not apply, not more than 30 days after completion of the work.

NOTE: Where the BCB is an approved inspector see regulation 20 of the Building (Approved Inspectors etc.) Regulations 2010 (as amended).

- 3.24 It would be useful to prepare a commissioning plan, identifying the systems that need to be tested and the tests that will be carried out and provide this with the design stage TER/DER and TFEE/DFEE rate calculations so that the BCB can check that the commissioning is being done as the work proceeds.

NOTE: The use of the templates in the Model Commissioning Plan (BSRIA BG 8/2009) is a way of documenting the process in an appropriate way.

- 3.25 Not all fixed building services will need to be commissioned. With some systems it is not possible as the only controls are 'on' and 'off' switches. Examples of this would be some mechanical extraction systems or single fixed electrical heaters. In other cases commissioning would be possible but in the specific circumstances would have no effect on energy use.

Fixed building services which do not require commissioning should be identified in the commissioning plan, along with the reason for not requiring commissioning.

- 3.26 Where commissioning is carried out, it should be done in accordance with procedures approved by the Secretary of State:
- For heating and hot water systems, the approved procedures are set out in the *Domestic Building Services Compliance Guide*.
 - For ventilation systems, the approved procedure is set out in the *Domestic Ventilation Compliance Guide*.
- 3.27 Commissioning is often carried out by the person who installs the system. In other cases, it may be carried out by a subcontractor or by a specialist firm. It is important that whoever carries it out follows the relevant approved procedure in doing so.
- 3.28 Where a building notice or full plans have been given to a local authority BCB the notice of completion of commissioning should be given to that BCB within five days of the completion of the commissioning work. In other cases, for example where work is carried out by a person registered with a competent person scheme, it must be given within 30 days.

- 3.29** Where an approved inspector is the **BCB** the notice of completion of **commissioning** should generally be given to the approved inspector within five days of the completion of work. However, where the work is carried out by a person registered with a competent person scheme the notice must be given within 30 days. Where the installation of **fixed building services** which require commissioning is carried out by a person registered with a competent person scheme, the notice of **commissioning** will be given by that person.
- 3.30** Until the **BCB** receives the **commissioning** notice, it may not consider it appropriate to give a completion/final certificate.

Section 4: Providing information

Criterion 5 – Provisions for energy-efficient operation of the dwelling

- 4.1 In accordance with regulation 40, the owner of the **dwelling** should be provided with sufficient information about the building, the **fixed building services** and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances.

Information about use of fuel and power

40. (1) This regulation applies where paragraph L1 of Schedule 1 imposes a requirement relating to building work.
(2) The person carrying out the building work shall not later than five days after the work has been completed provide to the owner sufficient information about the building, the fixed building services and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances.

- 4.2 A way of complying with the requirement is to provide a suitable set of operating and maintenance instructions aimed at assisting the occupiers of the **dwelling** achieve the expected level of energy efficiency. The documentation should be specific to the **dwelling**, and be in a durable format that can be kept and referred to over the service life of the various systems and components. The documentation should include relevant information in an easily understood format.
- 4.3 Without prejudice to the need to comply with health and safety requirements, this should:
- Explain the essential design principles (insulation, materials etc.) and the key features, with floor plans showing the location of the main heating and ventilation components in the **dwelling**.
 - Explain how to operate, control and maintain the following systems:
 - space heating system;
 - hot water heating system;
 - ventilation system;
 - any other technology which has been included in the **dwelling**, e.g. solar panels or other low and zero carbon technology, or a technology for which SAP Appendix Q has been utilised.
 - Signpost other important documentation which should include:
 - appliance manuals;
 - the data used in the **TER/DER** and **TFEE/DFEE** rate calculations;
 - the Recommendations Report generated with the 'on-construction' **energy performance certificate**, which will inform the occupier as to how the energy performance of the dwelling might be further improved.

NOTE: *It would also be sensible to retain an electronic copy of the input file for the energy calculation to facilitate any future analysis that may be required by the owner when altering or improving the **dwelling**.*

Section 5: Model designs

- 5.1 The TER and TFE rate are based on a dwelling of the same size and shape as the actual dwelling, constructed to a concurrent specification. If the actual dwelling is constructed entirely to this specification it will meet the TER and better the TFE rate and therefore pass Criterion 1. Table 4 provides a summary of the concurrent notional building specification. More detailed information can be found in SAP 2012 Appendix R.
- 5.2 It should be noted, however, that the concurrent notional building specifications are not prescriptive and may not be the most economic specification in every case. Designers are free to explore the most economic specification to meeting the TER and TFE rate in each case, provided that this specification meets all other provisions within this approved document, in particular the limiting fabric parameters in Table 2.
- 5.3 Some builders may prefer to adopt model design packages rather than to engage in design for themselves. Such model packages of fabric U-values, boiler seasonal efficiencies, window opening allowances etc should, if suitably robust, help the builder achieve compliance. The construction industry may develop model designs for this purpose and make them available on the Internet at: www.modeldesigns.info
- 5.4 It will still be necessary to demonstrate compliance in the particular case by going through the procedures described in paragraphs 2.8 to 2.17.

Table 4 Summary of concurrent notional dwelling specification

Element or system	Values
Opening areas (windows and doors)	Same as actual dwelling up to a maximum proportion of 25% of total floor area ¹
External walls (including opaque elements of curtain walls)	0.18 W/(m ² ·K)
Party walls	0.0 W/(m ² ·K)
Floor	0.13 W/(m ² ·K)
Roof	0.13 W/(m ² ·K)
Windows, roof windows, glazed roof-lights and glazed doors	1.4 W/(m ² ·K) (whole window U-value) ² g-value = 0.63 ³
Opaque doors	1.0 W/(m ² ·K)
Semi-glazed doors	1.2 W/(m ² ·K)
Airtightness	5.0 m ³ /(h·m ²)
Linear thermal transmittance	Standardised psi values – see SAP 2012 Appendix R, except use of $y = 0.05 \text{ W}/(\text{m}^2\cdot\text{K})$ if the default value of $y = 0.15 \text{ W}/(\text{m}^2\cdot\text{K})$ is used in the actual dwelling
Ventilation type	Natural (with extract fans) ⁴
Air-conditioning	None

Table 4 Summary of concurrent notional dwelling specification (continued)

Element or system	Values
Heating system	Mains gas If combi boiler in actual dwelling, combi boiler; otherwise regular boiler Radiators Room sealed Fan flue SEDBUK 2009 89.5% efficient
Controls	Time and temperature zone control ⁵ Weather compensation Modulating boiler with interlock
Hot water storage system	Heated by boiler (regular or combi as above) If cylinder specified in actual dwelling, volume of cylinder in actual dwelling If combi boiler, no cylinder. Otherwise 150 litres Located in heated space Thermostat controlled Separate time control for space and water heating
Primary pipework	Fully insulated
Hot water cylinder loss factor (if specified)	Declared loss factor equal or better than $0.85 \times (0.2 + 0.051 V^{2/3})$ kWh/day
Secondary space heating	None
Low-energy lighting	100% low-energy lighting
Thermal mass parameter (TMP)	Medium (TMP = 250)

Notes:

1. The Building Regulations do not specify minimum daylight requirements. However, reducing window area produces conflicting impacts on the predicted CO₂ emissions: reduced solar gain but increased use of electric lighting. As a general guide, if the area of glazing is much less than 20% of the total floor area (TFA), some parts of the dwelling may experience poor levels of daylight, resulting in increased use of electric lighting.
2. The orientation of the elemental building is the same as the actual building. In plotting buildings onto a site designers should consider the benefits of orientating buildings to the south (with large windows orientated south and smaller windows orientated north) to benefit from passive solar gains through having lower space heating demands. Designers should be aware of the risk of overheating through excessive solar gain in the summer and design shading to avoid excessive summer heat gain.
3. Higher g-values would also comply with the recipe as increasing solar gains reduces the space heat load. However, designers should be aware of the impact of g-value on the risk of overheating and optimise their choice accordingly. The U-value is set to 1.5 W/(m²K) for curtain walling glazed areas, as an allowance for thermal bridging.
4. See SAP 2012 Section 11: 2 fans for TFA up to 70 m²; 3 fans for TFA > 70–100 m²; 4 fans for TFA > 100 m². A recipe approach can be followed if extract fans are replaced with the same number of passive vents.
5. In order for a system to be specified with time and temperature zone control, it must be possible to programme the heating times of at least two heating zones independently, as well as having independent temperature controls. These two heating zones must be space heating zones. For single-storey open-plan dwellings in which the living area is greater than 70% of TFA, sub-zoning of temperature control is not appropriate and the recipe will default to programmer and room stat.

Appendix A: Key terms and abbreviations

Key terms

The following are key terms used in this document:

Air permeability is the physical property used to measure airtightness of the building fabric. It is defined as air leakage rate per hour per square metre of envelope area at the test reference pressure differential of 50 pascals (50 N/m²). The envelope area, or measured part of the building, is the total area of all floors, walls and ceilings bordering the internal volume that is the subject of the pressure test. This includes walls and floors below external ground level. Overall internal dimensions are used to calculate this envelope area and no subtractions are made for the area of the junctions of internal walls, floors and ceilings with exterior walls, floors and ceilings.

The **limiting air permeability** is the worst allowable **air permeability**.

The **design air permeability** is the target value set at the design stage, and must always be no worse than the limiting value.

The **assessed air permeability** is the value used in establishing the **DER** and the **DFEE** rate, and is based on a specific measurement of the **dwelling** concerned or on measurements of other **dwellings** of the same **dwelling type**.

NOTE: *The envelope area of a terraced house includes the party wall(s). The envelope area of a flat in a multiple-storey building includes the floors, walls and ceilings which are shared with adjacent flats.*

BCB means building control body – a local authority or an approved inspector.

Commissioning is the advancement of a **fixed building service** after all or part of the system has been installed, replaced or altered. The system is taken from a state of static completion to working order. Testing and adjusting, as necessary, ensure that the whole system uses no more fuel and power than is reasonable in the circumstances, without compromising the need to comply with health and safety requirements. For each system, **commissioning** includes the following: setting-to-work; regulation (that is, testing and adjusting repetitively) to achieve the specified performance; calibration, setting up and testing of the associated automatic control systems; and recording of the system settings and the performance test results that have been accepted as satisfactory.

Controlled service or fitting means a service or fitting in relation to which Part G (sanitation, hot water safety and water efficiency), H (drainage and waste disposal), J (combustion appliances and fuel storage systems), L (conservation of fuel and power) or P (electrical safety) of Schedule 1 to the Building Regulations imposes a requirement.

DER is the Dwelling CO₂ Emission Rate expressed as kgCO₂/(m²·year).

DFEE rate is the **dwelling** fabric energy efficiency rate expressed as kWh/(m²·year).

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

NOTE: *Buildings exclusively containing rooms for residential purposes, such as nursing homes, student accommodation and similar, are not dwellings, and in such cases, Approved Document L2A applies.*

Dwelling type is the particular group allocated to each **dwelling** on a development to provide the basis for assessing the pressure testing regime.

The allocation of each **dwelling** to a **dwelling type** should be the responsibility of the person carrying out the pressure testing. To be classed as of the same type, **dwelling**s should:

- i. be of the same generic form (i.e. detached, semi-detached, end terrace, mid-terrace, ground-floor flat (including ground-floor maisonette), mid-floor flat, top-floor flat (including top-floor maisonette));
- ii. include the same number of storeys;
- iii. have the same **design air permeability**;
- iv. have similar adjacency to unheated spaces such as stairwells, integral garages etc.
- v. have the same principal construction details;
- vi. have a similar (i.e. ± 1) number of significant penetrations, i.e. for windows, doors, flues/chimneys, supply/exhaust terminals, waste water pipes;
- vii. have envelope areas that do not differ by more than 10 per cent (see **air permeability** for a definition of envelope area).

Energy efficiency requirements means the requirements of regulations 23, 25A, 25B, 26, 26A, 28 and 40 of, and Part L of Schedule 1 to, the Building Regulations.

Energy performance certificate means a certificate which complies with regulation 7A of the Energy Performance of Buildings (England and Wales) Regulations 2012.

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

- (a) fixed internal or external lighting systems (but not including emergency escape lighting or specialist process lighting);
- (b) fixed systems for heating, hot water, air conditioning or mechanical ventilation; or
- (c) any combination of systems of the kinds referred to in paragraph (a) or (b).

Room for residential purposes means a room, or a suite of rooms, which is not a dwelling-house or a flat and which is used by one or more persons to live and sleep and includes a room in a hostel, an hotel, a boarding house, a hall of residence or a residential home, but does not include a room in a hospital, or other similar establishment, used for patient accommodation.

TER is the Target CO₂ Emission Rate expressed as kgCO₂/(m²·year).

TREE is the Target Fabric Energy Efficiency rate expressed as kWh/(m²·year).

Abbreviations

CO ₂ :	carbon dioxide
BRUKL:	Building Regulations UK Part L
UKAS:	The United Kingdom Accreditation Service
SEDBUK:	Seasonal Efficiency of Domestic Boilers in the UK
TFA:	total floor area
TMP:	thermal mass parameter

Appendix B: Types of work covered by this approved document

1. This approved document gives guidance on what, in ordinary circumstances, may be considered reasonable provision to comply with the requirements of regulations 26, 26A and 40 of, and Part L of Schedule 1 to, the Building Regulations for those creating new **dwelling**s. In addition, this approved document gives guidance on how to comply with regulations 25A, 27, 27A, 43 and 44 of the Building Regulations and regulation 20 of the Building (Approved Inspectors etc.) Regulations 2010 where an approved inspector is the **BCB**.

Live-work units

2. If a unit contains both living accommodation and space to be used for commercial purposes (e.g. as a workshop or office), the whole unit should be treated as a **dwelling**, as long as the commercial part can revert to domestic use. This can be the case if, for example:
 - a. there is direct access between the commercial space and the living accommodation; and
 - b. both are contained within the same thermal envelope; and
 - c. the living accommodation occupies a substantial proportion of the total area of the unit.

Note: *Sub-paragraph c means that, for example, the presence of a small flat for a manager in a large non-domestic building does not result in the whole building being treated as a **dwelling**. Similarly, if a room is used as an office or utility space within a **dwelling**, that does not mean that the building should not be treated as a **dwelling**.*

Mixed-use developments

3. When constructing a **dwelling** as part of a larger building that contains other types of accommodation, sometimes called a mixed-use development, use this Approved Document L1A for guidance in relation to each individual **dwelling**. Approved Document L2A gives guidance relating to the non-dwelling parts of such buildings, such as heated common areas, and in the case of mixed-use developments, the commercial or retail space.

Material changes of use

4. The act of erecting a new **dwelling** is not a material change of use. Approved Document L1B applies where a **dwelling** is being created in an existing building as the result of a material change of use of all or part of the building.

Appendix C: Reporting evidence of compliance

1. To facilitate effective communication between the builder and BCB, it would be beneficial to adopt a standardised format for presenting the evidence that demonstrates compliance with the energy efficiency requirements. (Other than the CO₂ and fabric energy efficiency targets, which are mandatory, the limiting values for individual fabric elements and building services represent reasonable provision in normal circumstances. In unusual circumstances, alternative limits may represent reasonable provision, but this would have to be demonstrated in the particular case.)
2. Since the data in SAP 2012 and the results it calculates can provide a substantial proportion of the evidence in support of the compliance demonstration, compliance software should produce this report as a standard output option.
3. Two versions of the standardised report may be produced by the compliance software: the first before commencement of works to include the TER/DER and TFEЕ/DFEЕ calculation plus supporting list of specifications, and the second after completion to include the as-built TER/DER and TFEЕ/DFEЕ calculation plus any changes to the list of specifications. The first design-stage report and accompanying list of specifications can then be used by the BCB to assist checking that what has been designed is actually built. A standardised report should enable the source of the evidence to be indicated, and allow the credentials of those submitting the evidence to be declared.
4. An important part of demonstrating compliance is to make a clear connection between the product specifications and the data inputs required by the compliance software (e.g. what is the wall construction that delivers the claimed U-value?). Examples as to how compliance software might provide this link are:
 - a. By giving each data input a reference code that can be mapped against a separate submission by the builder/developer that details the specification corresponding to each unique reference code in the data input.
 - b. By providing a free-text entry facility along with each input parameter that has a unique reference code, thereby allowing the software to capture the specification of each item and so include the full details in an integrated output report.
 - c. By including one or more utility programs that derive the data input from the specification, e.g. a U-value calculator that conforms to BR 443 and that calculates the U-value based on the layer thicknesses and conductivities, repeating thermal bridge effects etc. Outputs from such a utility program could then automatically generate the type of integrated report described at sub-paragraph b.

It would also help the BCB if the software included a facility to compare the 'as designed' and 'as constructed' data input files and automatically produce a schedule of changes.

5. The report should highlight any items whose specification is better than typically expected values. The BCB can then give particular attention to such ‘key features’, as their appropriate installation will be critical in achieving the TER and TFEE rate. The BCB is advised to give particular attention to those aspects where the claimed specification delivers an energy efficiency standard in advance of that defined in the following schedule.

Parameter	
Wall U-value	0.15 W/(m ² ·K)
Roof U-value	0.13 W/(m ² ·K)
Floor U-value	0.13 W/(m ² ·K)
Window/door U-value	1.20 W/(m ² ·K)
Party wall U-value	0.20 W/(m ² ·K)
Thermal bridging value	0.04 W/(m ² ·K)
Design air permeability	4.0 m ³ /(h·m ²) at 50 Pa
Any secondary heating appliance	
Any item involving SAP 2012 Appendix Q	
Use of any low-carbon or renewable energy technology	

Note: Solutions using electric resistance heating may have to better several of these fabric parameters if the design does not include an element of renewable energy provision.

Appendix D: Documents referred to

Air Tightness Testing and Measurement Association (ATTMA)

www.attma.org

Technical Standard L1 Measuring air permeability of building envelopes (dwellings) [2010].

BRE

www.bre.co.uk

BR 443 Conventions for U-value calculations [2006]. (www.bre.co.uk/uvalues)

BRE Report BR 497 Conventions for calculating linear thermal transmittance and temperature factors [2007 and 2010 amendment and conventions].

ISBN 978 1 86081 986 5

Information Paper IP 1/06 Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings [2006].

ISBN 978 1 86081 904 9

BSRIA

www.bsria.co.uk

BSRIA BG 8/2009 Model Commissioning Plan.

Chartered Institution of Building Services Engineers (CIBSE)

www.cibse.org

TM 36 Climate change and the indoor environment: impacts and adaptation [2005].

ISBN 978 1 90328 750 7

Department for Energy and Climate Change (DECC)

www.decc.gov.uk

The Government's Standard Assessment Procedure for energy rating of dwellings, SAP 2012. (Available at www.bre.co.uk/sap2012)

Department for Communities and Local Government

www.communities.gov.uk

National Planning Policy Framework [2012].

Domestic Building Services Compliance Guide [2013].

Domestic Ventilation Compliance Guide [2010].

Notice of Approval of the methodology of calculation of the energy performance of buildings in England.

National Association of Rooflight Manufacturers (NARM)

www.narm.org.uk

Technical Document NTD 2 Assessment of thermal performance of out-of-plane rooflights [2010].

Appendix E: Standards referred to

BS EN ISO 13370 Thermal performance of buildings. Heat transfer via the ground. Calculation methods [2007 incorporating corrigendum March 2009].

BS 8206-2 Lighting for buildings. Code of practice for daylighting [2008].

BS EN 14351-1 Windows and doors. Product standard, performance characteristics. Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics [2006 (+AMD 1:2010)].

Index

A

Air permeability

Definition Appendix A

Standards Table 2, 3.19

Testing 3.13–3.22

Approved Document L1A

Conventions i

Purpose 0.1–0.3

Types of work covered Appendix B

Assessed air permeability Appendix A, 2.9

Asset rating 2.1

B

BCB

See Building control body (BCB)

Boiler efficiency 2.37, Table 4

British Standards Appendix E

BS 8206–2 2.41

BS EN 14351-1 2.34

BS EN ISO 13370 Table 2

Building control body (BCB)

Air permeability test results 3.14–3.15, 3.18

Definition Appendix A

Demonstrating compliance 1.3–1.8, Appendix C

Notice of completion of commissioning
3.28–3.29

Notification of work iv

Building fabric

Construction quality 3.2–3.12

Design flexibility 2.31–2.32

U-values 2.33–2.35, Table 2

See also Dwelling Fabric Energy Efficiency (DFEE)
rate; Target Fabric Energy Efficiency (TFEE) rate

Building Regulations iii–iv, 1.1, 1.2

Building services

See Fixed building services

C

Cavity walls 3.3–3.8, Table 3

Chimneys 2.14

Circulation pipes 2.42

CO₂ emission rate

See Dwelling CO₂ Emission Rate (DER);

Target CO₂ Emission Rate (TER)

Cogeneration 2.23–2.24

Commissioning

Definition Appendix A

Heating and hot water systems 3.23–3.30

Common areas 2.28

Community energy systems 2.21, 2.25

Compliance with requirements i, iv

Demonstrating 1.3–1.8, Appendix C

Condensation risk 2.35

Conservatories 2.29

Construction quality 3.1–3.22

Controlled fittings

Definition Appendix A

See also Doors; Windows

Controlled services

Definition Appendix A

See also Fixed building services

D

Daylighting 2.41

DER

See Dwelling CO₂ Emission Rate (DER)

Design air permeability Appendix A

Design flexibility 1.5, 2.18, 2.31–2.32

Design standards 2.1–2.42

District heating 2.24

Doors Table 2

Dwelling

Definition Appendix A

Dwelling CO₂ Emission Rate (DER) 1.4, 1.7

Calculation 2.9–2.17

Internal lighting 2.15

Multiple dwellings 2.16

Secondary heating 2.14

Construction consistent with 3.1

Definition Appendix A

Dwelling Fabric Energy Efficiency (DFEE) rate

2.9, 2.12–2.13

Construction consistent with 3.1

Definition Appendix A

Multiple dwellings 2.17

See also Target Fabric Energy Efficiency (TFEE) rate**Dwelling type**

Definition Appendix A

E**Energy efficiency requirements** iii, 1.1

Compliance with 1.3–1.8

Definition Appendix A

Energy performance

Calculation 2.1

Minimum requirements 2.1–2.2

See also Dwelling CO₂ Emission Rate (DER); Target CO₂ Emission Rate (TER)**Energy performance certificate** 0.3, 1.4, 4.3

Definition Appendix A

F**Fabric***See* Building fabric**Fixed building services**

Commissioning 3.23–3.30

Definition Appendix A

Limits on design flexibility 1.5, 2.31–2.32

System efficiencies 2.36–2.37

Floors Table 2**Flues** 2.14**Fuel factor** Table 1, 2.4–2.5**G****Gas fires** 2.14**Glazing** 2.34–2.35, Table 2**H****Heating and hot water systems**

Commissioning 3.23–3.30

Multiple systems 2.14, 2.22

See also Fixed building services**High-efficiency alternative systems** 2.23–2.26**I****Information provision** 4.1–4.3**Internal lighting** 2.15**L****Lighting** 2.15**Limiting air permeability** Appendix A**Live-work units** Appendix B(2)**Low and zero carbon technologies** 2.18, 2.22, 2.24**Low-energy lighting** 2.15**M****Maintenance instructions** 4.1–4.3**Material change of use** iii, Appendix B(4)**Minimum energy performance requirements**
2.1–2.2**Mixed-use buildings** Appendix B(3)**Model designs** 5.1–5.4, Table 4**Multiple dwellings** 2.7, 2.16, 2.17, 2.28**Multiple heating systems** 2.14, 2.22**N****Notice of completion of commissioning**

3.28–3.30

Notification of work iv**Notional dwelling** 5.1, Table 4**O****Open fires** 2.14**Operating and maintenance instructions** 4.2–4.3

P

- Party walls** 3.3–3.8
 U-values 3.5–3.7, Table 2, Table 3
- Passive control measures** 1.6, 2.39
- Porches** 2.29
- Pressure testing** 3.13–3.21
- Publications (excluding British Standards)**
 Appendix D
 Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings (BRE IP 1/06, 2008) 3.10
 Climate change and the indoor environment (CIBSE TM 36, 2005) 2.40
 Conventions for calculating linear thermal transmittance and temperature factors (BRE 497, 2007) 3.10
 Conventions for U-value calculations (BR 443, 2006) 2.34, 2.35
 Domestic Building Services Compliance Guide (DCLG, 2013) 2.36–2.37, 2.42, 3.26
 Domestic Ventilation Compliance Guide (DCLG, 2010) 2.36
 Measuring air permeability of building envelopes (dwellings) (Technical Standard L1, ATTMA, 2010) 3.14
 Model Commissioning Plan (BSRIA BG 8/2009) 3.24
 National Planning Policy Framework (DCLG, 2012) 2.20

R

- Renewables** 2.24
- Robust Details** 3.4
- Roof-lights** 2.35, Table 2, Table 4
- Roofs** Table 2, Table 4
- Roof windows** 2.35, Table 2
- Room for residential purposes**
 Definition Appendix A

S

- SAP 2012** 2.3–2.4, 2.12, 2.14, 2.34, 2.40, 3.11, 4.3, 5.1, Table 4, Appendix C(2)
- Secondary heating** 2.14
- Software** 1.3, 2.26, Appendix C(2)–(4)
- Solar control** 1.6, 2.39–2.41
- Solar hot water systems** 2.22
- Special considerations** 2.27–2.30
- Standard Assessment Procedure**
 See SAP 2012
- Standards**
 See British Standards
- Swimming pool basins** 2.30, Table 2
- System efficiencies** 2.36–2.37

T

- Target CO₂ Emission Rate (TER)** 1.4, 2.2–2.7
 Calculation 2.4–2.5, 2.7
 Definition Appendix A
 Multiple dwellings 2.7
- Target Fabric Energy Efficiency (TFEE) rate**
 1.4, 2.2–2.7
 Calculation 2.3, 2.6–2.7
 Definition Appendix A
 Multiple dwellings 2.7
 See also Dwelling Fabric Energy Efficiency (DFEE) rate
- Thermal bridges** 3.7, 3.9–3.12
- Thermal elements**
 See Building fabric
- Trade-offs** 1.5, 2.15

U

- U-values** 2.34–2.35, Table 2
 Party walls 3.5–3.7, Table 3

W

- Walls** Table 2, Table 3
- Windows** 2.34–2.35, Table 2

List of approved documents

The following documents have been published to give practical guidance on how to meet the Building Regulations. You can find the date of the edition approved by the Secretary of State at www.gov.uk.

Approved Document A

Structure

Approved Document B: Volume 1

Fire safety – Dwellings

Approved Document B: Volume 2

Fire safety – Buildings other than dwellings

Approved Document C

Site preparation and resistance to contaminants and moisture

Approved Document D

Toxic substances

Approved Document E

Resistance to the passage of sound

Approved Document F

Ventilation

Approved Document G

Sanitation, hot water safety and water efficiency

Approved Document H

Drainage and waste disposal

Approved Document J

Combustion appliances and fuel storage systems

Approved Document K

Protection from falling, collision and impact

Approved Document L1A

Conservation of fuel and power in new dwellings

Approved Document L1B

Conservation of fuel and power in existing dwellings

Approved Document L2A

Conservation of fuel and power in new buildings other than dwellings

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Materials and workmanship

Published by NBS, part of RIBA Enterprises Ltd, and available from:

RIBA Bookshops Mail Order

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Newcastle Upon Tyne, NE1 1RH

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66 Portland Place, London W1B 1AD.

Tel +44 (0)20 7307 3753

ISBN 978 1 85946 743 5

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ISBN 978 1 85946 743 5

