



Proposals for amending Part L and Part F of the Building Regulations – *Consultation*

Volume 2: Proposed technical guidance for Part L



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Volume 2, Chapter 1

Proposed Approved Document L1A 2010 Edition

Approved Document L1A (2010)

Introduction

- 1 This document contains the proposed text of the 2010 Approved Document L1A: *Conservation of fuel and power in dwellings* (ADL1A), and is based on the Approved Document issued for consultation in 2008. The style and formatting of that consultation draft were strongly supported by consultees, and so have been retained for this consultation.
- 2 The regulatory guidance is shown in normal font, but the **proposed amendments to the 2008 consultation text are shown in blue**. Places where paragraphs have been deleted are shown by *<text deleted>*. To facilitate comparison with the 2008 consultation text, we have retained the same paragraph numbers as that version; where new paragraphs have been inserted, these have been given letter suffixes. Where paragraphs have been deleted, subsequent paragraphs have not been renumbered. A complete revision of the numbering will be carried out when documents are finally published.
- 3 As with the 2006 editions, *commentary text is included to help understanding and to provide pointers to useful information, but is not part of the technical guidance. This is shown in italics*. Finally, *some further text has been added as explanations of the proposed changes. These are shown in plum italicised text* and are only included to assist the consultation process.
- 4 Please note that where changes to the regulations are proposed, changes to the legal text have not been drafted. In these instances, the intent of the proposals is summarised in the explanatory text.

Main changes to the 2010 edition

- 5 The main strategic changes to ADL1A proposed are:
 - emphasise the distinction between requirements set out in the Building Regulations 2000 and guidance as set out in the AD;
 - remove the exemptions from the energy efficiency requirements (regulations 9(3) to 9(6)), but include specific guidance on what is reasonable provision with respect to the building work currently listed there (e.g. in buildings with low levels of heating, buildings with a planned life of less than two years);
 - define standards for swimming pool basins in new dwellings;

- require a design stage TER/BER calculation as a means of helping to improve compliance;
- revise guidance on demonstrating reasonable provision for the continuity of insulation;
- require that a commissioning plan should be made available with deposit of plans;
- raise standards generally.

Additional clarifications are given in the commentary accompanying the proposed changes.

As set out in Volume 1, the Government's preferred approach for new dwellings is "Flat 25%". The proposed Approved Document here also highlights the changes that would be necessary under the alternative "Aggregate 25%" approach.

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Section 1: Introduction

WHAT IS AN APPROVED DOCUMENT?

- 1.1 This document has been approved and issued by the Secretary of State to provide practical guidance on ways of complying with the energy efficiency requirements (see Section 2) and regulation 7 of the Building Regulations 2000 (SI 2000/2531) for England and Wales, as amended. The Building Regulations 2000 are referred to throughout the remainder of this Document as “the Building Regulations”.
- 1.2 The intention of issuing Approved Documents is to provide guidance about compliance with specific aspects of building regulations in some of the more common building situations. They set out what, in ordinary circumstances, would be reasonable provision for compliance with the relevant requirement(s) of building regulations to which they refer.
- 1.3 If guidance in an Approved Document is followed there will be a presumption of compliance with the requirement(s) covered by the guidance. However, this presumption can be overturned, so simply following guidance does not guarantee compliance; *for example, if the particular case is unusual in some way, then “normal” guidance may not be applicable.* It is also important to note that there may well be other ways of achieving compliance with the requirements. **There is therefore no obligation to adopt any particular solution contained in this Approved Document if you would prefer to meet the relevant requirement in some other way. Persons intending to carry out building work should always check with their building control body, either the local authority or an approved inspector, that their proposals comply with building regulations.**
- 1.3a It is important to note that this Approved Document, as well as containing guidance, also contains extracts from the Regulations. Such regulatory text must be complied with as stated. For example, the requirement that the target CO₂ emission rate for the building shall not be exceeded (regulation 17C) is a regulatory requirement. There is therefore no flexibility to ignore this requirement; neither can compliance with this particular regulation be demonstrated via any route other than that set out in regulations 17A and 17B.

To emphasise the important distinction between regulations and guidance.

- 1.4 The guidance contained in this Approved Document relates only to the particular requirements of the Building Regulations that the document addresses (set out in Section 2). However, building work may be subject to more than one requirement of building regulations. In such cases the work will also have to comply with any other applicable requirements of building regulations.
- 1.5 There are Approved Documents that give guidance on each of the Parts of Schedule 1 and on regulation 7. A full list of these is provided at the back of this document.

CONSIDERATION OF TECHNICAL RISK

- 1.6 In relation to the construction of new dwellings, building work must satisfy all the technical requirements set out in regulation 17C of, and Schedule 1 to, the Building Regulations. When considering the incorporation of energy efficiency measures in dwellings, attention should be paid in particular to the need to comply with Part B (fire safety), Part C (site preparation and resistance to contaminants and moisture), Part E (resistance to the passage of sound), Part F (ventilation), paragraph G3 (hot water storage), Part J (combustion appliances and fuel storage systems) and Part P (electrical safety), as well as Part L. *The adoption of any particular energy efficiency measure should not involve unacceptable technical risk of, for instance, excessive condensation. Designers and builders should refer to the relevant Approved Documents and to other generally available good practice guidance to help minimise these risks.*

ADs cannot expect to cover all aspects of good design practice. If thought appropriate, a list of relevant good practice information could be listed on the planning portal, but these would be third party publications. The difficulty of maintaining such a list is that it could never be exhaustive and, by its nature, a selective list may favour one particular system or technology. It may therefore be appropriate just to provide links to other information providers, such as the professional institutions and trade bodies.

HOW TO USE THIS APPROVED DOCUMENT

- 1.7a This Approved Document is subdivided into seven sections as detailed below. These main sections are followed by a number of supporting appendices.

This **introductory** section sets out the general context in which the guidance in the AD must be considered.

Section 2 sets out the relevant legal requirements as published in the Building Regulations.

Section 3 contains general guidance, including the definition of key terms, the types of building work covered by this Approved Document, the types of building work that are exempt, procedures for notifying work, materials and workmanship

and health and safety issues, an overview of the routes to compliance and how to deal with “special” areas of buildings that contain dwellings.

Section 4 details the considerations that apply to demonstrating that the design of the dwelling will meet the energy efficiency requirements. This section begins the detailed technical guidance relating to showing compliance with the energy efficiency requirements.

Section 5 details the considerations that apply when demonstrating that the design has been appropriately translated into actual construction performance.

Section 6 describes the information that should be provided to occupiers to help them achieve reasonable standards of energy efficiency in practice.

Section 7 provides a pointer to some useful information on different design approaches to meeting the energy efficiency requirements.

- 1.8 In this document the following conventions have been adopted to assist understanding and interpretation:
- a. texts shown **against a green background** are extracts from the Building Regulations or Building (Approved Inspectors) Regulations, both as amended, and set out the legal requirements that relate to compliance with the energy efficiency requirements of building regulations. *As stated previously, there is no flexibility in respect of such text; it defines a legal requirement, not guidance for typical situations.* It should also be remembered that, as noted above, building works must comply with all the other applicable provisions of building regulations.

To clarify the distinction between regulations and guidance.

- b. key terms are defined in paragraph 3.1 and are printed in ***bold italic text***;
- c. details of technical publications referred to in the text of this Document will be given in footnotes and repeated as end notes. A reference to a publication is likely to be made for one of two main reasons. The publication may contain additional or more comprehensive technical detail, which it would be impractical to include in full in the Document but which is needed to fully explain ways of meeting the requirements; or it is a source of more general information. The reason for the reference will be indicated in each case. The reference will be to a specified edition of the document. The Approved Document may be amended from time to time to include new references or to refer to revised editions where this aids compliance;

- 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, but is not part of the technical guidance itself.

WHERE YOU CAN GET FURTHER HELP

1.9 If you do not understand the technical guidance or other information set out in this Approved Document and the additional detailed technical references to which it directs you, there are a number of routes through which you can seek further assistance:

- the CLG website: www.communities.gov.uk;
- the Planning Portal website: www.planningportal.gov.uk;
- if you are the person undertaking the building work you can seek assistance either from your local authority building control service or from your approved inspector (depending on which building control service you are using, or intend to use, to certify compliance of your work with the requirements of the Building Regulations);
- businesses registered with a competent person self-certification scheme may be able to get technical advice from their scheme operator;
- if your query is of a highly technical nature you may wish to seek the advice of a specialist, or industry technical body, in the area of concern.

RESPONSIBILITY FOR COMPLIANCE

1.10 It is important to remember that if you are the person (e.g. designer, builder, installer) carrying out building work to which any requirement of building regulations applies you have a responsibility to ensure that the work complies with any such requirement. The building owner may also have a responsibility for ensuring compliance with building regulation requirements and could be served with an enforcement notice in cases of non-compliance.

Section 2: The Requirements

- 2.1 This Approved Document, which takes effect on xx xx 2010, deals with the **energy efficiency requirements** in the Building Regulations 2000 (as amended by SI). Regulation 2(1) of the Building Regulations defines the **energy efficiency requirements** as the requirements of regulations 4A, 17C, 17D and 17E and Part L of Schedule 1. The **energy efficiency requirements** relevant to this Approved Document, which deals with new dwellings, are those of regulations 17C and 17E and Part L of Schedule 1, and are set out below.

New buildings

Regulation 17C.

Where a building is erected, it shall not exceed the target CO₂ emission rate for the building that has been approved pursuant to regulation 17B.

Energy performance certificates

Regulation 17E.

- (1) This regulation applies where—
- (a) a building is erected; or
 - (b) a building is modified so that it has a greater or fewer number of parts designed or altered for separate use than it previously had, where the modification includes the provision or extension of any of the fixed services for heating, hot water, air conditioning or mechanical ventilation.
- (2) The person carrying out the work shall—
- (a) give an energy performance certificate for the building to the owner of the building; and
 - (b) give to the local authority notice to that effect, including the reference number under which the energy performance certificate has been registered in accordance with regulation 17F(4).
- (3) The energy performance certificate and notice shall be given not later than five days after the work has been completed.
- (4) The energy performance certificate must be accompanied by a recommendation report containing recommendations for the improvement of the energy performance of the building, issued by the energy assessor who issued the energy performance certificate.

Regulation 17E (*continued*).

- (5) An energy performance certificate must—
- (a) express the asset rating of the building in a way approved by the Secretary of State under regulation 17A;
 - (b) include a reference value such as a current legal standard or benchmark;
 - (c) be issued by an energy assessor who is accredited to produce energy performance certificates for that category of building; and
 - (d) include the following information—
 - (i) the reference number under which the certificate has been registered in accordance with regulation 17F(4);
 - (ii) the address of the building;
 - (iii) an estimate of the total useful floor area of the building;
 - (iv) the name of the energy assessor who issued it;
 - (v) the name and address of the energy assessor's employer, or, if he is self-employed, the name under which he trades and his address;
 - (vi) the date on which it was issued; and
 - (vii) the name of the approved accreditation scheme of which the energy assessor is a member.
- (6) Certification for apartments or units designed or altered for separate use in blocks may be based—
- (a) except in the case of a dwelling, on a common certification of the whole building for blocks with a common heating system; or
 - (b) on the assessment of another representative apartment or unit in the same block.
- (7) Where —
- (a) a block with a common heating system is divided into parts designed or altered for separate use; and
 - (b) one or more, but not all, of the parts are dwellings,
- certification for those parts which are not dwellings may be based on a common certification of all the parts which are not dwellings.

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; and
- (c) providing 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.

It is proposed that (iii) should be amended to include the objective that fixed building services should deliver their specified functional performance as well as using no more fuel and power than is necessary.

LIMITATION ON REQUIREMENTS

- 2.2 In accordance with regulation 8 of the Building Regulations, the requirements in Parts A to D, F to K and N and P (except for paragraphs H2 and J6) of Schedule 1 to the Building Regulations do not require anything to be done except for the purpose of securing reasonable standards of health and safety for persons in or about buildings (and any others who may be affected by buildings or matters connected with buildings).
- 2.3 Paragraphs H2 and J6 are excluded from regulation 8 because they deal directly with prevention of the contamination of water. Parts E and M (which deal, respectively, with resistance to the passage of sound and access to and use of buildings) are excluded from regulation 8 because they address the welfare and convenience of building users. Part L is excluded from regulation 8 because it addresses the conservation of fuel and power.

Section 3: General guidance

KEY TERMS

3.1 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 a test reference pressure differential across the building envelope of 50 Pascal (50 N/m²). The envelope area of the building, or measured part of the building, is the total area of all floors, walls and ceilings bordering the internal volume subject to the test. This includes walls and floors below external ground level. Overall internal dimensions are used to calculate this 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 is based on a specific measurement of the dwelling concerned, or on measurements of other dwellings of the same dwelling type.

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 means the advancement of a **fixed building service** following installation, replacement or alteration of the whole or part of the system, from the state of static completion to working order by testing and adjusting as necessary to ensure the system as a whole uses no more fuel and power than is reasonable in the circumstances, without prejudice to the need to comply with health and safety requirements. For each system **commissioning** includes setting-to-work, regulation (that is testing and adjusting repetitively) to achieve the specified performance, the 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.

Conservatory is an extension to a building:

- a) which is thermally separated from the attached building by walls, windows and doors with U-value and draught-stripping provisions no worse than provided elsewhere in the building, and if a heating system is provided, that system has independent temperature and on/off controls; and

- b) where the area of transparent or translucent material in its external envelope parts is more than 150% of its floor area.

It is suggested that the definition be included in the Regulations.

Controlled service or fitting means a service or fitting in relation to which Part G (hygiene), 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).

Dwelling means a self-contained unit, including a house or a flat, designed to be used separately to accommodate a single household. (**Rooms for residential purposes** are not **dwelling**s, so Approved Document L2A applies to their construction.)

Dwelling type is a means of allocating each dwelling on a development to a particular group to provide the basis for assessing the pressure testing regime. To be classed as of the same type **dwelling**s have to:

- i) be of the same generic form (i.e. detached, semi-detached, end terrace, mid terrace, ground floor flat (inc. ground floor maisonette), mid floor flat, top floor flat (inc. top floor maisonette);
- ii) be of the same number of storeys;
- iii) be of the same **design air permeability**;
- iv) have similar adjacency to unheated spaces such as stairwells, integral garages etc;
- iii) have the same principal construction details (as identified by the ACD or bespoke detail reference codes);
- iv) 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% (see **air permeability** for a definition of envelope area).

This revised definition (amended as necessary in the light of consultation feedback) will need to be integrated into the ATTMA guidance.

Energy efficiency requirements means the requirements of regulations 4A, 17C, 17D and 17E of, and Part L of Schedule 1 to, the Building Regulations.

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

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

It is proposed that the definition of fixed building services be amended to include (renewable) energy generation equipment, power distribution systems and (natural) ventilation components.

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, whether or not the room is separated from or arranged in a cluster group with other rooms, but does not include a room in a hospital, or other similar establishment, used for patient accommodation and, for the purposes of this definition, a “cluster” is a group of rooms for residential purposes which is:

- a. separated from the rest of the building in which it is situated by a door which is designed to be locked; and
- b. not designed to be occupied by a single household.

TER is the Target CO₂ Emission Rate expressed as kgCO₂/(m².year) (see paragraphs 4.2 to 4.6).

TYPES OF WORK COVERED BY THIS APPROVED DOCUMENT

- 3.2 This Approved Document is intended to give guidance on what, in ordinary circumstances, would be reasonable provision for compliance with the requirements of regulation 17C of, and Part L of Schedule 1 to, the Building Regulations for those creating new **dwelling**s. In addition it gives guidance on compliance with regulations 20B, 20C and 20D of the Building Regulations and 12B, 12C and 12D of the Building (Approved Inspectors etc) Regulations 2000 (SI 2000/2532) (“the Approved Inspectors Regulations”).

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

Live-work units

- 3.3 If a unit contains both living accommodation and space to be used for commercial purposes (e.g. workshop or office), the whole unit should be treated as a **dwelling** as long as the commercial part could revert to domestic use. This could 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.

*Sub paragraph c. means the presence of (e.g.) a small manager's flat in a large non-domestic building would not result in the whole building being treated as a **dwelling**. Similarly, the existence of a room used as an office or utility space within a **dwelling** would not mean that the building should not be treated as a **dwelling**.*

Mixed-use developments

- 3.5 When constructing a **dwelling** as part of a larger building that contains other types of accommodation, sometimes called a mixed-use development, this Approved Document L1A should be used 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.

Re-ordered as more logical to follow on from live-work units. Text is as before.

Material changes of use

- 3.4 Approved Document L1B applies where a **dwelling** is being created as the result of a material change of use.

"Material change of use" is defined in regulation 5 of the Building Regulations.

BUILDINGS THAT ARE EXEMPT FROM THE ENERGY EFFICIENCY REQUIREMENTS

- 3.6 The provisions for exempting buildings and building work from the Building Regulations requirements have changed and the new provisions are given in regulation 9 of the Building Regulations.

Regulation 9 is being reviewed. The aim is to rationalise the general exemptions and the exemptions from the energy efficiency requirements. This will require additional guidance and this is given in the relevant ADs.

NOTIFICATION OF WORK COVERED BY THE ENERGY EFFICIENCY REQUIREMENTS

3.7 In almost all cases of building new **dwelling**s it will be necessary to notify a BCB in advance of any work starting except as set out in paragraphs 3.8 to 3.11 below.

Competent person self-certification schemes

3.8 It is not necessary to notify a **BCB** in advance of carrying out work which is to be carried out by a person registered with a competent person self-certification scheme listed in Schedule 2A to the Building Regulations. In order to join such a scheme a person must demonstrate competence to carry out the type of work the scheme covers, and also the ability to comply with all relevant requirements in the Building Regulations.

3.9 Where work is carried out by a person registered with a competent person scheme, regulation 16A of the Building Regulations and regulation 11A of the Building (Approved Inspectors etc) Regulations 2000 require that the occupier of the building be given, within 30 days of the completion of the work, a certificate confirming that the work complies fully with all applicable building regulation requirements. There is also a requirement that the **BCB** be given a notice of the work carried out, again within 30 days of the completion of the work. These certificates and notices are usually made available through the scheme operator.

3.10 **BCBs** are authorised to accept these certificates and notices as evidence of compliance with the requirements of the Building Regulations. Local authority inspection and enforcement powers remain unaffected, but they are normally used only in response to a complaint that work does not comply.

3.11 A list of the self-certification schemes relating to the **energy efficiency requirements** in new **dwelling**s which are currently authorised can be found at www.communities.gov.uk

MATERIALS AND WORKMANSHIP

3.12 Any building work which is subject to the requirements imposed by Schedule 1 to the Building Regulations should, in accordance with regulation 7, be carried out with proper materials and in a workmanlike manner.

3.13 You may show that you have complied with regulation 7 in a number of ways. These include demonstrating the appropriate use of:

- a product bearing CE marking in accordance with the Construction Products Directive (89/106/EEC)¹, as amended by the CE Marking Directive (93/68/EC)², the Low Voltage Directive (2006/95/EC)³ and the EMC Directive (2004/108/EC)⁴;
- a product complying with an appropriate technical specification (as defined in those Directives mentioned above), a British Standard, or an alternative national technical specification of a Member State of the European Union or Turkey⁵, or of another State signatory to the Agreement on the European Economic Area (EEA) that provides an equivalent level of safety and protection;
- a product covered by a national or European certificate issued by a European Technical Approval Issuing body, provided the conditions of use are in accordance with the terms of the certificate.

3.14 You will find further guidance in the Approved Document which specifically supports regulation 7 on materials and workmanship.

Independent certification schemes

3.15 There are many UK product certification schemes. Such schemes certify compliance with the requirements of a recognised standard that is appropriate to the purpose for which the material is to be used. Materials which are not so certified may still conform to a relevant standard.

3.16 Many certification bodies that approve products under such schemes are accredited by the United Kingdom Accreditation Service (UKAS). [Such bodies can only issue certificates for the categories of product covered under the terms of their accreditation.](#)

3.17 **BCBs** may accept the certification of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard, Similarly, **BCBs** may accept the certification of the installation or maintenance of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Nonetheless, before accepting that certification constitutes compliance with building regulations, a **BCB** should establish in advance that the relevant scheme is adequate for that purpose. [In respect of the energy efficiency requirements, certificates confirming the results of CO₂ emission rate calculations and pressure testing are particularly relevant.](#)

¹ As implemented by the Construction Products Regulations 1991 (SI 1991/1620).

² As implemented by the Construction Products (Amendment) Regulations 1994 (SI 1994/3051).

³ As implemented by the Electrical Equipment (Safety) Regulations 1994 (SI 1994/3260).

⁴ As implemented by the Electromagnetic Compatibility Regulations 2006 (SI 2006/3418).

⁵ Decision No 1/95 of the EC-Turkey Association Council of 22 December 1995.

Standards and technical specifications

- 3.18 Building regulations are made for specific purposes, including securing the health, safety, welfare and convenience of people in or about buildings; furthering the conservation of fuel and power; furthering the protection or enhancement of the environment; and facilitating sustainable development. Guidance contained in standards and technical approvals is relevant to the extent that it relates to those purposes. However, the guidance may also address other aspects of performance such as serviceability, or aspects which, although they relate to health and safety, are not covered by building regulations.
- 3.19 When an Approved Document makes reference to a named standard or document, the relevant version of the standard or document is the one listed at the end of the Approved Document. If this version has been revised or updated by the issuing body, the latest version may be used as a source of guidance provided it continues to address the relevant requirements of the Building Regulations. However, until the reference in the Approved Document is revised, the standard or document listed remains the approved source.
- 3.20 The appropriate use of a product in compliance with a European Technical Approval as defined in the Construction Products Directive will meet the relevant requirements.
- 3.21 The Department intends to issue periodic amendments to its Approved Documents to reflect emerging harmonised European Standards. Where a national standard is to be replaced by a European harmonised standard, there will be a co-existence period during which either standard may be referred to. At the end of the coexistence period the national standard will be withdrawn.

THE WORKPLACE (HEALTH, SAFETY AND WELFARE) REGULATIONS 1992

- 3.22 The Workplace (Health, Safety and Welfare) Regulations 1992, as amended, apply to the common parts of flats and similar buildings if people such as cleaners, wardens and caretakers are employed to work in these common parts. These Regulations contain some requirements which affect building design. The main requirements are now covered by the Building Regulations, but for further information see *Workplace health, safety and welfare, Workplace (Health, Safety and Welfare) Regulations 1992, Approved Code of Practice and guidance*, HSE publication L24, HMSO, 1996.

- 3.23 Where the requirements of the Building Regulations that are covered by this Approved Document do not apply to **dwelling**s, the provisions may still be required in the situations described above in order to satisfy the Workplace Regulations.

DEMONSTRATING COMPLIANCE

- 3.25 In the Secretary of State's view, compliance with the **energy efficiency requirements** would be demonstrated by meeting all five criteria set out in the following paragraphs. **The compliance software will produce an output report that will assist BCBs to check that compliance has been achieved.**

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

- 3.25a The general approach to achieving an appropriate solution is to follow the following strategic sequence:
- a) reduce the energy demands as much as practicable by minimising the rate of heat flow through the building envelope and from pipes, ducts and vessels; then
 - b) meet the remaining energy demands with high efficiency systems that are well controlled and properly commissioned; then
 - c) use a mix of energy supplies and/or renewable energy systems that deliver a low overall carbon impact; and finally
 - d) provide appropriate operating instructions and energy monitoring facilities, enabling occupiers to effectively manage their use of energy so as to reduce operating costs and environmental impact.

To emphasise that it is not just about CO₂ reduction.

- 3.26 Criterion 1: in accordance with regulation 17C, the predicted rate of CO₂ emissions from the dwelling (the Dwelling Emission Rate, **DER**) must not be greater than the Target Emission Rate (**TER**), which is determined by following the procedure set out in paragraphs 4.2 to 4.15b.

To emphasise that Criterion 1 is a regulation and is therefore mandatory, whereas Criteria 2 to 5 are only guidance.

The calculations required as part of the procedure used to show compliance with this criterion can also provide the information needed to prepare the Energy Performance Certificate required by regulation 17E of the Building Regulations and the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007 (SI 2007/991) as amended by the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) (Amendment) Regulations 2007 (SI 2007/1669).

- 3.27 Criterion 2: the performance of the building fabric and the **fixed building services** should achieve reasonable overall standards of energy efficiency following the procedure set out in paragraphs 4.16 to 4.29b.

This is intended to place limits on design flexibility to discourage excessive and inappropriate trade-offs – e.g. buildings with poor insulation standards offset by renewable energy systems with uncertain service lives.

This emphasises the purpose of Criterion 2

- 3.28 Criterion 3: the **dwelling** should have appropriate passive control measures to limit the effect of solar gains on indoor temperatures in summer, **irrespective of whether or not the dwelling has mechanical cooling**. The guidance given in paragraphs 4.30 to 4.32 of this Approved Document provides a way of demonstrating that reasonable provision has been made.

The aim is to counter excessive internal temperature rise in summer to reduce or eliminate the need for air conditioners.

To clarify that Criterion 3 must be satisfied even if the dwelling is air conditioned.

- 3.29 Criterion 4: the performance of the **dwelling**, as built, should be consistent with the **DER**. The guidance in Section 5 should be used to demonstrate that this criterion has been met. **Extra credits will be given in the TER/DER calculation where builders provide robust evidence of quality assured procedures in the design and construction phases.**

The use of pressure tests, commissioning etc.

The use of “confidence factors” is intended to give impetus to improved quality and a narrowing of the gap between design intent and realised performance.

- 3.30 Criterion 5: the necessary provisions for energy efficient operation of the **dwelling** should be put in place. This would be achieved by following the guidance in Section 6.

“Special areas” related to dwellings

- 3.30a The following paragraphs describe some “special areas” that fall outside the normal five criteria, and give guidance on how reasonable provision for the conservation of fuel and power can be demonstrated.

Common areas in buildings with multiple dwellings

- 3.31 Any common areas of buildings containing multiple **dwelling**s are not classified as **dwelling**s, and therefore fall outside the scope of the five criteria outlined above. For such areas, reasonable provision would be:
- a. if they are heated, to follow the guidance in Approved Document L2A; or
 - b. if they are unheated, to adopt the same U-values and limitations to thermal bridging as in the rest of the building, and to limit opening area to 25% of the floor area of the common parts.

<text deleted>

Conservatories

- 3.32 If a **conservatory** is built as part of the new **dwelling**, then the performance of the **dwelling** should be assessed as if the **conservatory** were not there. The guidance in Approved Document L1B should be followed in respect of the construction of the **conservatory** itself.

*This means that the thermal separation between **dwelling** and **conservatory** must be constructed to a standard comparable to the rest of the external envelope of the **dwelling**.*

It is proposed that the exemption for conservatories be removed from Part L.

- 3.33 If any substantially glazed space forms an integral part of the **dwelling** (i.e. there is no thermal separation and by definition the space is therefore not a **conservatory**), then the space should be included as part of the new **dwelling** when checking against the five compliance criteria.

Swimming pool basins

- 3.33a Where a swimming pool is constructed as part of a new **dwelling**, 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 13370⁶.
- 3.33b 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.

⁶ BS EN ISO 13370 *Thermal performance of buildings – Heat transfer via the ground – Calculation methods.*

Section 4: Design standards

REGULATIONS 17A AND 17B

- 4.1 Regulations 17A, 17B and 17C implement Articles 3, 4 and 5 of the Energy Performance of Buildings Directive. Regulations 17A and 17B state that:

Methodology of calculation of the energy performance of buildings

17A.–(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 a numerical indicator of the amount of energy estimated to meet the different needs associated with a standardised use of the building; and

“operational rating” means a numerical indicator of the amount of energy consumed during the occupation of the building over a period of time.

Minimum energy performance requirements for buildings

17B.–The Secretary of State shall approve minimum energy performance requirements for new buildings, in the form of target CO₂ emission rates, which shall be based upon the methodology approved pursuant to regulation 17A.

Target CO₂ Emission Rate (TER)

- 4.2 The Target CO₂ Emission Rate (**TER**) is the minimum energy performance requirement for a new **dwelling** approved by the Secretary of State in accordance with regulation 17B. It is expressed in terms of the mass of CO₂, in units of kg per m² of floor area per year, emitted as a result of the provision of the **specified fixed building services** for a standardised household when assessed using approved calculation tools.
- 4.3 In accordance with the methodology approved by the Secretary of State in the Notice of Approval⁷, the **TER** for individual **dwellings** must be calculated using **approved software implementations of SAP 2009**⁸.

To emphasise that manual worksheets are not adequate.

⁷ Notice of Approval of the methodology of calculation of the energy performance of buildings in England and Wales, CLG, 2008.

⁸ See DECC consultation at www.bre.co.uk/sap2009

- 4.4 The **TER** is set as 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 as set out in the National Calculation Methodology⁹. No values may be varied from these reference values when establishing the **TER**. The appropriate reference values vary according to the fuel used for space heating, with the rules being detailed in the NCM. The CO₂ emission factors used in the calculation shall be as specified in the paper published by DECC¹⁰.

*Note that the main heating fuel will not always be that used for space heating. In compact **dwelling**s, the fuel used for hot water may constitute the main heating fuel.*

The main change is that the notional dwelling is now based on a set of parameters that deliver the targeted national improvement by approximately equalising the marginal abatement cost across all sectors. The impact of the chosen heating fuel is now allowed for by varying the heating system efficiency and the associated CO₂ emission factor according to the fuel used in the actual building. The envelope and system efficiency parameters are identical for all the fossil fuels. Biofuel and electric heat pumps use the same set of envelope parameters, but adopt different heating system efficiencies. For electrical resistance heating, a more demanding set of envelope specifications is used. The details of the method are spelled out in the NCM – see separate chapter in this consultation.

Note that this paragraph is based on the AD as it would appear if the aggregate 25% approach were adopted, since we want consultees to be able to assess the impact of the possible change. Under the Government's preferred flat 25% approach, the text would be very similar to the 2006 AD, except that after calculating the 2006 TER, that value would be reduced by a further 25% for all fuels (see chapter on NCM changes for full details).

Buildings containing multiple dwellings

- 4.6 Where a building contains more than one **dwelling** (such as in a terrace of houses or in a block of flats), an average **TER** can be calculated for all the **dwelling**s in the building. In such cases, the average **TER** is the floor-area-weighted average of all the individual **TER**s, and is calculated according to the following formula:

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

⁹ *Changes to NCM – see Volume 2, Chapter 5 of this consultation document.*

¹⁰ STP09/CO201 Revised emission factors for the National Calculation Methodologies, BRE, 2009, available at www.bre.co.uk/sap2009

CRITERION 1 – ACHIEVING THE TER

4.7 Regulation 17C states that

New buildings

17C. Where a building is erected, it shall not exceed the target CO₂ emission rate for the building that has been approved pursuant to regulation 17B.

Calculating the CO₂ emissions from the actual dwelling

4.8 To comply with regulation 17C, the proposed Dwelling CO₂ Emission Rate (**DER**) must be no worse than the **TER** calculated as set out in paragraphs 4.2 to 4.6. The final **DER** calculation produced in accordance with regulation 20D (see paragraph 4.9 below) must be based on the building as constructed, incorporating:

- a. any changes to the performance specifications that have been made during construction; and
- b. the **assessed air permeability**. The **assessed air permeability** shall be 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 tested, the **assessed air permeability** is the average test result obtained from other **dwelling**s of the same **dwelling type** on the development increased by a margin of +2.0 m³/(h.m²) at 50 Pa;
 - iii) on small developments (see paragraph 5.15), where the builder has opted to avoid testing, the **assessed air permeability** is the value of 15 m³/(h.m²) at 50 Pa.

Note that provided they are BINDT accredited, builders can self test. They can therefore test a greater proportion of their dwellings and take credit for the increased robustness of the data, compared to option b), where the assessed air permeability is taken as the average of other test results plus a safety margin. This margin has been taken as approximately one standard deviation as derived from the analysis of a large sample of data from post 2006 dwellings. The outcome of this change is that the design air permeability should be at most 8.0, so that untested dwellings should achieve an assessed air permeability less than the limiting value of 10 m³/(h.m²) at 50 Pa.

CO₂ emission rate calculations

4.9 Regulation 20D¹¹ states:

- 20D.–(1) Subject to paragraph (4), where regulation 17C applies the person carrying out the work shall give the local authority a notice which specifies:
- a. the target CO₂ emission rate for the building; and
 - b. the calculated CO₂ emission rate for the building as constructed.
- (2) The notice shall be given to the local authority not later than five days after the work has been completed.
- (3) A local authority is authorised to accept, as evidence that the requirements of regulation 17C would be satisfied if the building were constructed in accordance with an accompanying list of specifications, a certificate to that effect by an energy assessor as defined in regulation 17J who is accredited to produce such certificates for that category of building.
- (4) Where such a certificate is given to the local authority:
- a. paragraph (1) does not apply; and
 - b. the person carrying out the work shall provide to the local authority not later than five days after the work has been completed a notice which–
 - i. states whether the building has been constructed in accordance with the list of specifications which accompanied the certificate; and
 - ii. if it has not, lists any changes to the specifications to which the building has been constructed.

It is proposed that the regulations be amended to require a design stage TER/DER calculation as part of the plans submission – see paragraph 4.11.

4.11 As required by [amendments to the current Building Regulations, details to be confirmed], the builder shall carry out a preliminary calculation before construction starts based on plans and specifications and provide this to the **BCB** as part of the submission of plans. The results of these calculations and the associated data inputs should be provided to the **BCB**, along with the specification that corresponds to the claimed performance values.

*The calculation will give an indication of whether a design is compliant and will produce a list of those features of the design that are critical to achieving compliance. This “exceptions list” can be used to prioritise the risk-based inspection of the **dwelling** as part of confirming compliance with Regulation 17C. The specification will assist the **BCB** to identify that what is built aligns with the claimed performance.*

¹¹ There is a similar regulation (Regulation 12D) in the Building (Approved Inspectors etc.) Regulations 2000 (SI 2000/2532) which applies when an approved inspector is the BCB.

Main heating system

Secondary heating

- 4.12 A secondary heating appliance may meet part of the space heat demand. When calculating the **DER**, the fraction provided by the secondary heating system must be as defined by SAP 2009 for the particular combination of main heating system and secondary heating appliance. The following secondary heating appliance must be used 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 actually installed, then the presence of the following appliances shall 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%;
 - ii. if there is no gas point, then an open fire in grate for burning multi-fuel with an efficiency of 37%, unless the **dwelling** is in a smoke control area when the fuel should be taken as smokeless solid mineral fuel;
 - c. Otherwise it shall 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

- 4.13 In all cases the **DER** shall be calculated assuming the proportion of low energy lamps as actually installed in the fixed lighting locations.

This means low energy lighting provision is tradable. The minimum amount that would be reasonable provision in the actual building is given in the Domestic Building Services Compliance Guide.

Buildings containing multiple dwellings

- 4.14 Where a building contains more than one **dwelling** (such as in a terrace of houses or in a block of flats), compliance with regulation 17C is achieved if:
- a. EITHER every individual **dwelling** has a **DER** that is no greater than its corresponding **TER**;

- b. OR the average **DER** is no greater than the average **TER**. The average **DER** is the floor-area-weighted average of all the individual **DERs**, and is calculated in the same way as the average **TER** (see paragraph 4.6).

*When adopting the average **DER** approach, it will still be necessary to provide information for each individual **dwelling**, as required by regulation 20D.*

Achieving the target

- 4.15 Provided the **dwelling** satisfies the limits on design flexibility as set out in Criterion 2, the compliance procedure allows the designer full flexibility to achieve the **TER** utilising fabric and system measures and the integration of low and zero carbon (LZC) technologies in whatever mix is appropriate to the scheme. The approved compliance tools include appropriate algorithms that enable the designer to assess the role LZC technologies (including local renewable and low-carbon schemes driven by planning requirements¹²) can play in achieving the **TER**.
- 4.15a Where a **dwelling** is connected to a community energy system, the same percentage reduction in emissions should be attributed to each connected **dwelling**, and the submission should demonstrate that the capacity of the community scheme is sufficient to provide the percentage that is assumed.
- 4.15b In order to facilitate incorporation of improvements in system efficiencies and the integration with low and zero carbon technologies, the designer should:
- a) consider adopting heating system designs that use low distribution temperatures; and
 - b) where multiple systems serve the same end use, organise the control strategies such that priority is given to the least carbon intensive option; and
- For example, where a solar hot water system is available, the controls should be arranged so that the best use is made of the available solar energy.*
- c) consider making the dwelling “LZC ready” by providing appropriate facilities at the construction stage so that it will be much easier and cheaper to add the LZC technology at a later date.

CRITERION 2 – LIMITS ON DESIGN FLEXIBILITY

- 4.16 Whilst the approach to complying with Criterion 1 allows considerable design flexibility, Paragraph L1(a)(i) of Schedule 1 to the Building Regulations requires that reasonable provision should 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 should be provided.

¹² See the Planning Policy Statement *Planning and climate change* and its supporting practice guidance at: www.communities.gov.uk/planningandbuilding/planning/planningpolicyguidance/planningpolicystatements/planningpolicystatements/ppsclimatechange/

4.16a Reasonable provision for showing that the requirement has been satisfied is to demonstrate that the fabric elements and the **fixed building services** all satisfy minimum energy efficiency standards as specified in the following paragraphs.

*Note that in order to satisfy the **TER**, the building specification will need to be considerably better than the stated values in many aspects of the design.*

Fabric standards

4.22 U-values shall be calculated using the methods and conventions as set out in BR 443¹³.

4.23 Table 1 sets out the worst acceptable standards for fabric properties. The stated value represents the area weighted average value for all elements of that type.

The fabric longstops have been left unchanged from the values established in 2006. This is because improving plane element U-values may not always be the most cost effective way to improve energy efficiency. Reducing the heat loss via party walls, improved thermal bridging and better system efficiency improvements can have a big impact, especially in “connected” dwellings such as terraced and semi-detached houses.

¹³ BR 443 *Conventions for U-value calculations*, BRE, 2006.

Table 1: Limiting fabric parameters	
Roof	0.25 W/m ² .K
Wall	0.35 W/m ² .K
Floor	0.25 W/m ² .K
Windows, roof windows, glazed rooflights, curtain walling & pedestrian doors	2.2 W/m ² .K ^{1,2}
Air permeability	10.0 m ³ /(h.m ²) at 50 Pa
<p>¹ The U-values for roof windows and rooflights in this table are based on the U-value having been assessed with the roof window or rooflight 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.</p> <p>² The U-values of the glazing can be calculated for the actual unit, the smaller of the two standard windows defined in BS EN 14351-1 1¹⁴, or the standard windows set out in BR 443. SAP 2009 Table 6e gives values for different window configurations that can be used in the absence of test data or calculated values.</p>	

Approved Document C gives limiting values for individual elements to minimise condensation risk.

System efficiencies

4.29a Each **fixed building service** should be at least as efficient as the worst acceptable value for the particular type of appliance as set out in the *Domestic Building Services Compliance Guide* ¹⁵. If the type of appliance is not covered by the Guide, then reasonable provision would be to demonstrate that the proposed system is not less efficient than a comparable system that is covered by the Guide.

To not inhibit innovation.

4.29b The efficiency claimed for the **fixed building service** should be based on the appropriate test standard as set out in the Guide and the test data should be certified by a notified body. It would be reasonable for **BCBs** to accept such data at face value. In the absence of such quality assured data, the **BCB** should satisfy themselves that the claimed performance is justified.

CRITERION 3 – LIMITING THE EFFECTS OF SOLAR GAINS IN SUMMER

4.30 As required by paragraph L1(a)(i) of Schedule 1 to the Building Regulations, reasonable provision should be made to limit solar gains. Solar gains are beneficial in winter as a means of offsetting heating demand, but can contribute to overheating in the summer months. Limiting the effects of solar gain in summer can be achieved

¹⁴ EN 14351-1 *Windows and doors – Product standard, performance characteristics*, 2006.

¹⁵ *Domestic Building Services Compliance Guide* – see Volume 2, Chapter 6 of this consultation.

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.

- 4.31 [SAP 2009](#) Appendix P contains a procedure enabling designers to check whether solar gains are excessive. Reasonable provision would be achieved if the SAP assessment indicates the **dwelling** will 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.*

Designers may wish to go beyond 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 environment¹⁶ gives guidance on this issue.

- 4.32 When seeking to limit solar gains, consideration should be given to the provision of adequate levels of daylight. BS 8206 Part 2 Code of practice for daylighting¹⁷ gives guidance on maintaining adequate levels of daylight.

*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, some parts of the **dwelling** may experience poor levels of daylight, resulting in increased use of electric lighting.*

¹⁶ TM36 *Climate change and the indoor environment: impacts and adaptation*, CIBSE, 2005.

¹⁷ BS 8206–2:1992 *Lighting for buildings. Code of practice for daylighting*.

Section 5: Quality of construction and commissioning

CRITERION 4 – BUILDING PERFORMANCE CONSISTENT WITH DER

5.1 **Dwellings** should be constructed and equipped so that performance is consistent with the predicted **DER**. As indicated in paragraph 4.8, a final calculation of the **DER** 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** as required by regulation 17C. The following paragraphs in this section set out what in normal circumstances would be reasonable provision to ensure that the actual performance of the building is consistent with the **DER**.

*The provision of information referred to in paragraph 4.9 and 4.11 will assist **BCBs** in checking the key features of the design are included during the construction process.*

- 5.2 In accordance with Part L and regulation 7, the building fabric should be constructed to reasonable quality of construction so that:
- a. the insulation is reasonably continuous over the whole building envelope; and
 - b. the **air permeability** is within reasonable limits.

Party walls and other thermal bypasses

5.2a Contrary to previous assumptions, party cavity-walls are not zero heat loss walls because air flow in the cavity provides a heat loss mechanism.

Where outside air is able to flow into the party wall cavity a cold zone is created which results in heat flux through the wall sections on either side. The extent of air flow and heat flux will depend on external conditions such as wind and temperatures and also on the setting up of a ventilation stack 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.

5.2b The heat loss can be reduced by measures that restrict air movement through the cavity, either by means of fully filling the cavity and/or by providing effective sealing around the perimeter. The extent to which heat loss can be reduced will be dependent on the detailed design and the quality of construction. In the absence of any specific, independent scientific field evidence, reasonable provision would be to adopt the guidance on U-values in paragraph 5.2c.

5.2c In calculating the **DER** for a **dwelling**, the party wall U-value to be assumed for the type of construction adopted, is set out in Table 2.

Table 2: 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

5.2d In applying the U-values in Table 2 it is important that where edge sealing is adopted, either on its own or in conjunction with a fully filled cavity, the sealing is effective in restricting air flow and is aligned with the thermal envelope. Although effective sealing may be part of a cavity barrier, which is provided in order to comply with Part B (Fire), a cavity barrier on its own may not be effective in restricting airflow. In order to claim a reduced U-value (0.2 or 0.0) it will be necessary to demonstrate that the design adopted is likely to be robust under normal site conditions. In addition, it is important that the sealing system be applied in such away as to be in line with the thermal envelope.

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 (though 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.

5.2e 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. This will be the case even where the party wall U-value is zero. The evaluation of thermal bridges should ensure that any bridging at the party wall is 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).

- 5.2f The party wall is a particular case of the more general thermal bypass problem that occurs where 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 them should be filled with solid material such as in a masonry wall.

Thermal bridges

- 5.3 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.
- 5.4 Linear thermal transmittances and temperature factors should be calculated following the guidance set out in BR 497¹⁸. Reasonable provision would be to demonstrate that the specified details deliver a level of performance no worse than the standards set out in BRE IP 1/06¹⁹.
- 5.5 In addition, the builder would have to demonstrate that an appropriate system of site inspection is in place to give confidence that the construction procedures achieve the required standards of consistency.
- 5.5a Ways of demonstrating that reasonable provision has been made are:
- a. to adopt an accredited construction details approach²⁰. The details published via such scheme(s) have accredited linear thermal transmittance values associated with them, and these values can be used directly in the **DER** calculation;

Such scheme(s) also accredit details in terms of buildability, and have an associated quality assurance regime scheme that inspects a sample of sites to confirm that the details are being implemented correctly.

- b. to use the builder's own details. In this case, the linear thermal transmittances should be calculated by a person with suitable expertise and experience following the guidance set out in BR 497. When used in the **DER** calculation, the values so calculated should be increased by 25% because there is no independent assessment of robustness, and no historical evidence that the expected performance will be realised in practice. To assist with buildability, builders following this route must also provide a process flow sequence, indicating the way in which the detail should be constructed;

¹⁸ BR 497 Conventions for calculating linear thermal transmittance and temperature factors, BRE 2007.

¹⁹ IP 1/06 Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings, BRE 2006.

²⁰ For details of this approach, see Volume 1, Chapter 3 of this consultation document.

Consultees' views on the appropriateness of the proposed 25% margin would be particularly welcome. CLG would also welcome independent scheme(s) whereby modellers of thermal bridge performance could be formally accredited.

*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. Builders following this route will inevitably add to the burden of checking required of the **BCB**. Possible changes to the local authority building control charging regime²¹ could mean that adopting this route may attract higher building control fees than the alternative approaches.*

- c. to use unaccredited details, with no specific quantification of the thermal bridge values. In such cases a conservative default γ -value of 0.15 must be used in the **DER** calculation.

5.5b The alternative approaches a) and b) above are not mutually exclusive. For example, a builder could use accredited construction details for the majority of the junctions, but use a bespoke detail for the window head. In this case, the 25% margin would apply only to the thermal transmittance of the window head detail.

Air permeability and pressure testing

5.6 In order to demonstrate that an acceptable **air permeability** has been achieved, Regulation 20B states:

Pressure testing

20B.–(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 17C 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.

²¹ See separate CLG consultation on building control charges at www.communities.gov.uk/consultations

- (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 British Institute of Non-destructive Testing 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.

- 5.7 The approved procedure for pressure testing is given in the ATTMA publication *Measuring air permeability of building envelopes*²², and specifically, the method that tests the building envelope. The manner approved for recording the results and the data on which they are based is given in section 4 of that document.

Note that the main change arising from the change in the preferred test method is that trickle ventilators should now be temporarily sealed rather than just closed.

- 5.8 The approved circumstances under which the Secretary of State requires pressure testing to be carried out are set out in paragraphs 5.9 to 5.15.
- 5.8b When a certificate is offered under regulation 20B(4), the local authority should confirm that the person is registered to test the specific class of building concerned. If the notice of the results is submitted from a non-registered person, or from a person not registered for the class of building concerned, the local authority should require evidence that the test facilities have been calibrated within the previous 12 months using a UKAS accredited facility and that the tester has had appropriate training in the use of the equipment and the test method. One way of showing such training is to have successfully completed a BINDT accredited domestic airtightness training course.

Test schedule for dwellings that have adopted accredited construction details

- 5.9 On each development, an air pressure test should be carried out on two units of each **dwelling type** selected by the **BCB**. 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**.

²² Measuring air permeability of building envelopes, ATTMA, 2006. A new edition will be published to reflect the proposed changes to the test method (see paragraph 5.7 and commentary) and the definition of **dwelling type** (paragraph 3.1).

*Most larger developments will include many **dwelling types** – and two of each type should be tested to confirm the robustness of the designs and the construction procedures.*

The testing frequency has been increased by a factor of ~2.

Test schedule for dwellings that have NOT adopted accredited construction details

5.10 Air pressure tests should be carried out on each **dwelling type** in the development to the number specified in Table 3. 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.

Table 3: Number of pressure tests for dwellings that have not adopted accredited construction details	
Number of instances of the dwelling type	Number of tests to be carried out on the dwelling type
4 or less	Two tests of each dwelling type
Greater than 4, but equal to or less than 40	Three tests of each dwelling type
More than 40	At least 10% of the dwelling type, unless the first 5 units of the type that are tested achieve the design air permeability, when the sampling frequency can be subsequently reduced to 2%

5.11 The specific **dwellings** making up the test sample should be selected by the **BCB** in consultation with the builder. They should be selected so that about half of the scheduled tests for each **dwelling type** are carried out during construction of the first 25% of each **dwelling type**.

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

Showing compliance with regulation 20B and the consequences of failing a pressure test

5.12 Compliance with the requirements would be demonstrated if:

- a. the measured **air permeability** is not worse than the limit value of 10 m³/(h.m²) at 50 Pa; and
- b. the **DER** calculated using the measured **air permeability** is not worse than the **TER**.

*This means that if a design adopted a low (i.e. better) **design air permeability** in order to achieve a performance better than the **TER**, it would not fail to comply with Part L if the pressure test achieved the limit value and the **TER** was achieved.*

- 5.13 If satisfactory performance is not achieved, then remedial measures should be carried out on the **dwelling** and a new test carried out until the **dwelling** achieves the criteria set out in paragraph 5.12. In addition, a further **dwelling** of the same **dwelling type** should be tested, thereby increasing the overall sample size.
- 5.14 In addition to the remedial work on a **dwelling** that failed the initial test, other **dwelling**s of the same **dwelling type** that have not been tested should be examined and, where appropriate, similar remedial measures applied.

Alternative to pressure testing on small developments

- 5.15 As an alternative approach to specific pressure testing on development sites where no more than two **dwelling**s are to be erected, reasonable provision would be:
- to demonstrate that during the preceding 12 month period, a **dwelling** of the same **dwelling type** constructed by the same builder had been pressure tested according to the procedures given in paragraphs 5.6 to 5.11 and had achieved the **design air permeability**; or
 - avoid the need for any pressure testing by using a value of $15 \text{ m}^3/(\text{h} \cdot \text{m}^2)$ at 50 Pa for the **air permeability** when calculating the **DER**.

*The effect of using this cautious value would then have to be compensated for by improved standards elsewhere in the **dwelling** design.*

COMMISSIONING OF HEATING AND HOT WATER SYSTEMS

- 5.16 Paragraph L1(b)(iii) of Schedule 1 to the Building Regulations imposes a requirement that **fixed building services** are 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 20C states:

20C Commissioning

- (1) 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.
- (2) Where this regulation applies the person carrying out the work shall, for the purpose of ensuring compliance with paragraph L1(b) of Schedule 1, 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.
- (3) The notice shall be given to the local authority—
 - (a) not later than the date on which the notice required by regulation 15(4) is required to be given; or
 - (b) where that regulation does not apply, not more than 30 days after completion of the work.

- 5.16a Reasonable provision would be to prepare a commissioning plan, identifying the systems that need to be tested and the tests that will be carried out. This should be provided with the design stage **TER/DER** calculation so that the **BCB** can check the **commissioning** is being done as the work proceeds. The notice required by regulation 20C should confirm that the commissioning plan has been followed and that every system has been inspected in an appropriate sequence and to a reasonable standard and that the test results confirm that performance is reasonably in accordance with the design requirements.
- 5.17 Not all **fixed building services** will need to be commissioned. With some systems adjustment 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**.
- 5.18 Where **commissioning** is carried out it must be done in accordance with a procedure 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, an approved procedure would to follow the guidance in the [Domestic Ventilation: Installation and Commissioning Compliance Guide](#)²³.

²³ *Domestic Ventilation: Installation and Commissioning Compliance Guide*—see Volume 3, Chapter 2 of this consultation document.

- 5.19 **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.
- 5.20 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 (see paragraph 3.9), it must be given within 30 days.
- 5.21 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 (see paragraph 3.9) 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.
- 5.22 Where the **BCB** does not receive the notice within the required period the **BCB** cannot be reasonably satisfied that Part L has been complied with and consequently is unlikely to be able to give a completion/final certificate.

Section 6: Providing information

CRITERION 5 – PROVISIONS FOR ENERGY EFFICIENT OPERATION OF THE DWELLING

- 6.1 In accordance with paragraph L1(c) of Schedule 1, 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.
- 6.2 A way of complying with the requirement would be to provide a suitable set of operating and maintenance instructions aimed at achieving efficiency in the use of fuel and power in a way that householders can understand, in a durable format that can be kept and referred to over the service life of the system(s). The instructions should be directly related to the particular system(s) installed in the **dwelling**.
- 6.3 Without prejudice to the need to comply with health and safety requirements, the instructions should explain to the occupier of the **dwelling** how to operate the system(s) efficiently. This should include
- a. how to make adjustments to the timing and temperature control settings; and
 - b. what routine maintenance is needed to enable operating efficiency to be maintained at a reasonable level through the service live(s) of the system(s).
- 6.3a The data used to calculate the **TER** and the **DER** should be included in the log book. The occupier should also be provided with the recommendations report generated in parallel with the “on-construction” Energy Performance Certificate. This will inform the occupier how the energy performance of the **dwelling** might be further improved.

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

Section 7: Model designs

- 7.1 Some builders may prefer to adopt model design packages rather than to engage in design for themselves. These model packages of fabric U-values, boiler seasonal efficiencies, window opening allowances etc. should achieve compliant overall performance within certain constraints. The construction industry may develop model designs for this purpose, with information about such designs being made available at www.modeldesigns.info.
- 7.2 It will still be necessary to demonstrate compliance in the particular case by going through the procedures described in paragraphs 4.7 to 4.14.

Volume 2, Chapter 2

**Proposed Approved Document L1B
2010 Edition**

Approved Document L1B (2010)

Introduction

- 1 This document contains the proposed text of the 2010 Approved Document L1B: *Conservation of fuel and power in existing dwellings* (ADL1B), and is based on the Approved Document issued for consultation in 2008. The style and formatting of that consultation draft were strongly supported by consultees, and so have been retained for this consultation.
- 2 The regulatory guidance is shown in normal font, but the [proposed amendments to the 2008 consultation text are shown in blue](#). Places where paragraphs have been deleted are shown by *<text deleted>*. To facilitate comparison with the 2008 consultation text, we have retained the same paragraph numbers as that version; where new paragraphs have been inserted, these have been given letter suffixes. Where paragraphs have been deleted, subsequent paragraphs have not been renumbered. A complete revision of the numbering will be carried out when documents are finally published.
- 3 As with the 2006 editions, *commentary text is included to help understanding and to provide pointers to useful information, but is not part of the technical guidance. This is shown in italics*. Finally, *some further text has been added as explanations of the proposed changes. These are shown in plum italicised text* and are only included to assist the consultation process.
- 4 Please note that where changes to the regulations are proposed, changes to the legal text have not been drafted. In these instances, the intent of the proposals is summarised in the explanatory text.

Main changes to the 2010 edition

- 5 The main strategic changes to ADL1B proposed are:
 - emphasise the distinction between requirements set out in the Building Regulations 2000 and guidance as set out in the AD;
 - remove the exemptions from the energy efficiency requirements (regulations 9(3) to 9(6)), but include specific guidance on what is reasonable provision with respect to the building work currently listed there (e.g. in historic buildings, buildings with low levels of heating);
 - remove the exemption for conservatories in Part L;

- revise the definition of renovation;
- define standards for swimming pool basins in existing dwellings;
- raise standards generally.

Additional clarifications are given in the commentary accompanying the proposed changes.

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Section 1: Introduction

WHAT IS AN APPROVED DOCUMENT?

- 1.1 This document has been approved and issued by the Secretary of State to provide practical guidance on ways of complying with the energy efficiency requirements (see Section 2) and regulation 7 of the Building Regulations 2000 (SI 2000/2531) for England and Wales, as amended. The Building Regulations 2000 are referred to throughout the remainder of this Document as “the Building Regulations”.
- 1.2 The intention of issuing Approved Documents is to provide guidance about compliance with specific aspects of building regulations in some of the more common building situations. They set out what, in ordinary circumstances, would be reasonable provision for compliance with the relevant requirement(s) of building regulations to which they refer.
- 1.3 If guidance in an Approved Document is followed there will be a presumption of compliance with the requirement(s) covered by the guidance. However, this presumption can be overturned, so simply following guidance does not guarantee compliance; *for example, if the particular case is unusual in some way, then “normal” guidance may not be applicable.* It is also important to note that there may well be other ways of achieving compliance with the requirements. **There is therefore no obligation to adopt any particular solution contained in this Approved Document if you would prefer to meet the relevant requirement in some other way. Persons intending to carry out building work should always check with their building control body, either the local authority or an approved inspector, that their proposals comply with building regulations.**
- 1.3a It is important to note that this Approved Document, as well as containing guidance, also contains extracts from the Regulations. Such regulatory text must be complied with as stated. For example, the requirement that **fixed building services** must be commissioned (regulation 20C) is a regulatory requirement. There is therefore no flexibility to ignore this requirement; neither can compliance with this particular regulation be demonstrated via any route other than that set out in regulation 20C.

To emphasise the important distinction between regulations and guidance.

- 1.4 The guidance contained in this Approved Document relates only to the particular requirements of the Building Regulations that the document addresses (set out in Section 2). However, building work may be subject to more than one requirement of building regulations. In such cases the work will also have to comply with any other applicable requirements of building regulations.

- 1.5 There are Approved Documents that give guidance on each of the Parts of Schedule 1 and on regulation 7. A full list of these is provided at the back of this document.

CONSIDERATION OF TECHNICAL RISK

- 1.6 Building work to existing dwellings must satisfy all the technical requirements set out in regulations 4A, 4B, 17D and 17E of, and Schedule 1 to, the Building Regulations. When considering the incorporation of energy efficiency measures in dwellings, attention should be paid in particular to the need to comply with Part B (fire safety), Part C (site preparation and resistance to contaminants and moisture), Part E (resistance to the passage of sound), Part F (ventilation), paragraph G3 (hot water storage), Part J (combustion appliances and fuel storage systems) and Part P (electrical safety), as well as Part L. *The adoption of any particular energy efficiency measure should not involve unacceptable technical risk of, for instance, excessive condensation. Designers and builders should refer to the relevant Approved Documents and to other generally available good practice guidance to help minimise these risks.*

ADs cannot expect to cover all aspects of good design practice. If thought appropriate, a list of relevant good practice information could be listed on the planning portal, but these would be third party publications. The difficulty of maintaining such a list is that it could never be exhaustive and, by its nature, a selective list may favour one particular system or technology. It may therefore be appropriate just to provide links to other information providers, such as the professional institutions and trade bodies.

HOW TO USE THIS APPROVED DOCUMENT

- 1.7a This Approved Document is subdivided into seven sections as detailed below. These sections are followed by a number of supporting appendices.

This **introductory** section sets out the general context in which the guidance in this AD must be considered.

Section 2 sets out the relevant legal requirements as published in the Building Regulations.

Section 3 contains general guidance, including the definition of key terms, the types of building work covered by this Approved Document, the types of building work that are exempt, procedures for notifying work, materials and workmanship and health and safety issues.

Section 4 gives guidance on reasonable provision for various types of building work.

Section 5 deals with the particular case of work to *thermal elements*.

Section 6 gives guidance in support of the requirement for *consequential improvements* for buildings over 1,000 m².

Section 7 describes the information that should be provided to occupiers to help them achieve reasonable standards of energy efficiency in practice.

- 1.8 In this document the following conventions have been adopted to assist understanding and interpretation:
- a. Texts shown against a green background are extracts from the Building Regulations or Building (Approved Inspectors) Regulations, both as amended, and set out the legal requirements that relate to compliance with the **energy efficiency requirements** of building regulations. *As stated previously, there is no flexibility in respect of such text; it defines a legal requirement, not guidance for typical situations.* It should also be remembered that, as noted above, building works must comply with all the other applicable requirements of building regulations.

To clarify the distinction between regulations and guidance.

- b. Key terms are defined in paragraph 3.1 and are printed in **bold italic text**.
- c. Details of technical publications referred to in the text of this Approved Document will be given in footnotes and repeated as end notes. A reference to a publication is likely to be made for one of two main reasons. The publication may contain additional or more comprehensive technical detail, which it would be impractical to include in full in the Approved Document but which is needed to fully explain ways of meeting the requirements; or it is a source of more general information. The reason for the reference will be indicated in each case. The reference will be to a specified edition of the document. The Approved Document may be amended from time to time to include new references or to refer to revised editions where this aids compliance.
- 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, but is not part of the technical guidance itself.

WHERE YOU CAN GET FURTHER HELP

- 1.9 If you do not understand the technical guidance or other information set out in this Approved Document and the additional detailed technical references to which it directs you, there are a number of routes through which you can seek further assistance:

- the CLG website: www.communities.gov.uk;
- the Planning Portal website: www.planningportal.gov.uk;
- if you are the person undertaking the building work, you can seek assistance either from your local authority building control service or from your approved inspector (depending on which building control service you are using, or intend to use, to certify compliance of your work with the requirements of the Building Regulations);
- businesses registered with a competent person self-certification scheme may be able to get technical advice from their scheme operator;
- if your query is of a highly technical nature, you may wish to seek the advice of a specialist, or industry technical body, in the area of concern.

RESPONSIBILITY FOR COMPLIANCE

1.10 It is important to remember that if you are the person (e.g. designer, builder, installer) carrying out building work to which any requirement of building regulations applies you have a responsibility to ensure that the work complies with any such requirement. The building owner may also have a responsibility for ensuring compliance with building regulation requirements and could be served with an enforcement notice in cases of non-compliance.

Section 2: The requirements

- 2.1 This Approved Document, which takes effect on xx xx 2010, deals with the **energy efficiency requirements** in the Building Regulations (as amended by SI.....). The **energy efficiency requirements** relevant to existing **dwelling**s are in regulations 4A, 17D and 17E of, and Part L of Schedule 1 to, those Regulations, as set out below.

Requirements relating to thermal elements

Regulation 4A.

- (1) Where a person intends to renovate a thermal element, such work shall be carried out as is necessary to ensure that the whole thermal element complies with the requirements of paragraph L1(a)(i) of Schedule 1.
- (2) Where a thermal element is replaced, the new thermal element shall comply with the requirements of paragraph L1(a)(i) of Schedule 1.

Consequential improvements to energy performance

Regulation 17D.

- (1) Paragraph (2) applies to an existing building with a total useful floor area over 1000 m² where the proposed building work consists of or includes—
 - (a) an extension;
 - (b) the initial provision of any fixed building services; or
 - (c) an increase to the installed capacity of any fixed building services.
- (2) Subject to paragraph (3), where this paragraph applies, such work, if any, shall be carried out as is necessary to ensure that the building complies with the requirements of Part L of Schedule 1.
- (3) Nothing in paragraph (2) requires work to be carried out if it is not technically, functionally or economically feasible.

Energy performance certificates

Regulation 17E.

- (1) This regulation applies where—
 - (a) a building is erected; or
 - (b) a building is modified so that it has a greater or fewer number of parts designed or altered for separate use than it previously had, where the modification includes the provision or extension of any of the fixed services for heating, hot water, air conditioning or mechanical ventilation.
- (2) The person carrying out the work shall—
 - (a) give an energy performance certificate for the building to the owner of the building; and
 - (b) give to the local authority notice to that effect, including the reference number under which the energy performance certificate has been registered in accordance with regulation 17F(4).
- (3) The energy performance certificate and notice shall be given not later than five days after the work has been completed.
- (4) The energy performance certificate must be accompanied by a recommendation report containing recommendations for the improvement of the energy performance of the building, issued by the energy assessor who issued the energy performance certificate.
- (5) An energy performance certificate must—
 - (a) express the asset rating of the building in a way approved by the Secretary of State under regulation 17A;
 - (b) include a reference value such as a current legal standard or benchmark;
 - (c) be issued by an energy assessor who is accredited to produce energy performance certificates for that category of building; and
 - (d) include the following information—
 - (i) the reference number under which the certificate has been registered in accordance with regulation 17F(4);
 - (ii) the address of the building;
 - (iii) an estimate of the total useful floor area of the building;
 - (iv) the name of the energy assessor who issued it;
 - (v) the name and address of the energy assessor's employer, or, if he is self-employed, the name under which he trades and his address;
 - (vi) the date on which it was issued; and
 - (vii) the name of the approved accreditation scheme of which the energy assessor is a member.

- (6) Certification for apartments or units designed or altered for separate use in blocks may be based—
- (a) except in the case of a dwelling, on a common certification of the whole building for blocks with a common heating system; or
 - (b) on the assessment of another representative apartment or unit in the same block.
- 7) Where—
- (a) a block with a common heating system is divided into parts designed or altered for separate use; and
 - (b) one or more, but not all, of the parts are dwellings,
- certification for those parts which are not dwellings may be based on a common certification of all the parts which are not dwellings.

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; and
- (c) providing 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.

It is proposed that (iii) should be amended to include the objective that fixed building services should deliver their specified functional performance as well as using no more fuel and power than is necessary.

LIMITATION ON REQUIREMENTS

- 2.2 In accordance with regulation 8, the requirements in Parts A to D, F to K and N (except for paragraphs H2 and J6) of Schedule 1 to the Building Regulations do not require anything to be done except for the purpose of securing reasonable

standards of health and safety for persons in or about buildings (and any others who may be affected by buildings or matters connected with buildings).

- 2.3 Paragraphs H2 and J6 are excluded from regulation 8 because they deal directly with prevention of the contamination of water. Parts E and M (which deal, respectively, with resistance to the passage of sound, and access to and use of buildings) are excluded from regulation 8 because they address the welfare and convenience of building users. Part L is excluded from regulation 8 because it addresses the conservation of fuel and power.
- 2.4 In addition, regulation 4(1A) of the Building Regulations states that where the work is being carried out in order to comply with regulation 4A (requirements relating to renovation or replacement of a thermal element), regulation 4B (requirements relating to a change of a building's energy status) or regulation 17D (consequential improvements to energy performance), and is not a material alteration, it need only comply with the requirements of Part L.

Section 3: General guidance

KEY TERMS

3.1 The following are key terms used in this document:

BCB means Building Control Body: a local authority or an approved inspector.

Change to a building's energy status means any change which results in a building becoming a building to which the **energy efficiency requirements** of the Building Regulations apply, where previously it was not.

For example, this could occur where a previously unheated building was to be heated in future, or where a previously exempt building was no longer within the exempted categories.

Commissioning means the advancement of a **fixed building service** following installation, replacement or alteration of the whole or part of the system, from the state of static completion to working order by testing and adjusting as necessary to ensure the system as a whole uses no more fuel and power than is reasonable in the circumstances, without prejudice to the need to comply with health and safety requirements. For each system **commissioning** includes setting-to-work, regulation (that is testing and adjusting repetitively) to achieve the specified performance, the 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.

Consequential improvements means those energy efficiency improvements required by regulation 17D.

Conservatory is an extension to a building:

- a) which is thermally separated from the attached building by walls, windows and doors with U-value and draught-stripping provisions no worse than provided elsewhere in the building, and if a heating system is provided, that system has independent temperature and on/off controls; and
- b) where the area of transparent or translucent material in its external envelope parts is more than 150% of its floor area.

It is suggested that the definition should be included in the Regulations.

Controlled service or fitting means a service or fitting in relation to which Part G (hygiene), 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.

Dwelling means a self-contained unit, including a house or a flat, designed to be used separately to accommodate a single household. (**Rooms for residential purposes** are not **dwellings** so Approved Document L2B applies to work in such buildings.)

Energy efficiency requirements means the requirements of regulations 4A, 17C, 17D and 17E of, and Part L of Schedule 1 to, the Building Regulations.

In respect of existing dwellings the applicable requirements consist of Part L and regulations 4A and 17D.

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

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

It is proposed that the definition of fixed building services should be amended to include (renewable) energy generation equipment and (natural) ventilation components.

Renovation in relation to a thermal element means the provision of a new layer in the thermal element or the replacement of an existing layer, but excludes decorative finishes, and “renovate” shall be construed accordingly.

It is proposed to amend the definition of renovation to make the application of the guidance easier. The following gives the current working proposals.

Definition: “Renovation in relation to a thermal element means the process of stripping down the element to expose the basic structural components (brick/blockwork, timber/metal frame, joists, rafters etc.) and then rebuilding to achieve all the necessary performance requirements. Renovation only applies where the area to be refurbished is greater than one of the following limits (smaller proportions being regarded as repairs):

- a) 50% of the surface of the individual element; or
- b) 25% of the total building envelope {to be consistent with the EPBD requirement}.”

Guidance: “When assessing the area proportion, the area of the element should be taken as that of the individual element, not all the elements of that type in the building. The area of the element should also be interpreted in the context of whether the element is being stripped down from inside or outside, i.e. if removing all the plaster finish from the inside of a solid brick wall, the area of the element is the area of external wall in the room. If removing external render, it is the area of the elevation in which that wall sits.

This means that if all the roofing on the flat roof of an extension is being stripped down, the area of the element is the roof area of the extension, not the total roof area of the dwelling. If plaster is being removed from a bedroom wall, the relevant area is the area of the external wall in the room, not the area of the elevation which contains that wall section. This is because the marginal cost of dry-lining with insulated plasterboard rather than plain plasterboard is small.”

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, whether or not the room is separated from or arranged in a cluster group with other rooms, but does not include a room in a hospital, or other similar establishment, used for patient accommodation and, for the purposes of this definition, a “cluster” is a group of rooms for residential purposes which is:

- a. separated from the rest of the building in which it is situated by a door which is designed to be locked; and
- b. not designed to be occupied by a single household.

Simple payback means the amount of time it will take to recover the initial investment through energy savings, and is calculated by dividing the marginal additional cost of implementing an energy efficiency measure by the value of the annual energy savings achieved by that measure taking no account of VAT:

- a. the marginal additional cost is the additional cost (materials and labour) of incorporating (e.g.) additional insulation, not the whole cost of the work;
- b. the cost of implementing the measure should be based on prices current at the date the proposals are made known to the **BCB** and be confirmed in a report signed by a suitably qualified person;
- c. the annual energy savings should be estimated using SAP 2009;

- d. for the purposes of this Approved Document, the energy prices that are current [at the time of the application to building control](#) should be used when evaluating the annual energy savings. [Current energy prices can be obtained from the BIS \(Department for Business Innovation and Skills\) website¹](#).

<text deleted>

Thermal element is defined in regulation 2A as follows.

(2A) In these Regulations “thermal element” means a wall, floor or roof (but does not include windows, doors, roof windows or roof-lights) which separates a thermally conditioned part of the building (“the conditioned space”) from:

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

and includes all parts of the element between the surface bounding the conditioned space and the external environment or other part of the building as the case may be.

(2B) Paragraph (2A)(b)(iii) only applies to a building which is not a dwelling, where the other part of the building is used for a purpose which is not similar or identical to the purpose for which the conditioned space is used.

Note that this definition encompasses the walls and floor of a swimming pool basin.

TYPES OF WORK COVERED BY THIS APPROVED DOCUMENT

- 3.2 This Approved Document is intended to give guidance on what, in ordinary circumstances, would be reasonable provision for compliance with the requirements of regulation 4A and 17D of, and Part L of Schedule 1 to, the Building Regulations for those carrying out building work to existing **dwelling**s. In addition it gives guidance on compliance with regulations 20B, 20C and 20D of the Building Regulations and 12B, 12C and 12D of the Building (Approved Inspectors etc) Regulations 2000 (SI 2000/2532) (“the Approved Inspectors Regulations”).

*Buildings exclusively containing **rooms for residential purposes** such as nursing homes, student accommodation and similar are not **dwelling**s, and in such cases Approved Document L2B applies.*

¹ See www.berr.gov.uk/energy/statistics/publications/prices/index.html. The relevant average gas and electricity prices can be found in Tables 2.2.3 and 2.3.3.

- 3.3 In particular, this Approved Document gives guidance relating to the following activities:
- a) an extension (see paragraphs 4.2a to 4.12);
 - b) a material change of use (paragraphs 4.13 to 4.15);
 - c) a material alteration to an existing **dwelling** (paragraphs 4.16 to 4.17a), [including such work as loft and garage conversions](#);
 - d) a change to a **dwelling's** energy status (paragraphs 4.13 to 4.15);
 - e) the provision or extension of a **controlled service** or **controlled fitting** (paragraphs 4.18 to 4.22f);
 - f) the replacement or **renovation** of a **thermal element** (Section 5);
- 3.4 Where the activities include building work in a **dwelling** that is part of a mixed use building, account should also be taken of the guidance in Approved Document L2B in relation to those parts of the building that are not **dwellings**, including any common areas.

*It should be noted that **dwellings** are defined as self-contained units. **Rooms for residential purposes** are not **dwellings**, and so Approved Document L2B applies to them.*

BUILDINGS EXEMPT FROM THE ENERGY EFFICIENCY REQUIREMENTS

- 3.5 The provisions for exempting buildings and building work from the Building Regulations requirements have changed and the new provisions are given in regulation 9.

9 —.(3) The energy efficiency requirements of these Regulations apply to:

- a. the erection of any building of a kind falling within this paragraph;
- b. the extension of any such building, other than an extension falling within class VII in Schedule 2; and
- c. the carrying out of any work to or in connection with any such building or extension.

(4) A building falls within paragraph (3) if it:

- a. is a roofed construction having walls;
- b. uses energy to condition the indoor climate; and
- c. does not fall within the categories listed in paragraph (5).

(5) The categories referred to in paragraph (4)(c) are:

- a. buildings which are:
 - i. listed in accordance with section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990;
 - ii. in a conservation area designated in accordance with section 69 of that Act; or
 - iii. included in the schedule of monuments maintained under section 1 of the Ancient Monuments and Archaeological Areas Act 1979;

where compliance with the energy efficiency requirements would unacceptably alter their character or appearance;

- b. buildings which are used primarily or solely as places of worship;
 - c. temporary buildings with a planned time of use of two years or less, industrial sites, workshops and non-residential agricultural buildings with low energy demand;
 - d. stand-alone buildings other than dwellings with a total useful floor area of less than 50 m².
- (6) In this regulation:
- a. building means the building as a whole or parts of it that have been designed or altered to be used separately; and
 - b. the following terms have the same meaning as in European Parliament and Council Directive 2002/91/EC on the energy performance of buildings:
 - i. industrial sites;
 - ii. low energy demand;
 - iii. non-residential agricultural buildings;
 - iv. places of worship;
 - v. stand-alone;
 - vi. total useful floor area;
 - vii. workshops.

The current exemptions from the energy efficiency requirements were copied out from the EPBD, and are optional. It is proposed that some, perhaps all, of these exemptions be deleted, because they overlap with the general exemptions to the Regulations (see Schedule 2) and this has caused confusion. It is proposed that the special considerations that apply in the different classes of building (e.g. historic buildings) be covered through guidance. Note that the existing exemption for historic buildings is conditional on the nature of the work, i.e. historic buildings are currently not exempt per se. It is proposed that the exemption be removed, but specific guidance be provided in the AD as to where special considerations apply, and how to arrive at an appropriate balance between heritage and energy conservation.

SCHEDULE 2**Exempt building and work**

Class VII

Extensions

The extension of a building by the addition at ground level of —

- (a) a conservatory, porch, covered yard or covered way; or
- (b) a carport open on at least two sides;

where the floor area of that extension does not exceed 30 m², provided that in the case of a conservatory or porch which is wholly or partly glazed, the glazing satisfies the requirements of Part N of Schedule 1.

It is proposed that the exemption for conservatories be removed from Part L, but that work on conservatories be included in the list of building work that is not notifiable to building control (Schedule 2B). This Approved Document gives guidance on appropriate standards for conservatories (see paragraph 4.11 et seq), and outlines the evidence that should be provided to local authorities should they wish to satisfy themselves that reasonable provision for the conservation of fuel and power has indeed been made.

Historic and traditional buildings

- 3.6 When establishing reasonable provision for the conservation of fuel and power, special considerations apply to the following classes of building:
- a) listed buildings;
 - b) buildings in conservation areas;
 - c) designated ancient monuments;
 - d) buildings which are of architectural and historical interest and which are referred to as a material consideration in a local authority's development plan;
 - e) buildings which are of architectural and historical interest within national parks, areas of outstanding natural beauty, registered historic parks and gardens, registered battlefields, the curtilages of scheduled ancient monuments, and world heritage sites;
 - f) buildings of traditional construction with permeable fabric that both absorbs and readily allows the evaporation of moisture.

- 3.7 When undertaking work on or in connection with a building that falls within one of the classes listed in paragraph 3.6, the aim should be to improve energy efficiency where and to the extent that it is reasonable and practically possible. The work should not prejudice the character of the host building or increase the risk of long-term deterioration of the building fabric or fittings. The guidance given by English Heritage² should be taken into account in determining appropriate energy performance standards for building work in historic buildings. Particular issues relating to work in historic buildings that warrant sympathetic treatment and where advice from others could therefore be beneficial include:
- a. restoring the historic character of a building that has been subject to previous inappropriate alteration, e.g. replacement windows, doors and rooflights;
 - b. rebuilding a former historic building (e.g. following a fire or filling a gap site in a terrace);
 - c. making provisions enabling the fabric of historic buildings to “breathe” to control moisture and potential long term decay problems.
- 3.8 In arriving at a balance between historic building conservation and reasonable provision for energy efficiency improvements, it would be appropriate to take into account the advice of the local authority’s conservation officer.
- 3.8a Other classes of buildings to which special considerations apply are usually non-domestic in character, and so are covered in ADL2A and ADL2B.

NOTIFICATION OF WORK COVERED BY THE ENERGY EFFICIENCY REQUIREMENTS

- 3.9 In most instances in order to comply with the Building Regulations it will be necessary to notify a **BCB** before the work commences either in the form of a deposit of full plans or by a building notice. In certain situations, however, other procedures apply.

These include:

- a. where the work is being carried out by a person registered with a relevant competent person self-certification scheme (CP scheme) listed in Schedule 2A to the Building Regulations no advance notification to the **BCB** is needed (see paragraphs 3.10 to 3.13);
- b. where the work involves an emergency repair, e.g. to a failed boiler or a leaking hot water cylinder. In these cases, in accordance with regulation 12(7) of the Building Regulations, there is no need to delay making the repair in order to make an advance notification to the **BCB**. However, in such cases it will still be

² *Building regulations and historic buildings*, English Heritage, 2002 (revised 2004).

necessary for the work to comply with the relevant requirements and to give a notice to the **BCB** at the earliest opportunity, unless an installer registered under an appropriate CP scheme carries out the work. A completion certificate can then be issued in the normal way;

- c. where the work is of a minor nature as described in the schedule of non-notifiable work (Schedule 2B to the Building Regulations), the work must still comply with the relevant requirements but need not be notified to the **BCB** (see paragraphs 3.14 to 3.16).

Competent person self-certification schemes

- 3.10 It is not necessary to notify a **BCB** in advance of carrying out work which is to be carried out by a person registered with a competent person self-certification scheme listed in Schedule 2A to the Building Regulations. In order to join such a scheme a person must demonstrate competence to carry out the type of work the scheme covers, and also the ability to comply with all relevant requirements in the Building Regulations.
- 3.11 Where work is carried out by a person registered with a competent person scheme, regulation 16A of the Building Regulations and regulation 11A of the Building (Approved Inspectors etc) Regulations 2000 require that the occupier of the building be given, within 30 days of the completion of the work, a certificate confirming that the work complies fully with all applicable building regulation requirements. There is also a requirement that the **BCB** be given a notice of the work carried out, again within 30 days of the completion of the work. These certificates and notices are usually made available thorough the scheme operator.
- 3.12 **BCBs** are authorised to accept these certificates and notices as evidence of compliance with the requirements of the Building Regulations. Local authority inspection and enforcement powers remain unaffected, but they are normally used only in response to a complaint that work does not comply.
- 3.13 A list of the self-certification schemes relating to the energy efficiency requirements in existing dwellings which are currently authorised can be found at www.communities.gov.uk

Work which need not be notified

- 3.14 Schedule 2B to the Building Regulations sets out types of work where there is no requirement to notify a **BCB** that work is to be carried out. These types of work are mainly of a minor nature where there is no significant risk to health, safety or energy efficiency. Note that the health, safety and **energy efficiency requirements** continue to apply to these types of work, and that only the need to notify a **BCB** has been removed. In addition, where only non-notifiable work is carried out by a

member of a competent person self-certification scheme there is no requirement for a certificate of building regulations compliance to be given to the occupier or the **BCB**.

3.15 The types of non-notifiable work in Schedule 2B relevant to the **energy efficiency requirements** of the Regulations are:

- a. in a heating, hot water, ventilation or air-conditioning system the replacement of any part which is not a combustion appliance (such as a radiator, valve or pump) or the addition of an output device (such as a radiator or fan) or the addition of a control device (such as a thermostatic radiator valve). However, the work will remain notifiable whenever **commissioning** is possible and necessary to enable a reasonable use of fuel and power (see paragraphs 4.33 to 4.39);
- b. the installation of a stand-alone, self-contained fixed heating, hot water, ventilation or air-conditioning service. Such services must consist only of a single appliance and any associated controls and must not be connected to, or form part of, any other **fixed building service**. Examples of non-notifiable services would be a fixed electric heater, a mechanical extractor fan in a kitchen or bathroom, and a room air-conditioning unit. However, if any of the following apply, the work will remain notifiable building work:
 - i the service is a combustion appliance;
 - ii any electrical work associated with the installation is notifiable;
 - iii **commissioning** is possible and would affect the service's energy efficiency (see paragraphs 4.33 to 4.39);
 - iv in the case of a ventilation appliance, the appliance is installed in a room containing a natural draught open-flued combustion appliance or service such as a gas fire which uses a chimney as its flue.
- c. [the construction of a conservatory.](#)

3.16 Schedule 2B also sets out what types of electrical installation work in dwellings are non-notifiable. Full information on this is given in Approved Document P.

MATERIALS AND WORKMANSHIP

3.17 Any building work which is subject to the requirements imposed by Schedule 1 to the Building Regulations should, in accordance with regulation 7, be carried out with proper materials and in a workmanlike manner.

3.18 You may show that you have complied with regulation 7 in a number of ways. These include demonstrating the appropriate use of:

- a product bearing CE marking in accordance with the Construction Products Directive (89/106/EC)³ as amended by the CE Marking Directive (93/68/EC)⁴, the Low Voltage Directive (2006/95/EC)⁵ and the EMC Directive (2004/108/EC)⁶;
- a product complying with an appropriate technical specification (as defined in those Directives mentioned above), a British Standard, or an alternative national technical specification of a Member State of the European Union or Turkey⁷, or of another State signatory to the Agreement on the European Economic Area (EEA) that provides an equivalent level of safety and protection;
- a product covered by a national or European certificate issued by a European Technical Approval Issuing body, provided the conditions of use are in accordance with the terms of the certificate.

3.19 You will find further guidance in the Approved Document which specifically supports regulation 7 on materials and workmanship.

Independent certification schemes

3.20 There are many UK product certification schemes. Such schemes certify compliance with the requirements of a recognised standard that is appropriate to the purpose for which the material is to be used. Materials which are not so certified may still conform to a relevant standard.

3.21 Many certification bodies that approve products under such schemes are accredited by the United Kingdom Accreditation Service (UKAS). [Such bodies can only issue certificates for the categories of product covered under the terms of their accreditation.](#)

3.22 **BCBs** may accept the certification of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Similarly, **BCBs** may accept the certification of the installation or maintenance of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Nonetheless, before accepting that certification constitutes compliance with building regulations, a **BCB** should establish in advance that the relevant scheme is adequate for that purpose.

³ As implemented by the Construction Products Regulations 1991 (SI 1991/1620).

⁴ As implemented by the Construction Products (Amendment) Regulations 1994 (SI 1994/3051).

⁵ As implemented by the Electrical Equipment (Safety) Regulations 1994 (SI 1994/3260).

⁶ As implemented by the Electromagnetic Compatibility Regulations 2006 (SI 2006/3418).

⁷ Decision No 1/95 of the EC-Turkey Association Council of 22 December 1995.

Standards and technical specifications

- 3.23 Building regulations are made for specific purposes including: securing the health, safety, welfare and convenience of people in or about buildings; furthering the conservation of fuel and power; furthering the protection or enhancement of the environment; and facilitating sustainable development. Guidance contained in standards and technical approvals is relevant to the extent that it relates to those purposes. However, the guidance may also address other aspects of performance such as serviceability, or aspects which, although they relate to health and safety, are not covered by building regulations.
- 3.24 When an Approved Document makes reference to a named standard or document the relevant version of the standard or document is the one listed at the end of the Approved Document. If this version has been revised or updated by the issuing body, the latest version may be used as a source of guidance provided it continues to address the relevant requirements of the Building Regulations. However, until the reference in the Approved Document is revised, the standard or document listed remains the approved source.
- 3.25 The appropriate use of a product that complies with a European Technical Approval as defined in the Construction Products Directive will meet the relevant requirements.
- 3.26 The Department intends to issue periodic amendments to its Approved Documents to reflect emerging harmonised European Standards. Where a national standard is to be replaced by a European harmonised standard, there will be a co-existence period during which either standard may be referred to. At the end of the coexistence period the national standard will be withdrawn.

THE WORKPLACE (HEALTH, SAFETY AND WELFARE) REGULATIONS 1992

- 3.27 The Workplace (Health, Safety and Welfare) Regulations 1992, as amended, apply to the common parts of flats and similar buildings if people such as cleaners, wardens and caretakers are employed to work in these common parts. These Regulations contain some requirements which affect building design. The main requirements are now covered by the Building Regulations, but for further information see *Workplace health, safety and welfare, Workplace (Health, Safety and Welfare) Regulations 1992, Approved Code of Practice and guidance*, HSE publication L24, 1996.
- 3.28 Where the requirements of the Building Regulations that are covered by this Approved Document do not apply to **dwelling**s, the provisions may still be required in the situations described above in order to satisfy the Workplace Regulations.

Section 4: Guidance relating to building work

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THE EXTENSION OF A DWELLING

Reference method

Fabric Standards

- 4.3 Reasonable provision would be for the proposed extension to incorporate the following:
- a. newly constructed **thermal elements** that meet the standards set out in paragraphs 5.1 to 5.5;
 - b. **doors, windows, roof windows and rooflights** that meet the standards set out in paragraphs 4.18b to 4.22;
 - c. **improvements** to fabric elements that are to become **thermal elements**, following the guidance in paragraphs 5.6 to 5.10.

Area of windows, roof windows and doors

- 4.4 In most circumstances reasonable provision would be to limit the total area of windows, roof windows and doors in extensions so that it does not exceed the sum of:
- a. 25% of the floor area of the extension; plus
 - b. the total area of any windows or doors which, as a result of the extension works, no longer exist or are no longer exposed.

*As a general guide, if the area of glazing is much less than 20% of the total floor area, some parts of the extension and especially the part of the **dwelling** it covers may experience poor levels of daylight, resulting in increased use of electric lighting.*

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Heating and lighting in the extension

- 4.6 Where a **fixed building service** is provided or extended as part of constructing the extension, reasonable provision would be to follow the guidance in paragraphs 4.22a to 4.39.

Optional approaches with more design flexibility

4.7 The approach set out in paragraphs 4.3 to 4.6 is somewhat prescriptive. The following paragraphs offer more flexible approaches to demonstrating reasonable provision has been made. These alternative approaches allow some elements of the design to be relaxed through compensating measures elsewhere.

Area weighted U-value method

4.7a One way of complying would be to show that the area-weighted U-value of all the elements in the extension is no greater than that of an extension of the same size and shape that complies with the fabric standards referred to in paragraph 4.3 and the opening area standards in paragraph 4.4. Any **fixed building service** provided or extended as part of constructing the extension should follow the guidance in paragraphs 4.22a to 4.39.

The area-weighted U-value is give by the following expression:

$$\{(U1 \times A1) + (U2 \times A2) + (U3 \times A3) + \dots\} \div \{(A1 + A2 + A3 + \dots)\}$$

<text deleted>

Whole dwelling calculation method

4.9 Where even greater design flexibility is required, reasonable provision would be to use [SAP 2009](#)⁸ to show that the calculated CO₂ emission rate from the **dwelling** with its proposed extension is no greater than for the **dwelling** plus a notional extension built to the standards of paragraphs 4.3 to 4.6. The openings in the notional extension should conform with paragraph 4.22 with door area set equal to the door area of the proposed extension, with the remainder of the openings being classified as windows. The data in [SAP 2009](#) Appendix S can be used to estimate the performance of the elements of the existing building where these are unknown.

⁸ See separate DECC consultation at www.bre.co.uk/sap2009

- 4.10 If, as part of achieving the standard set out in paragraph 4.9, **upgrades are proposed to the existing dwelling**, such upgrades should be implemented to a standard that is no worse than set out in the relevant guidance contained in this Approved Document. The relevant standards for improving retained **thermal elements** are as set out in column (b) of Table 5.

Where it is proposed to upgrade the original building, the standards set out in this Approved Document are cost effective and should be implemented in full. It will be worthwhile implementing them even if the improvement is greater than necessary to achieve compliance. In some cases therefore, the standard of the extended house may be better than that required by paragraph 4.9 alone. Paragraph 4.10 sets limits on design flexibility and ensures that no cost-effective improvement opportunities are traded away.

Conservatories

- 4.11 Where the extension is a **conservatory**, reasonable provision would be to provide:

- a. glazed elements that comply with the standards given in Table 2 and **thermal elements** that have U-values that are no worse than the standards given in Table 4;
- b. a heating system that meets the minimum standards in the *Domestic Building Services Compliance Guide* and has automatic on/off controls;

Automatic controls would mean that the conservatory heating need not default to the same schedule as the main house.

- c. secure ventilation openings totalling 5% of the combined area of the **conservatory** and the room to which it is attached, with a minimum of 0.5 m² free opening area being provided at high level (minimum of 2 m above the floor level).
- 4.11a Although the construction of a **conservatory** is not notifiable, the local authority may check that any **conservatory** that has been constructed has made reasonable provision for the conservation of fuel and power. The person responsible for constructing the **conservatory** should therefore produce a schedule that details the provisions that have been made to satisfy the requirements, and provide this to the owner so that it can be used as evidence of compliance if this is called for by the local authority. This document should include details of:
- a. the provisions made for maintaining thermal separation and, in particular, the details of the door separating the **dwelling** from the **conservatory** and its closing mechanism;

- b. a schedule of elemental performance standards for each element of construction, compared with the values referred to in paragraph 4.11 sub-paragraph a);
- c. details of the heating system, with specific guidance on how the occupier should adjust the controls to match the intended use of the **conservatory** (see sub-paragraph e) below);
- d. details of the ventilation provisions intended to limit summer overheating;
- e. a copy of the guidance given to the occupier, explaining how different patterns of use will influence energy consumption and running costs.

This is the first stage of a proposed progressive tightening of conservatory standards, such that after two further revisions of Part L (scheduled for 2013 and 2016), conservatories would be treated exactly the same as any other extension.

Substantially glazed extensions

- 4.12 If a substantially glazed extension fails to qualify as a **conservatory** because it has less than the minimum qualifying amounts of transparent or translucent material, reasonable provision would be to follow the guidance in paragraphs 4.9 to 4.10.

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This approach would need to demonstrate that the extension provides a real energy benefit.

Swimming pool basins

- 4.12a Where a swimming pool is being provided in a building, the U-value of the basin (walls and floor) should be not worse than 0.25 W/m².K as calculated according to BS EN ISO 13370⁹.

MATERIAL CHANGE OF USE AND CHANGE OF ENERGY STATUS

- 4.13 Material change of use is defined in regulation 5 as follows:

⁹ BS EN ISO 13370 *Thermal performance of buildings – Heat transfer via the ground – Calculation methods.*

For the purposes of paragraph 8(1)(e) of Schedule 1 to the Act and for the purposes of these Regulations, there is a material change of use where there is a change in the purposes for which or the circumstances in which a building is used, so that after that change:

- a. the building is used as a dwelling, where previously it was not;
- b. the building contains a flat, where previously it did not;
- c. the building is used as an hotel or a boarding house, where previously it was not;
- d. the building is used as an institution, where previously it was not;
- e. the building is used as a public building, where previously it was not;
- f. the building is not a building described in Classes I to VI in Schedule 2, where previously it was;
- g. the building, which contains at least one dwelling, contains a greater or lesser number of dwellings than it did previously;
- h. the building contains a room for residential purposes, where previously it did not;
- i. the building, which contains at least one room for residential purposes, contains a greater or lesser number of such rooms than it did previously; or
- j. the building is used as a shop where previously it was not.

4.13a A change to a building's energy status is defined in regulation 2(1) as:

any change which results in a building becoming a building to which the energy efficiency requirements of these Regulations apply, where previously it was not.

4.14 In normal circumstances, reasonable provision where there is a material change of use or a change to the building's energy status would be:

- a. where **controlled services or fittings** are being provided or extended, to meet the standards set out in paragraphs 4.18 to 4.39. If the area of openings in the newly created **dwelling** is more than 25% of the total floor area, the area of openings should either be reduced to be not greater than 25%, or the larger area should be compensated for in some other way using the procedure described in paragraph 4.15;
- b. where the work involves the provision of a **thermal element**, to meet the standards set out in paragraphs 5.1 to 5.5;

For the purposes of Building Regulations, provision means both new and replacement elements.

<text deleted>

- d. where any **thermal element** is being retained, to upgrade it following the guidance given in paragraphs 5.9 and 5.10;
- e. where an existing window (including roof window or rooflight) or door which separates a conditioned space from an unconditioned space or the external environment has a U-value that is worse than 3.3 W/m².K, to provide replacement units following the guidance in paragraphs 4.19 to 4.22.

Option providing more design flexibility

- 4.15 To provide more design flexibility, [SAP 2009](#) can be used to demonstrate that the total CO₂ emissions from all the **dwelling**s in the building as it will become are no greater than if each **dwelling** had been improved following the guidance set out in paragraph 4.14.

MATERIAL ALTERATION

- 4.16 A material alteration is defined in regulation 3(2) and (3) of the Building Regulations as follows:

3(2) An alteration is material for the purposes of these Regulations if the work, or any part of it, would at any stage result:

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

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

- a. Part A (structure);
- b. paragraph B1 (means of warning and escape);
- c. paragraph B3 (internal fire spread – structure);
- d. paragraph B4 (external fire spread);
- e. paragraph B5 (access and facilities for the fire service);
- f. Part M (access to and use of buildings).

4.16a Examples of a material alteration include:

- a) loft conversions;
- b) garage conversions;
- c) creating a new opening (door, window etc).

4.17 When carrying out a material alteration, reasonable provision would be:

- a. where the work involves the provision of a **thermal element**, to follow the guidance in paragraphs 5.1a to 5.5;

For the purposes of Building Regulations, provision means both new and replacement elements.

- b. where the work involves the renovation of a **thermal element**, to follow the guidance in paragraphs 5.6 and 5.7;
- c. where an existing element becomes part of the external fabric of the **dwelling** where previously it was not, to follow the guidance in paragraphs 5.9 and 5.10;

Sub-paragraph c) is to satisfy regulation 4, i.e. the building is no more unsatisfactory in relation to a requirement than before the work was carried out. This is intended to cover situations that apply when converting existing unheated spaces into living accommodation (e.g. loft and garage conversions). Consideration is being given to making such alterations material changes of use. Consultees' views on such a change would be welcome.

- d. when providing a **controlled fitting**, to limit total opening area to not more than 25% of the total floor area and to follow the guidance on performance standards given in paragraphs 4.18b to 4.22. If the owner wishes to incorporate more than 25% area of openings, reasonable provision can be demonstrated using the procedure described in paragraph 4.17a;
- e. when providing or extending a **controlled service**, to follow the guidance on **controlled services** given in paragraphs 4.22a to 4.39.

4.17a To provide more flexibility, SAP 2009 can be used to demonstrate that the total CO₂ emissions from the modified **dwelling** will be no greater than if the **dwelling** had been improved following the guidance in paragraph 4.17.

WORK ON CONTROLLED FITTINGS AND SERVICES

4.18 **Controlled services or fittings** are defined in regulation 2 as follows:

controlled service or fitting means a service or fitting in relation to which Part G, H, J, L or P of Schedule 1 imposes a requirement;

4.18a In the context of this Approved Document, the application of the term **controlled fitting** to a window, roof window, rooflight or door refers to a whole unit, i.e. including the frame. Consequently, replacing the glazing whilst retaining an existing frame is not providing a **controlled fitting**, and so such work is not notifiable and does not have to meet the Part L standards, although where practical it would be sensible to do so.

Controlled fittings

4.18b The U-value of windows, roof windows, rooflights and doors shall be calculated in accordance with BR 443¹⁰, and must be based on the whole unit (i.e. in the case of a window, the combined performance of the glazing and frame). The U-values can be calculated for the actual unit, the smaller of the two standard windows defined in BS EN 14351-1¹¹, or the standard windows set out in BR 443. The U-values for roof windows and rooflights given in this Approved Document are based on the U-value having been assessed with the roof window or rooflight in the vertical position.

4.19 Where windows, roof windows, rooflights or doors are to be provided, reasonable provision in normal cases would be the installation of draught-proofed units whose performance is no worse than given in Table 2. In addition, insulated cavity closers should be installed where appropriate. Where windows, roof windows, rooflights or glazed doors have to be hand-made (e.g. to match existing retained windows), a Window Energy Rating¹² or composite U-value may not be available, and it may be unreasonable to expect the necessary calculations to be done for a one-off unit. Only in such exceptional circumstances may the alternative standard of a centre-pane U-value of 1.2 W/m².K be accepted.

¹⁰ BR 443 *Conventions for U-value calculations*, BRE, 2006.

¹¹ EN 14351-1 *Windows and doors – Product standard, performance characteristics*, 2006.

¹² See BFRC website at www.bfrc.org

Table 2: Standards for controlled fittings

Fitting	Standard
Window, roof window or rooflight	WER = Band C
Doors with >50% of internal face glazed	U-value=1.8 W/m ² .K
Other doors	U-value=1.8 W/m ² .K

It is proposed that we simplify matters and just set the same standard irrespective of whether new or replacement. The new dwelling market will drive the required improvement.

<text deleted>

4.22 If a window is enlarged or a new one created, then the area of windows, roof windows, **rooflights** and doors should not exceed 25% of the total floor area of the **dwelling** unless compensating measures are included elsewhere in the work.

Controlled services

4.22a Whenever a **fixed building service** is extended or provided, reasonable provision would be demonstrated by following the guidance set out in the *Domestic Building Services Compliance Guide*¹³. The Guide covers the following services:

- a) heating and hot water systems (including insulation of pipes, ducts and vessels;
- b) mechanical ventilation;
- c) mechanical cooling/air conditioning;
- d) fixed internal lighting;
- e) fixed external lighting;
- f) renewable energy systems.

4.22b The efficiency claimed for the **fixed building service** should be based on the appropriate test standard as set out in the *Domestic Building Services Compliance Guide* and the test data should be certified by a notified body. It would be reasonable for **BCBs** to accept such data at face value. In the absence of such quality assured data, **BCBs** should satisfy themselves that the claimed performance is justified.

4.22c When replacing an existing appliance, the efficiency of the new appliance should not be significantly less than the efficiency of the appliance being replaced. If the replacement involves a fuel switch, then the relative carbon emissions associated

¹³ *Domestic Building Services Compliance Guide* – see Volume 2, Chapter 6 of this consultation document.

with the new and existing fuels should be considered when assessing the reasonableness of the proposed new appliance. The *Domestic Building Services Compliance Guide* contains the detailed guidance on this issue.

- 4.22d If a renewable energy generator such as a wind turbine or PV array is being replaced, the new system should have an electrical output that is not significantly less than the original installation.
- 4.22e If a particular technology is not covered in the *Domestic Building Services Compliance Guide*, reasonable provision would be demonstrated by showing that the proposed technology gives a performance that is no worse than a reference system of the same type whose details are given in the Guide.

This would eliminate a possible barrier to innovative technologies.

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COMMISSIONING OF FIXED BUILDING SERVICES

- 4.33 Paragraph L1(b)(iii) of Schedule 1 to the Building Regulations imposes a requirement that **fixed building services** are 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 20C states:

20C Commissioning

- (1) 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.
- (2) Where this regulation applies the person carrying out the work shall, for the purpose of ensuring compliance with paragraph L1(b) of Schedule 1, 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.
- (3) The notice shall be given to the local authority—
 - (a) not later than the date on which the notice required by regulation 15(4) is required to be given; or
 - (b) where that regulation does not apply, not more than 30 days after completion of the work.

4.33a Reasonable provision would be to prepare a commissioning plan, identifying the systems that need to be tested and the tests that will be carried out. The notice required by regulation 20C should confirm that the commissioning plan has been followed and that every system has been inspected in an appropriate sequence and to a reasonable standard and that the test results confirm that performance is reasonably in accordance with the design requirements.

4.34 Not all **fixed building services** will need to be commissioned. With some systems adjustment 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**.*

4.35 Where **commissioning** is carried out it must be done in accordance with a procedure 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, an approved procedure would follow the guidance in the *Domestic Ventilation: Installation and Commissioning Compliance Guide*¹⁴.

4.36 **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.

4.37 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 5 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 (see paragraph 3.11), it must be given within 30 days.

4.38 Where an approved inspector is the **BCB**, the notice of completion of **commissioning** should generally be given to the approved inspector within 5 days of the completion of work. However, where the work is carried out by a person registered with a competent person scheme (see paragraph 3.11), 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.

4.39 Where the **BCB** does not receive the notice within the required period, the **BCB** cannot be reasonably satisfied that Part L has been complied with and consequently is unlikely to be able to give a completion/final certificate.

¹⁴ *Domestic Ventilation: Installation and Commissioning Compliance Guide*—see Volume 3, Chapter 2 of this consultation document.

Section 5: Guidance on thermal elements

5.1 New **thermal elements** must comply with Part L1(a)(i) of Schedule 1 to the Building Regulations. Work on existing **thermal elements** must comply with regulation 4A of the Building Regulations which states:

4A.–(1) Where a person intends to renovate a thermal element, such work shall be carried out as is necessary to ensure that the whole thermal element complies with the requirements of paragraph L1(a)(i) of Schedule 1.

(2) Where a thermal element is replaced, the new thermal element shall comply with the requirements of paragraph L1(a)(i) of Schedule 1.

THE PROVISION OF THERMAL ELEMENTS

U-values

5.1a U-values shall be calculated using the methods and conventions set out in BR 443.

5.2 Reasonable provision for newly constructed **thermal elements** such as those constructed as part of an extension would be to meet the standards set out in Table 4. *<text deleted>*

5.3 Reasonable provision for those **thermal elements** constructed as replacements for existing elements would be to meet the standards set out in Table 4.

Table 4: Standards for new thermal elements

Element ¹	Standard (W/m ² .K)
Wall	0.28 ²
Pitched roof – insulation at ceiling level	0.16
Pitched roof – insulation at rafter level	0.16
Flat roof or roof with integral insulation	0.16
Floors ³	0.22 ⁴
Swimming pool basin	0.25
Notes: 1. "Roof" includes the roof parts of dormer windows, and "wall" includes the wall parts (cheeks) of dormer windows. 2. Area weighted average values. 3. A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall. 4. A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels. The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged dwelling.	

Continuity of insulation and airtightness

- 5.4 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. Reasonable provision should also be made to reduce unwanted air leakage through the new envelope parts.
- 5.5 A suitable approach to showing the requirement has been achieved would be to provide insulated cavity closers in all openings and to adopt design details for other junctions as published on the Accredited Construction Details website¹⁵.

It is impractical to expect thermal bridge and temperature factor calculations for work in existing buildings.

RENOVATION OF THERMAL ELEMENTS

- 5.6 Where a **thermal element** is subject to a **renovation**, the performance of the whole element should be improved to achieve or better the relevant U-value set out in column (b) of Table 5. The definition of **renovation** is given in paragraph 3.1.
- 5.7 If achievement of the relevant U-value set out in column (b) of Table 5 is not technically or functionally feasible or would not achieve a **simple payback** of 15 years or less, the element should be upgraded to the best standard that is technically and functionally feasible and which can be achieved within a **simple payback** of no greater than 15 years. Guidance on this approach is given in Appendix A.

RETAINED THERMAL ELEMENTS

- 5.9 Part L of Schedule 1 to the Building Regulations applies to retained **thermal elements** in the following circumstances:
- a. where an existing **thermal element** is part of a building subject to a material change of use;
 - b. where an existing element is to become part of the thermal envelope where previously it was not, e.g. as part of a loft or garage conversion where the space is now to be heated;

¹⁵ See Volume 1, Chapter 3 of this consultation document.

- 5.10 Reasonable provision would be to upgrade those **thermal elements** whose U-value is worse than the threshold value in column (a) of Table 5 to achieve the U-values given in column (b) of Table 5 provided this is technically, functionally and economically feasible. A reasonable test of economic feasibility is to achieve a **simple payback** of 15 years or less. Where the standard given in column (b) is not technically, functionally or economically feasible, then the **thermal element** should be upgraded to the best standard that is technically and functionally feasible and delivers a **simple payback** period of 15 years or less. **Generally, this lesser standard should not be worse than 0.7 W/m².K.**

Examples of where lesser provision than column (b) might apply are where the thickness of the additional insulation might reduce usable floor area of any room by more than 5% or create difficulties with adjoining floor levels, or where the weight of the additional insulation might not be supported by the existing structural frame.

Table 5: Upgrading retained thermal elements

Element ¹	a) Threshold U-value W/m ² .K	(b) Improved U-value W/m ² .K
Wall – cavity insulation ²	0.70	0.55
Wall – external or internal insulation ³	0.70	0.30
Floor ^{4,5}	0.70	0.25
Pitched roof – insulation at ceiling level	0.35	0.16
Pitched roof – insulation between rafters	0.35	0.16
Flat roof or roof with integral insulation	0.35	0.16
Notes:		
1 “Roof” includes the roof parts of dormer windows and “wall” includes the wall parts (cheeks) of dormer windows.		
2 This only applies in the case of a wall suitable for the installation of cavity insulation. Where this is not the case, it should be treated as “wall-external or internal insulation”.		
3 A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall.		
4 The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged building.		
5 A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels.		

Section 6: Consequential improvements to energy performance

- 6.1 Regulation 17D of the Building Regulations may require additional work to be undertaken to make an existing building more energy efficient when certain types of building work are proposed.
- 6.2 This requirement arises in existing buildings with a total useful floor area of over 1,000 m² where the proposed work consists of:
- a) an extension;
 - b) the initial provision of any **fixed building service** (other than a renewable energy generator);
 - c) an increase to the installed capacity of any **fixed building service** (other than a renewable energy generator);
- 6.3 **Consequential improvements** should only be carried out to the extent that they are technically, functionally and economically feasible.
- 6.4 Only a relatively small number of existing dwellings will exceed 1,000 m² in size. Where there is doubt the **BCB** can be consulted for advice.
- 6.5 Technical guidance on achieving compliance with regulation 17D is not given in this Approved Document but where the regulation applies it is available in Approved Document L2B.

Section 7: Providing information

- 7.1 On completion of the work, in accordance with paragraph L1(c) of Schedule 1, the owner of the **dwelling** should be provided with sufficient information about the building, the **fixed building services** and their operating and maintenance requirements so that the **dwelling** can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances. **This requirement only applies to the work that has actually been carried out – e.g., if the work involves replacing windows, there is no obligation on the contractor to provide details on the operation of the heating system.**
- 7.2 **Where the work involves the provision of a new heating system**, a way of complying would be to provide a suitable set of operating and maintenance instructions aimed at achieving economy in the use of fuel and power in terms that householders can understand in a durable format that can be kept and referred to over the service life of the system(s). The instructions should be directly related to the particular system(s) installed as part of the work that has been carried out.
- 7.3 Without prejudice to the need to comply with health and safety requirements, any instructions should explain to the occupier of the **dwelling** how to operate the system(s) efficiently. This should include:
- a. the making of adjustments to timing, temperature and flow control settings;
 - b. what routine maintenance is needed to enable operating efficiency to be maintained at a reasonable level through the service live(s) of the system(s); and
 - c **where a conservatory has been installed, guidance on the impact that different patterns of use can have on energy demand and cost.**

Appendix A: Work to thermal elements

- 1 Where work involves the **renovation** of a **thermal element**, an opportunity exists for cost-effective insulation improvements to be undertaken at marginal additional cost. This appendix provides guidance on the cost effectiveness of insulation measures when undertaking various types of work on a **thermal element**.
- 2 Table A1 sets out the circumstances and the level of performance that would be considered reasonable provision in ordinary circumstances. When dealing with existing **dwelling**s some flexibility in the application of standards is necessary to ensure that the context of each scheme can be taken into account while securing, as far as possible, the reasonable improvement. The final column in Table A1 provides guidance on a number of specific issues that may need to be considered in determining an appropriate course of action. As part of this flexible approach, it will be necessary to take into account technical risk and practicality in relation to the **dwelling** under consideration and the possible impacts on any adjoining building. In general the proposed works should take account of:
 - a. the requirements of any other relevant parts of Schedule 1 to the Building Regulations;
 - b. the general guidance on technical risk relating to insulation improvements contained in BR 262¹⁶;
 - c. for buildings falling within the categories set out in paragraphs 3.6 to 3.8a, the guidance produced by English Heritage.

Where it is not reasonable in the context of the works project to achieve the performance set out in Table A1 the level of performance achieved should be as close to this as practically possible.

- 3 Table A1 incorporates, in outline form, examples of construction that would achieve the proposed performance, but designers are free to use any appropriate construction that satisfies the energy performance standard, so long as they do not compromise performance with respect to any other part of the Building Regulations.
- 4 [General guidance is available from such sources as the Energy Saving Trust and relevant British Standards.](#)

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¹⁶ BR 262 *Thermal insulation: Avoiding risks*, BRE, 2002.

Table A1: Cost-effective U-value targets when undertaking renovation works to thermal elements

Proposed works	Target U-value (W/m ² .K)	Typical construction	Comments (reasonableness, practicability and cost-effectiveness)
Pitched roof constructions ¹⁷			
Renewal of roof covering – No living accommodation in the roof void – existing insulation (if any) at ceiling level. No existing insulation, existing insulation less than 50 mm, in poor condition, and/or likely to be significantly disturbed or removed as part of the planned work	0.16	Provide loft insulation – 250 mm mineral fibre or cellulose fibre as quilt laid between and across ceiling joists or loose fill or equivalent	Assess condensation risk in roof space and make appropriate provision in accordance with the requirements of Part C relating to the control of condensation. Additional provision may be required to provide access to and insulation of services in the roof void
Renewal of roof covering – Existing insulation in good condition and will not be significantly disturbed by proposed works. Existing insulation thickness 50 mm or more but less than 100 mm	0.16	Top up loft insulation to at least 250 mm mineral fibre or cellulose fibre as quilt laid between and across ceiling joists or loose fill or equivalent. This may be boarded out	Assess condensation risk in roof space and make appropriate provision in line with the requirements of Part C relating to the control of condensation. Additional provision may be required to provide insulation and access to services in the roof void. Where the loft is already boarded out and the boarding is not to be removed as part of the work, the practicality of insulation works would need to be considered

¹⁷ Specification of thickness of insulation is based on lambda values (conductivity) of 0.04 W/m.K.

Table A1: Cost-effective U-value targets when undertaking renovation works to thermal elements

Proposed works	Target U-value (W/m ² .K)	Typical construction	Comments (reasonableness, practicability and cost-effectiveness)
Renewal of the ceiling to cold loft space. Existing insulation at ceiling level removed as part of the works	0.16	Provide loft insulation – 250 mm mineral fibre or cellulose fibre as quilt laid between and across ceiling joists or loose fill or equivalent. This may be boarded out	Assess condensation risk in roof space and make appropriate provision in accordance with the requirements of Part C relating to the control of condensation. Additional provision may be required to provide insulation and access to services in the roof void. Where the loft is already boarded out and the boarding is not to be removed as part of the work, insulation can be installed from the underside but the target U-value may not be achievable
Renewal of roof covering – Living accommodation in roof space (room-in- the-roof type arrangement), with or without dormer windows	0.16	Cold structure – Insulation (thickness dependent on material) placed between and below rafters. Warm structure – Insulation placed between and above rafters	Assess condensation risk (particularly interstitial condensation), and make appropriate provision in accordance with the requirements of Part C relating to the control of condensation (Clause 8.4 of BS 5250:2002 and BS EN ISO 13788:2001). Practical considerations with respect to an increase in structural thickness (particularly in terraced dwellings) may necessitate a lower performance target

Table A1: Cost-effective U-value targets when undertaking renovation works to thermal elements

Proposed works	Target U-value (W/m ² .K)	Typical construction	Comments (reasonableness, practicability and cost-effectiveness)
Dormer window constructions			
Renewal of cladding to side walls	0.30	Insulation (thickness dependent on material) placed between and/or fixed to outside of wall studs. Or fully external to existing structure depending on construction	Assess condensation risk and make appropriate provision in accordance with the requirements of Part C
Renewal of roof covering	–	Follow guidance on improvement to pitched or flat roofs as appropriate	Assess condensation risk and make appropriate provision in accordance with the requirements of Part C
Flat roof constructions			
Renewal of roof covering – Existing insulation, if any, less than 100 mm, mineral fibre (or equivalent resistance), or in poor condition and likely to be significantly disturbed or removed as part of the planned work	0.16	Insulation placed between and over joists as required to achieve the target U-value – Warm structure	Assess condensation risk and make appropriate provision in accordance with the requirements of Part C. Also see BS 6229:2003 for design guidance
Renewal of the ceiling to flat roof area. Existing insulation removed as part of the works	0.16	Insulation placed between and to underside of joists to achieve target U-value	Assess condensation risk and make appropriate provision in accordance with the requirements of Part C. Also see BS 6229:2003 for design guidance. Where ceiling height would be adversely affected, a lower performance target may be appropriate

Table A1: Cost-effective U-value targets when undertaking renovation works to thermal elements

Proposed works	Target U-value (W/m ² .K)	Typical construction	Comments (reasonableness, practicability and cost-effectiveness)
Solid wall constructions			
Renewal of internal finish to external wall or applying a finish for the first time	0.30	<p>Dry-lining to inner face of wall – insulation between studs fixed to wall to achieve target U-value – thickness dependent on insulation and stud material used.</p> <p>Insulated wall board fixed to internal wall surface to achieve the required U-value – thickness dependent on material used</p>	<p>Assess the impact on internal floor area. In general it would be reasonable to accept a reduction of no more than 5% in the area of a room. However, the use of the of room and the space requirements for movement and arrangements of fixtures, fittings and furniture should be assessed. In situations where acoustic attenuation issues are particularly important (e.g. where insulation is returned at party walls) a less demanding U-value may be more appropriate. In such cases, the U-value target may have to be increased to 0.35 or above depending on the circumstances.</p> <p>Assess condensation and other moisture risks and make appropriate provision in accordance with the requirements of Part C. This will usually require the provision of a vapour control and damp protection to components. Guidance on the risks involved is provided in BR 262 and, on the technical options, in Energy Saving Trust publications</p>

Table A1: Cost-effective U-value targets when undertaking renovation works to thermal elements

Proposed works	Target U-value (W/m ² .K)	Typical construction	Comments (reasonableness, practicability and cost-effectiveness)
Renewal of finish or cladding to external wall area or elevation (render or other cladding) or applying a finish or cladding for the first time	0.30	External insulation system with rendered finish or cladding to give required U-value	Assess technical risk and impact of increased wall thickness on adjoining buildings
Ground floor constructions			
Renovation of a solid or suspended floor involving the replacement of screed or a timber floor deck	See comment	Solid floor – replace screed with an insulated floor deck to maintain existing floor level. Suspended timber floor – fit insulation between floor joists prior to replacement of floor deck	The cost-effectiveness of floor insulation is complicated by the impact of the size and shape of the floor (perimeter/area ratio). In many cases existing un-insulated floor U-values are already relatively low when compared with wall and roof U-values. Where the existing floor U-value is greater than 0.70 W/m ² .K, then the addition of insulation is likely to be cost-effective. Analysis shows that the cost-benefit curve for the thickness of added insulation is very flat, and so a target U-value of 0.25 W/m ² .K is appropriate subject to other technical constraints (adjoining floor levels, etc.)

Volume 2, Chapter 3

Proposed Approved Document L2A 2010 Edition

Approved Document L2A (2010)

Introduction

- 1 This document contains the proposed text of the 2010 Approved Document L2A: *Conservation of fuel and power in new buildings other than dwellings* (ADL2A), and is based on the Approved Document issued for consultation in 2008. The style and formatting of that consultation draft were strongly supported by consultees, and so have been retained for this consultation.
- 2 The regulatory guidance is shown in normal font, but the [proposed amendments to the 2008 consultation text are shown in blue](#). Places where paragraphs have been deleted are shown by *<text deleted>*. To facilitate comparison with the 2008 consultation text, we have retained the same paragraph numbers as that version; where new paragraphs have been inserted, these have been given letter suffixes. Where paragraphs have been deleted, subsequent paragraphs have not been renumbered. A complete revision of the numbering will be carried out when documents are finally published.
- 3 As with the 2006 editions, *commentary text is included to help understanding and to provide pointers to useful information, but is not part of the technical guidance. This is shown in italics*. Finally, *some further text has been added as explanations of the proposed changes. These are shown in plum italicised text* and are only included to assist the consultation process.
- 4 Please note that where changes to the regulations are proposed, changes to the legal text have not been drafted. In these instances, the intent of the proposals is summarised in the explanatory text.

Main changes to the 2010 edition

- 5 The main strategic changes to ADL2A proposed are:
 - emphasise the distinction between requirements set out in the Building Regulations 2000 and guidance as set out in the AD;
 - remove the exemptions from the energy efficiency requirements (regulations 9(3) to 9(6)), but include specific guidance on what is reasonable provision with respect to the building work currently listed there (e.g. in buildings with low levels of heating, buildings with a planned life of less than two years);

- clarify that the energy efficiency requirements apply not just to spaces that use energy for the purposes of providing human comfort, but to any building space where energy is used to condition the indoor climate (e.g. computer rooms, cold stores etc);
- define standards for swimming pool basins in buildings;
- change the basis of the notional building used to determine the TER;
- require a design stage TER/BER calculation as a means of helping to improve compliance;
- revise guidance on shell and core developments;
- revise the procedure for demonstrating that reasonable provision has been made to limit the effects of solar gain in summer;
- revise guidance on demonstrating reasonable provision for the continuity of insulation;
- require that a commissioning plan should be made available with deposit of plans;
- raise standards generally.

Additional clarifications are given in the commentary accompanying the proposed changes.

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Section 1: Introduction

WHAT IS AN APPROVED DOCUMENT?

- 1.1 This document has been approved and issued by the Secretary of State to provide practical guidance on ways of complying with the energy efficiency requirements (see Section 2) and regulation 7 of the Building Regulations 2000 (SI 2000/2531) for England and Wales, as amended. The Building Regulations 2000 are referred to throughout the remainder of this Document as “the Building Regulations”.
- 1.2 The intention of issuing Approved Documents is to provide guidance about compliance with specific aspects of building regulations in some of the more common building situations. They set out what, in ordinary circumstances, would be accepted as reasonable provision for compliance with the relevant requirement(s) of building regulations to which they refer.
- 1.3 If guidance in an Approved Document is followed there will be a presumption of compliance with the requirement(s) covered by the guidance. However, this presumption can be overturned, so simply following guidance does not guarantee compliance; [for example, if the particular case is unusual in some way, then “normal” guidance may not be applicable](#). It is also important to note that there may well be other ways of achieving compliance with the requirements. **There is therefore no obligation to adopt any particular solution contained in this Approved Document if you would prefer to meet the relevant requirement in some other way. Persons intending to carry out building work should always check with their building control body, either the local authority or an approved inspector, that their proposals comply with building regulations.**
- 1.3a It is important to note that this Approved Document, as well as containing guidance, also contains extracts from the Regulations. Such regulatory text must be complied with as stated. For example, the requirement that the target CO₂ emission rate for the building shall not be exceeded (regulation 17C) is a regulatory requirement. There is therefore no flexibility to ignore this requirement; neither can compliance with this particular regulation be demonstrated via any route other than that set out in regulations 17A and 17B.

To emphasise the important distinction between regulations and guidance.

- 1.4 The guidance contained in this Approved Document relates only to the particular requirements of the Building Regulations that the document addresses (set out in Section 2). However, building work may be subject to more than one requirement of building regulations. In such cases the work will also have to comply with any other applicable of building regulations.
- 1.5 There are Approved Documents that give guidance on each of the Parts of Schedule 1 and on regulation 7. A full list of these is provided at the back of this document.

CONSIDERATION OF TECHNICAL RISK

- 1.6 In relation to the construction of new buildings other than dwellings, building work must satisfy all the technical requirements set out in regulations 17C and 17E of, and Schedule 1 to, the Building Regulations. When considering the incorporation of energy efficiency measures in dwellings, attention should be paid in particular to the need to comply with Part B (fire safety), Part C (site preparation and resistance to contaminants and moisture), Part E (resistance to the passage of sound), Part F (ventilation), Paragraph G3 (hot water storage), Part J (combustion appliances and fuel storage systems) and Part P (electrical safety), as well as Part L. [The adoption of any particular energy efficiency measure should not involve unacceptable technical risk of, for instance, excessive condensation. Designers and builders should refer to the relevant Approved Documents and to other generally available good practice guidance to help minimise these risks.](#)

ADs cannot expect to cover all aspects of good design practice. If thought appropriate, a list of relevant good practice information could be listed on the planning portal, but these would be third party publications. The difficulty of maintaining such a list is that it could never be exhaustive and, by its nature, a selective list may favour one particular system or technology. It may therefore be appropriate just to provide links to other information providers, such as the professional institutions and trade bodies.

HOW TO USE THIS APPROVED DOCUMENT

- 1.7a This Approved Document is subdivided into seven sections as detailed below. These main sections are followed by a number of supporting appendices.

This **introductory** section sets out the general context in which the guidance in the AD must be considered.

Section 2 sets out the relevant legal requirements as published in the Building Regulations.

Section 3 contains general guidance, including the definition of key terms, the types of building work covered by this Approved Document, the types of building work that are exempt, procedures for notifying work, materials and workmanship and health and safety issues, an overview of the routes to compliance and how to deal with “special” areas of buildings that contain dwellings.

Section 4 details the considerations that apply to demonstrating that the design of the building will meet the energy efficiency requirements. This section begins the detailed technical guidance relating to showing compliance with the energy efficiency requirements.

Section 5 details the considerations that apply when demonstrating that the design has been appropriately translated into actual construction performance.

Section 6 describes the information that should be provided to occupiers to help them achieve reasonable standards of energy efficiency in practice.

Section 7 provides a pointer to some useful information on different design approaches to meeting the energy efficiency requirements.

- 1.8 In this document the following conventions have been adopted to assist understanding and interpretation:
- a. Texts shown **against a green background** are extracts from the Building Regulations or Building (Approved Inspectors) Regulations, both as amended, and set out the legal requirements that relate to compliance with the energy efficiency requirements of building regulations. *As stated previously, there is no flexibility in respect of such text; it defines a legal requirement, not guidance for typical situations.* It should also be remembered that, as noted above, building works must comply with all the other applicable provisions of building regulations.

To clarify the distinction between regulations and guidance.

- b. Key terms are defined in paragraph 3.1 and are printed in ***bold italic text***.
- c. Details of technical publications referred to in the text of this Document will be given in footnotes and repeated as end notes. A reference to a publication is likely to be made for one of two main reasons. The publication may contain additional or more comprehensive technical detail, which it would be impractical to include in full in the Document but which is needed to fully explain ways of meeting the requirements; or it is a source of more general information. The reason for the reference will be indicated in each case. The reference will be to a specified edition of the document. The Approved Document may be amended

from time to time to include new references or to refer to revised editions where this aids compliance.

- 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, but is not part of the technical guidance itself.

WHERE YOU CAN GET FURTHER HELP

1.9 If you do not understand the technical guidance or other information set out in this Approved Document and the additional detailed technical references to which it directs you, there are a number of routes through which you can seek further assistance:

- the CLG website: www.communities.gov.uk;
- the Planning Portal website: www.planningportal.gov.uk;
- if you are the person undertaking the building work you can seek assistance either from your local authority building control service or from your approved inspector (depending on which building control service you are using, or intend to use to certify compliance of your work with the requirements of the Building Regulations);
- businesses registered with a competent person self-certification scheme may be able to get technical advice from their scheme operator;
- if your query is of a highly technical nature you may wish to seek the advice of a specialist, or industry technical body, in the area of concern.

RESPONSIBILITY FOR COMPLIANCE

1.10 It is important to remember that if you are the person (e.g. designer, builder, installer) carrying out building work to which any requirement of building regulations applies you have a responsibility to ensure that the work complies with any such requirement. The building owner may also have a responsibility for ensuring compliance with building regulation requirements and could be served with an enforcement notice in cases of non-compliance.

Section 2: The Requirements

- 2.1 This Approved Document, which takes effect on xx xx 2010, deals with the **energy efficiency requirements** in the Building Regulations 2000 (as amended by SI). Regulation 2(1) of the Building Regulations defines the **energy efficiency requirements** as the requirements of regulations 4A, 17C, 17D and 17E and Part L of Schedule 1. The **energy efficiency requirements** relevant to this Approved Document, which deals with new buildings other than dwellings, are those of regulations 17C and 17E and Part L of Schedule 1, and are set out below.

New buildings

Regulation 17C.

Where a building is erected, it shall not exceed the target CO₂ emission rate for the building that has been approved pursuant to regulation 17B.

Energy performance certificates

Regulation 17E.

- (1) This regulation applies where—
 - (a) a building is erected; or
 - (b) a building is modified so that it has a greater or fewer number of parts designed or altered for separate use than it previously had, where the modification includes the provision or extension of any of the fixed services for heating, hot water, air conditioning or mechanical ventilation.
- (2) The person carrying out the work shall—
 - (a) give an energy performance certificate for the building to the owner of the building; and
 - (b) give to the local authority notice to that effect, including the reference number under which the energy performance certificate has been registered in accordance with regulation 17F(4).
- (3) The energy performance certificate and notice shall be given not later than five days after the work has been completed.
- (4) The energy performance certificate must be accompanied by a recommendation report containing recommendations for the improvement of the energy performance of the building, issued by the energy assessor who issued the energy performance certificate.

Regulation 17E (*continued*).

- (5) An energy performance certificate must—
- (a) express the asset rating of the building in a way approved by the Secretary of State under regulation 17A;
 - (b) include a reference value such as a current legal standard or benchmark;
 - (c) be issued by an energy assessor who is accredited to produce energy performance certificates for that category of building; and
 - (d) include the following information—
 - (i) the reference number under which the certificate has been registered in accordance with regulation 17F(4);
 - (ii) the address of the building;
 - (iii) an estimate of the total useful floor area of the building;
 - (iv) the name of the energy assessor who issued it;
 - (v) the name and address of the energy assessor's employer, or, if he is self-employed, the name under which he trades and his address;
 - (vi) the date on which it was issued; and
 - (vii) the name of the approved accreditation scheme of which the energy assessor is a member.
- (6) Certification for apartments or units designed or altered for separate use in blocks may be based—
- (a) except in the case of a dwelling, on a common certification of the whole building for blocks with a common heating system; or
 - (b) on the assessment of another representative apartment or unit in the same block.
- 7) Where —
- (a) a block with a common heating system is divided into parts designed or altered for separate use; and
 - (b) one or more, but not all, of the parts are dwellings,
- certification for those parts which are not dwellings may be based on a common certification of all the parts which are not dwellings

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; and
- (c) providing 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.

It is proposed that (iii) should be amended to include the objective that fixed building services should deliver their specified functional performance as well as using no more fuel and power than is necessary.

LIMITATION ON REQUIREMENTS

- 2.2 In accordance with regulation 8 of the Building Regulations, the requirements in Parts A to D, F to K and N and P (except for paragraphs H2 and J6) of Schedule 1 to the Building Regulations do not require anything to be done except for the purpose of securing reasonable standards of health and safety for persons in or about buildings (and any others who may be affected by buildings or matters connected with buildings).
- 2.3 Paragraphs H2 and J6 are excluded from regulation 8 because they deal directly with prevention of the contamination of water. Parts E and M (which deal, respectively, with resistance to the passage of sound, and access to and use of buildings) are excluded from regulation 8 because they address the welfare and convenience of building users. Part L is excluded from regulation 8 because it addresses the conservation of fuel and power.

Section 3: General guidance

KEY TERMS

3.1 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 across the building envelope of 50 Pascal (50 N/m²). The envelope area of the building, or measured part of the building, is the total area of all floors, walls and ceilings bordering the internal volume subject to the test. This includes walls and floors below external ground level. Overall internal dimensions are used to calculate this 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 **BER**, and is based on a specific measurement of the building concerned.

BCB means Building Control Body: a local authority or an approved inspector.

BER is the Building CO₂ Emission Rate expressed as kgCO₂/(m².year).

Commissioning means the advancement of a fixed building service following installation, replacement or alteration of the whole or part of the system, from the state of static completion to working order by testing and adjusting as necessary to ensure the system as a whole uses no more fuel and power than is reasonable in the circumstances, without prejudice to the need to comply with health and safety requirements. For each system **commissioning** includes setting-to-work, regulation (that is testing and adjusting repetitively) to achieve the specified performance, the 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.

Conservatory is an extension to a building:

- a) which is thermally separated from the attached building by walls, windows and doors with U-value and draught-stripping provisions no worse than provided elsewhere in the building, and if a heating system is provided, that system has independent temperature and on/off controls; and
- b) where the area of transparent or translucent material in its external envelope parts is more than 150% of its floor area.

Controlled service or fitting means a service or fitting in relation to which Part G (hygiene), 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.

<text deleted>.

Display window means an area of glazing, including glazed doors, intended for the display of products or services on offer within the building, positioned:

- a. at the external perimeter of the building; and
- b. at an access level and immediately adjacent to a pedestrian thoroughfare.

There should be no permanent workspace within one glazing height of the perimeter. Glazing more than 3 m above such an access level should not be considered part of a **display window** except:

- a. where the products on display require a greater height of glazing;
- b. in cases of building work involving changes to the façade and glazing requiring planning consent, where planners should have discretion to require a greater height of glazing, e.g. to fit in with surrounding buildings or to match the character of the existing façade.

It is expected that **display windows** will be found in Planning Use Classes A1, A2, A3 and D2 as detailed in Table 1.

Table 1: Planning Use Classes	
Class	Use
A1	Shops: including retail-warehouse, undertakers, showrooms, post offices, hairdressers, shops for sale of cold food for consumption off premises
A2	Financial and professional services: banks, building societies, estate and employment agencies, betting offices
A3	Food and drink: restaurants, pubs, wine bars, shops for sale of hot food for consumption off premises
D2	Assembly and leisure: cinemas, concert halls, bingo halls, casinos, sports and leisure uses

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

Dwelling means a self-contained unit designed to accommodate a single household. (**Rooms for residential purposes** are not **dwellings** so Approved Document L2A applies to their construction.)

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

Energy efficiency requirements means the requirements of regulations 4A, 17C, 17D and 17E of, and Part L of Schedule 1 to, the Building Regulations.

In respect of new buildings other than dwellings, the applicable requirements are those of Part L and regulation 17C.

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

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

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

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

It is proposed that the definition of fixed building services be amended to include (renewable) energy generation equipment, power distribution systems and (natural) ventilation components.

High usage entrance door means a door to an entrance primarily for the use of people that is expected to experience large traffic volumes, and where robustness and/or powered operation is the primary performance requirement. To qualify as a high usage entrance door, the door should be equipped with automatic closers and, except where operational requirements preclude, be protected by a lobby.

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, whether or not the room is separated from or arranged in a cluster group with other rooms, but does not include a room in a hospital, or other similar establishment, used for patient accommodation and, for the purposes of this definition, a “cluster” is a group of rooms for residential purposes which is:

- a. separated from the rest of the building in which it is situated by a door which is designed to be locked; and
- b. not designed to be occupied by a single household.

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

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

Total useful floor area is the total area of all enclosed spaces measured to the internal face of the external walls, that is to say it is the gross floor area as measured in accordance with the guidance issued to surveyors by the RICS. In this convention:

- a. the area of sloping surfaces such as staircases, galleries, raked auditoria, and tiered terraces should be taken as their area on plan; and
- b. areas that are not enclosed such as open floors, covered ways and balconies are excluded.

TYPES OF WORK COVERED BY THIS APPROVED DOCUMENT

3.2 This Approved Document is intended to give guidance on what, in ordinary circumstances, would be reasonable provision for compliance with the requirements of regulation 17C of, and Part L of Schedule 1 to, the Building Regulations in relation to works comprising:

- a. the construction of new buildings other than **dwelling**s;
- b. **fit-out works** where the work is included as part of the construction of a new building. This includes the first fit-out of a shell and core development where the shell is sold or let before the **fit-out work** is carried out. (Approved Document L2B applies to **fit-out works** in other circumstances.)

- c. The construction of extensions to existing buildings that are not **dwelling**s where the **total useful floor area** of the extension is greater than 100 m² and greater than 25% of the **total useful floor area** of the existing building.

- 3.3 When constructing a building that contains **dwelling**s, account should also be taken of the guidance in Approved Document L1A. In most instances, Approved Document L1A should be used for guidance relating to the work on the individual **dwelling**s, with this Approved Document L2A giving guidance relating to the parts of the building that are not a **dwelling** such as heated common areas and, in the case of mixed-use developments, the commercial or retail space.

*It should be noted that **dwelling**s refer to self-contained units. **Rooms for residential purposes** are not **dwelling**s, and so Approved Document L2A applies to, for instance, boarding houses, hostels and student accommodation blocks.*

- 3.4 If a building contains both living accommodation and space to be used for commercial purposes (e.g. workshop or office), then the whole building should be treated as a **dwelling** as long as the commercial part could revert to domestic use. This could be the case if, for example:

- a. there is direct access between the industrial or 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 building.

*Sub paragraph c) means that a small manager's flat in a large non-domestic building would not mean the whole building should be treated as a **dwelling**. Similarly, the existence of a room used as an office or utility space within a **dwelling** would not mean that the building should not be treated as a **dwelling**.*

NEW BUILDINGS OTHER THAN DWELLINGS THAT ARE EXEMPT FROM THE ENERGY EFFICIENCY REQUIREMENTS

- 3.5 The provisions for exempting buildings and building work from the Building Regulations requirements have changed and the new provisions are given in regulation 9. In relation to the **energy efficiency requirements**, paragraphs (3) to (6) of regulation 9 set out the current rules on which buildings and work have to comply, and which are exempt.

- 9 — (3) The energy efficiency requirements of these Regulations apply to:
- a. the erection of any building of a kind falling within this paragraph;
 - b. the extension of any such building, other than an extension falling within class VII in Schedule 2; and
 - c. the carrying out of any work to or in connection with any such building or extension.
- (4) A building falls within paragraph (3) if it:
- a. is a roofed construction having walls;
 - b. uses energy to condition the indoor climate; and
 - c. does not fall within the categories listed in paragraph (5).
- (5) The categories referred to in paragraph (4)(c) are:
- a. buildings which are:
 - i. listed in accordance with section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990;
 - ii. in a conservation area designated in accordance with section 69 of that Act; or
 - iii. included in the schedule of monuments maintained under section 1 of the Ancient Monuments and Archaeological Areas Act 1979,
where compliance with the energy efficiency requirements would unacceptably alter their character or appearance;
 - b. buildings which are used primarily or solely as places of worship;
 - c. temporary buildings with a planned time of use of two years or less, industrial sites, workshops and non-residential agricultural buildings with low energy demand;
 - d. stand-alone buildings other than dwellings with a total useful floor area of less than 50 m².
- (6) In this regulation:
- a. building means the building as a whole or parts of it that have been designed or altered to be used separately; and
 - b. the following terms have the same meaning as in European Parliament and Council Directive 2002/91/EC on the energy performance of buildings:
 - i. industrial sites;
 - ii. low energy demand;
 - iii. non-residential agricultural buildings;
 - iv. places of worship;
 - v. stand-alone;
 - vi. total useful floor area;
 - vii. workshops.

SCHEDULE 2

Exempt building and work

Class VII

Extensions

The extension of a building by the addition at ground level of —

- (a) a conservatory, porch, covered yard or covered way; or
- (b) a carport open on at least two sides;

where the floor area of that extension does not exceed 30 m², provided that in the case of a conservatory or porch which is wholly or partly glazed, the glazing satisfied the requirements of Part N of Schedule 1.

The current exemptions were copied out from the EPBD, and are optional. It is proposed that these exemptions be deleted, because they overlap with the general exemptions to the Regulations (see Schedule 2) and this has caused confusion. It is proposed that the special considerations that apply in the different classes of building (e.g. temporary buildings) be covered through guidance.

3.5a The energy efficiency requirements apply to buildings that use energy to condition the indoor climate. This does not limit the application to spaces that are only heated or cooled to provide thermal comfort for occupants. It also applies where the space is conditioned for the benefit of processes going on inside the space, e.g. computer rooms and cold stores.

Special considerations

3.5b Special considerations apply to certain classes of non-exempt building. These building types are:

- a) historic buildings and buildings used primarily or solely as places of worship; the considerations that apply to such existing buildings are given in ADL1B and ADL2B;
- b) buildings with low energy demand; the guidance specific to such buildings is given in the section following paragraph 3.6a;
- c) modular and portable buildings; the guidance specific to such buildings is given in the section beginning with paragraph 4.19c;
- d) shell and core developments; the guidance specific to such buildings is given in the section beginning with paragraph 4.19g.

Buildings with low energy demand

3.6a For the purposes of this Approved Document, buildings with low energy demand are taken to be those buildings or parts thereof where:

- a) **fixed building services** are used to heat or cool only a localised area rather than the entire enclosed volume of the space concerned (e.g. localised radiant heaters at a workstation in a generally unheated space); or
- b) **fixed building services** are used to heat to space temperatures substantially less than those normally provided for human comfort (e.g. to provide condensation or frost protection in a warehouse); or
- c) the intended use of the space is such that it is likely to be conditioned for less than 15 hours per week. Such buildings are only likely to be found under Planning Use Class D1, *Non-residential institutions*, and then only associated with non-commercial activities such as village and church halls.

Is it appropriate to include c) as a building with low levels of heating? The problem is that there is no mechanism to require an improvement should the hours of use increase significantly. Consultees' views on this are particularly welcome.

3.6b In such situations, it is not reasonable to expect the entire building envelope to be insulated to the standard expected for more typical buildings. In such situations, no **TER/BER** calculation is required, but reasonable provision would be for every fixed building service that is installed to meet the energy efficiency standards set out in the *Non-Domestic Building Services Compliance Guide*¹. In addition, the building envelope should be insulated to a degree that is reasonable in the particular case. If some general heating is provided (case b) or c) above), then it would be reasonable that no part of the opaque fabric had a U-value worse than 0.7 W/m².K.

3.6c If a part of a building with low energy demand is partitioned off and heated normally (e.g. an office area in an unheated warehouse), the separately heated area should be treated as a separate “building” and the normal procedures for demonstrating compliance (including a **TER/BER** calculation) should be followed in respect of the enclosure.

¹ *Non-Domestic Building Services Compliance Guide* – see Volume 2, Chapter 7 of this consultation document.

- 3.6d If a building with low energy demand subsequently changes such that the space is generally conditioned, then this is likely to involve the initial provision or an increase in the installed capacity of a **fixed building service**. Such activities are covered by Regulation 17D. The guidance in ADL2B would require the building envelope to be upgraded and a consequential improvement to be made, a process that is likely to be much more expensive than incorporating suitable levels of insulation at the new-build stage. Alternatively, if the building shell was designed as a building with low energy demand and the first occupier of the building wanted to install (e.g.) heating, this would be a first fit-out, and a full **TER/BER** submission would then be required (see paragraph 3.2b).

NOTIFICATION OF WORK COVERED BY THE ENERGY EFFICIENCY REQUIREMENTS

- 3.10 In almost all cases of constructing new buildings other than **dwelling**s it will be necessary to notify a **BCB** in advance of any work starting except as set out in paragraphs 3.11 to 3.14 below.

Competent person self-certification schemes

- 3.11 It is not necessary to notify a **BCB** in advance of work which is covered by this Approved Document if that work is to be carried out by a person registered with a relevant competent person self-certification scheme listed in Schedule 2A to the Building Regulations. In order to join such a scheme a person must demonstrate his or her competence to carry out the type of work the scheme covers and also the ability to comply with all relevant requirements in the Building Regulations.
- 3.12 Where work is carried out by a person registered with a competent person scheme, regulation 16A of the Building Regulations and regulation 11A of the Building (Approved Inspectors etc) Regulations 2000 require that the occupier of the building be given, within 30 days of the completion of the work, a certificate confirming that the work complies fully with all applicable building regulation requirements. There is also a requirement that the **BCB** be given a notice of the work carried out, again within 30 days of the completion of the work. These certificates and notices are usually made available through the scheme operator.
- 3.13 **BCBs** are authorised to accept these certificates and notices as evidence of compliance with the requirements of the Building Regulations. However, local authority inspection and enforcement powers remain unaffected, although they are normally used only in response to a complaint that work does not comply.

- 3.14 A list of the schemes relating to energy efficiency in new buildings other than **dwelling**s which are currently authorised can be found at www.communities.gov.uk

MATERIALS AND WORKMANSHIP

- 3.15 Any building work which is subject to the requirements imposed by Schedule 1 to the Building Regulations should, in accordance with regulation 7, be carried out with proper materials and in a workmanlike manner.
- 3.16 You may show that you have complied with regulation 7 in a number of ways. These include demonstrating the appropriate use of:
- a product bearing CE marking in accordance with the Construction Products Directive (89/106/EC)² as amended by the CE Marking Directive (93/68/EC)³, the Low Voltage Directive (2006/95/EC)⁴ and the EMC Directive (2004/108/EC)⁵;
 - a product complying with an appropriate technical specification (as defined in those Directives mentioned above), a British Standard, or an alternative national technical specification of a Member State of the European Union or Turkey⁶, or of another State signatory to the Agreement on the European Economic Area (EEA) that provides an equivalent level of safety and protection;
 - a product covered by a national or European certificate issued by a European Technical Approval Issuing body, provided the conditions of use are in accordance with the terms of the certificate.
- 3.17 You will find further guidance in the Approved Document which specifically supports regulation 7 on materials and workmanship.

Independent certification schemes

- 3.18 There are many UK product certification schemes. Such schemes certify compliance with the requirements of a recognised document that is appropriate to the purpose for which the material is to be used. Materials which are not so certified may still conform to a relevant standard.

² As implemented by the Construction Products Regulations 1991 (SI 1991/1620).

³ As implemented by the Construction Products (Amendment) Regulations 1994 (SI 1994/3051).

⁴ As implemented by the Electrical Equipment (Safety) Regulations 1994 (SI 1994/3260).

⁵ As implemented by the Electromagnetic Compatibility Regulations 2006 (SI 2006/3418).

⁶ Decision No 1/95 of the EC-Turkey Association Council of 22 December 1995.

- 3.19 Many certification bodies that approve such schemes are accredited by the United Kingdom Accreditation Service (UKAS). [Such bodies can only issue certificates for the categories of product covered under the terms of their accreditation.](#)
- 3.20 **BCBs** may accept the certification of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Similarly, **BCBs** may accept the certification of the installation or maintenance of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Nonetheless, a **BCB** will wish to establish, in advance of the work, that any such scheme is adequate for the purposes of the Building Regulations. [In respect of the energy efficiency requirements, certificates confirming the results of CO₂ emission rate calculations and pressure testing are particularly relevant.](#)

Standards and technical specifications

- 3.21 Building regulations are made for specific purposes, including securing the health, safety, welfare and convenience of people in or about buildings; furthering the conservation of fuel and power; furthering the protection or enhancement of the environment; and facilitating sustainable development. Guidance contained in standards and technical approvals is relevant to the extent that it relates to those purposes. However, the guidance may also address other aspects of performance such as serviceability, or aspects which, although they relate to health and safety, are not covered by building regulations.
- 3.22 When an Approved Document makes reference to a named standard or document, the relevant version of the standard or document is the one listed at the end of the Approved Document. If this version has been revised or updated by the issuing standards body, the latest version may be used as a source of guidance provided it continues to address the relevant requirements of the Building Regulations. However, until the reference in the Approved Document is revised, the standard or document listed remains the approved source.
- 3.23 The appropriate use of a product that complies with a European Technical Approval as defined in the Construction Products Directive will meet the relevant requirements.
- 3.24 The Department intends to issue periodic amendments to its Approved Documents to reflect emerging harmonised European Standards. Where a national standard is to be replaced by a European harmonised standard, there will be a co-existence period during which either standard may be referred to. At the end of the coexistence period the national standard will be withdrawn.

THE WORKPLACE (HEALTH, SAFETY AND WELFARE) REGULATIONS 1992

- 3.25 The Workplace (Health, Safety and Welfare) Regulations 1992, as amended, apply to the common parts of flats and similar buildings if people such as cleaners, wardens and caretakers are employed to work in these common parts. These Regulations contain some requirements which affect building design. The main requirements are now covered by the Building Regulations, but for further information see *Workplace health, safety and welfare, Workplace (Health, Safety and Welfare) Regulations 1992, Approved Code of Practice and guidance*, HSE publication L24, 1996.
- 3.26 Where the requirements of the Building Regulations that are covered by this Approved Document do not apply to dwellings, the provisions may still be required in the situations described above in order to satisfy the Workplace Regulations.

DEMONSTRATING COMPLIANCE

- 3.28 In the Secretary of State's view, compliance with the **energy efficiency requirements** would be demonstrated by meeting the five separate criteria set out in the following paragraphs. [The compliance software will produce an output report that will assist **BCBs** check that compliance has been achieved.](#)

*The [output report](#) can benefit both developers and **BCBs**.*

- 3.28a [The general approach to achieving an appropriate solution is to follow the following strategic sequence:](#)
- a) [reduce the energy demands as much as practicable by minimising the rate of heat flow through the building envelope and from pipes, ducts and vessels; then](#)
 - b) [meet the remaining energy demands with high efficiency systems that are well controlled and properly commissioned; then](#)
 - c) [use a mix of energy supplies and/or renewable energy systems that deliver a low overall carbon impact; and finally](#)
 - d) [provide appropriate operating instructions and energy monitoring facilities, enabling occupiers to effectively manage their use of energy so as to reduce operating costs and environmental impact.](#)

[To emphasise that it is not just about CO₂ reduction.](#)

- 3.29 Criterion 1: [in accordance with regulation 17C](#), the predicted CO₂ emission rate for the building as constructed (the Building Emission Rate, **BER**) must not be greater than the Target CO₂ Emission Rate (**TER**) which is determined by following the procedures set out in paragraphs 4.1 to 4.6; and

This is required by regulation 17C – see paragraph 4.9.

The calculations required as part of the procedure used to show compliance with this criterion can also provide the information needed to prepare the Energy Performance Certificate required by regulation 17E of the Building Regulations and the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007 (SI 2007/991) as amended by the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) (Amendment) Regulations 2007 (SI 2007/1669).

To emphasise that Criterion 1 is a regulation and is therefore mandatory, whereas Criteria 2 to 5 are only guidance.

- 3.30 Criterion 2: the performance of the building fabric and the heating, hot water and fixed lighting systems should **achieve reasonable overall standards of energy efficiency following the procedure** set out in paragraphs 4.20 to 4.31b; and

This emphasises the purpose of Criterion 2.

- 3.31 Criterion 3: **demonstrate that** the building has appropriate passive control measures to limit solar gains. The guidance given in paragraphs 4.50 to 4.53d of this Approved Document provides a way of demonstrating that suitable provisions have been made; and

The purpose is to limit solar gains to reasonable levels during the summer period, in order to reduce the need for or installed capacity of air conditioning systems.

- 3.32 Criterion 4: the performance of the building, as built, should be consistent with the prediction made in the **BER**. The procedures described in Section 5 can be used to show this criterion has been met. **Extra credits will be given in the TER/DER calculation where builders provide robust evidence of quality assured procedures in the design and construction phases;** and

The use of “confidence factors” is intended to give impetus to improved quality and a narrowing of the gap between design intent and realised performance.

- 3.33 Criterion 5: the necessary provisions for enabling energy efficient operation of the building should be put in place. The procedures described in Section 6 can be used to show this criterion has been met.

Paragraph 3.33 addresses the requirement in Part L1(c).

“Special areas”

3.33a The following paragraphs describe some “special areas” that fall outside the normal five criteria, and give guidance on how reasonable provision for the conservation of fuel and power can be demonstrated.

Conservatories

3.33b If a **conservatory** is built as part of the new building, then the performance of the building should be assessed as if the conservatory were not there. The guidance in Approved Document L2B should be followed in respect of the construction of the **conservatory** itself.

*This means that the thermal separation between building and **conservatory** must be constructed to a standard comparable to the rest of the external envelope of the building.*

It is proposed that the exemption for conservatories be removed from Part L.

3.33c If any substantially glazed space forms an integral part of the building (i.e. there is no thermal separation and by definition the space is therefore not a **conservatory**), then the space should be included as part of the new building when checking against the five compliance criteria.

Swimming pool basins

3.33d Where a swimming pool basin is being provided as part of a building, the U-value of the basin (walls and floor) should achieve a U-value not worse than 0.25 W/m².K as calculated according to BS EN ISO 13370⁷

3.33e In terms of Criterion 1, the building 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.

⁷ BS EN ISO 13370 *Thermal performance of buildings – Heat transfer via the ground – Calculation methods.*

Section 4: Design standards

REGULATIONS 17A AND 17B

4.1 Regulations 17A, 17B and 17C of the Building Regulations implement Articles 3, 4 and 5 of the Energy Performance of Buildings Directive. Regulations 17A and 17B state that:

Methodology of calculation of the energy performance of buildings

17A.–(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 a numerical indicator of the amount of energy estimated to meet the different needs associated with a standardised use of the building; and

“operational rating” means a numerical indicator of the amount of energy consumed during the occupation of the building over a period of time.

Minimum energy performance requirements for buildings

17B.–The Secretary of State shall approve minimum energy performance requirements for new buildings, in the form of target CO₂ emission rates, which shall be based upon the methodology approved pursuant to regulation 17A.

Target carbon dioxide Emission Rate (TER)

4.2 The Target CO₂ Emission Rate (**TER**) is the minimum energy performance requirement for a new building approved by the Secretary of State in accordance with regulation 17B. It is expressed in terms of the mass of CO₂ emitted per year per square metre of the **total useful floor area** of the building (kg/m²/year).

4.3 The **TER** must be calculated using one of the calculation tools included in the methodology for calculating the energy performance of buildings approved by the Secretary of State pursuant to regulation 17A. Those tools include:

- a. the Simplified Building Energy Model (SBEM)⁸ for those buildings whose design features are capable of being adequately modelled by SBEM; or
- b. other software tools approved under the Notice of Approval⁹.

⁸ Simplified Building Energy Model (SBEM) User manual and software, available at www.2010ncm.bre.co.uk

⁹ *Notice of Approval of the methodology of calculation of the energy performance of buildings in England and Wales*, CLG, 2008.

- 4.4 From time to time further software may be approved. An up-to-date list can be found on the Department's website at www.communities.gov.uk
- 4.5 As part of the submission to a **BCB** (see paragraphs 4.10 to 4.11), the applicant must show that the software tool used is appropriate to the application.
- 4.6 The **TER** is established by using approved software to calculate the CO₂ emission rate from a notional building with specified properties as set out in the NCM Modelling Guide¹⁰.

The main change is that the notional building is now based on a set of parameters that deliver the targeted national improvement by approximately equalising the marginal abatement cost across all sectors. The impact of the chosen heating fuel is now allowed for by varying the heating system efficiency and the associated CO₂ emission factor according to the fuel used in the actual building. The envelope and system efficiency parameters are identical for all the fossil fuels. Biofuel and electric heat pumps use the same set of envelope parameters, but adopt different heating system efficiencies.

Note that this paragraph is based on the AD as it would appear if the aggregate 25% approach were adopted, since it involves a more significant change to the text than the flat 25% approach and we want consultees to be able to assess the impact of the possible change. If the flat 25% approach were adopted, the text would be very similar to the 2006 AD, except that after calculating the 2006 TER, that value would be reduced by a further 25% for all fuels.

CRITERION 1 – ACHIEVING AN ACCEPTABLE BUILDING CO₂ EMISSION RATE (BER)

- 4.9 Regulation 17C states that:

New buildings

17C. Where a building is erected, it shall not exceed the target CO₂ emission rate for the building that has been approved pursuant to regulation 17B.

Calculating the CO₂ emissions from the actual building

- 4.10 To demonstrate that the requirement in regulation 17C has been met, the actual building's **BER** must be no greater (no worse) than the **TER** calculated as set out in paragraphs 4.2 to 4.6.

¹⁰ *Changes to NCM – see Volume 2, Chapter 5 of this consultation document.*

- 4.11 The **BER** must be calculated using the same calculation tool as used for establishing the **TER**.
- a. The final calculation produced in accordance with regulation 20D must be based on the building as constructed, incorporating:
 - i. any changes to the performance specifications that have been made during construction; and
 - ii. the measured **air permeability**, ductwork leakage and fan performances as commissioned.

CO₂ emission rate calculations

- 4.12 Regulation 20D¹¹ of the Building Regulations and regulation 12D of the Building (Approved Inspectors) Regulations 2000 state:

20D.—(1) Subject to paragraph (4), where regulation 17C applies the person carrying out the work shall provide to the local authority a notice which specifies—

- a. the target CO₂ emission rate for the building; and
- b. the calculated CO₂ emission rate for the building as constructed.

(2) The notice shall be given to the local authority not later than five days after the work has been completed.

(3) A local authority is authorised to accept, as evidence that the requirements of regulation 17C would be satisfied if the building were constructed in accordance with an accompanying list of specifications, a certificate to that effect by an energy assessor as defined in regulation 17J who is accredited to produce such certificates for that category of building.

(4) Where such a certificate is given to the local authority—

- a. paragraph (1) does not apply; and
- b. the person carrying out the work shall provide to the local authority not later than five days after the work has been completed a notice which—
 - i. states whether the building has been constructed in accordance with the list of specifications which accompanied the certificate; and
 - ii. if it has not, lists any changes to the specifications to which the building has been constructed.

¹¹ There is a similar regulation (regulation 12D) in the Building (Approved Inspectors etc.) Regulations 2000 (SI 2000/2532) which applies when an approved inspector is the BCB.

It is proposed that the Regulations be amended to require a design stage TER/DER calculation as part of the plans submission – see paragraph 4.14.

- 4.13 Regulation 20D(2) means that the notice shall be given to the **BCB** not later than seven days after the final pressure test required by regulation 20B (and regulation 12B of the Approved Inspectors Regulations) is carried out (see paragraph 5.6).
- 4.14 As required by [amendments to the current Building Regulations, details to be confirmed] the builder shall carry out a preliminary calculation before construction starts based on plans and specifications and provide this to the **BCB** as part of the submission of plans. The results of these calculations and the associated data inputs should be provided to the **BCB**, along with the specification that corresponds to the claimed performance value. Given that for some non-domestic buildings, construction may start before the design is finalised, the precise timing of when the information should be submitted should be a matter of negotiation between the client’s design team and the **BCB**. However the general principle is that the **BCB** should have available the specification of the principal elements of the building envelope and the fixed building services in advance of their construction/installation so that the appropriate checks can be made.

*The calculation will give an indication of whether a design is compliant and will produce a list of those features of the design that are critical to achieving compliance. This “exceptions list” can be used to prioritise the risk-based inspection of the dwelling as part of confirming compliance with regulation 17C. The specification will assist the **BCB** to identify that what is built aligns with the claimed performance.*

This is an important element in the proposals to improve levels of compliance. Through having the specification, BCBs can check that what is actually being installed is what was claimed. They can check (e.g.) the thickness and type of insulation more easily than confirming that a wall has a specified U-value.

- 4.15 In order to determine the **BER**, the CO₂ emission factors shall be as specified in the paper published by DECC¹².

¹² STP09/CO201 Revised emission factors for the National Calculation Methodologies, BRE, 2009, available at www.bre.co.uk/sap2009

- 4.16 When systems are capable of being fired by more than one fuel, then:
- a. where a biomass heating appliance is supplemented by an alternative appliance (e.g. gas), the CO₂ emission factor for the overall heating system should be based on a weighted average for the two fuels based on the anticipated usage of those fuels. The **BER** submission should be accompanied by a report, signed by a suitably qualified person, detailing how the combined emission factor has been derived;
 - b. where the same appliance is capable of burning both biomass fuel and fossil fuel, the CO₂ emission factor for dual fuel appliances should be used, except where the building is in a smoke control area when the anthracite figure should be used;
 - c. in all other cases, the fuel with the highest CO₂ emission factor should be used.

This option is to cover dual fuel systems, where the choice of fuel actually used depends on prevailing market prices.

- 4.17 If thermal energy is supplied from a district or community heating or cooling system, emission factors should be determined by considering the particular details of the scheme. Calculations should take account of the annual average performance of the whole system (i.e. the distribution circuits and all the heat generating plant, including any CHP, and any waste heat recovery or heat dumping). The electricity generated by any CHP or trigeneration scheme is always credited at an emission factor equal to the grid average. CO₂ emissions associated with the thermal energy streams of a trigeneration scheme should be attributed in proportion to the output energy streams. The **BER** submission should be accompanied by a report, signed by a suitably qualified person, detailing how the emission factors have been derived.

*This means that if a trigeneration scheme burns F kWh of input fuel to produce E kWh of electricity, H kWh of useful heat and C kWh of useful cooling, the emission factor for the heat and cooling output should both be taken as $1/(H+C) * (F * CO_{2F} - E * CO_{2E})$ where CO_{2F} is the emission factor for the input fuel, and CO_{2E} the factor for grid electricity.*

See NCM Modelling Guide at www.communities.gov.uk and Volume 2, Chapter 5 of this consultation document.

Achieving the TER

4.18 Certain management features offer improved energy efficiency in practice. Where these management features are provided in the actual building, the **BER** can be reduced by an amount equal to the product of the factor given in Table 2 and the CO₂ emissions for the system(s) to which the feature is applied.

*For example, if the CO₂ emissions due to electrical energy consumption were 70 kgCO₂/(m².year) without power factor correction, the provision of correction equipment to achieve a power factor of 0.95 would enable the **BER** to be reduced by $70 \times 0.025 = 1.75 \text{ kgCO}_2/(\text{m}^2.\text{year})$.*

Feature	Adjustment factor
Automatic monitoring and targeting with alarms for out of range values ¹	0.050
Power factor correction to achieve a whole-building power factor > 0.90 ²	0.010
Power factor correction to achieve a whole building power factor > 0.95 ²	0.025
Notes: ¹ Automatic monitoring and targeting with alarms for out of range values means a complete installation that measures, records, transmits, analyses, reports and communicates meaningful energy management information to enable the operator to manage the energy it uses. ² The power factor adjustment can only be taken if the whole building power factor is corrected to the level stated. The two levels of power factor correction are alternative values, not additive.	

4.19 Provided the building satisfies the limits on design flexibility as set out in Criterion 2, the compliance procedure allows the designer full flexibility to achieve the TER utilising fabric and system measures and the integration of low and zero carbon (LZC) technologies in whatever mix is appropriate to the scheme. The approved compliance tools include appropriate algorithms that enable the designer to assess the role LZC technologies (including local renewable and low-carbon schemes driven by planning requirements¹³) can play in achieving the TER.

4.19a In order to facilitate incorporation of improvements in system efficiencies and the integration with low and zero carbon technologies, the designer should:

- a) consider adopting heating and cooling systems that use low distribution temperatures; and

¹³ See the Planning Policy Statement: *Planning and Climate Change* and its supporting practice guidance at www.communities.gov.uk/planningandbuilding/planning/planningpolicyguidance/planningpolicystatements/planningpolicystatements/ppscclimatechange/

- b) where multiple systems serve the same end use, organise the control strategies such that priority is given to the least carbon intensive option; and

For example, where a solar hot water system is available, the controls should be arranged so that the best use is made of the available solar energy.

- c) consider making the building “LZC ready” by providing appropriate facilities at the construction stage so that it will be much easier and cheaper to add the LZC technology at a later date.

4.19b Similarly, the designer should consider the potential impact of future climate change on the performance of the building. This might include giving consideration to how a cooling system might be provided at some future point.

Special considerations

Modular and portable buildings

4.19c Special considerations apply to modular and portable buildings. The following paragraphs detail what is considered as reasonable provision for a variety of different circumstances.

The delivery of an existing module to a new site is considered to be a new building as far as the Building Regulations are concerned. In that context, it is not always appropriate to expect such a relocated unit to meet the new build standards set out in this Approved Document, especially as the embodied energy in an existing module is retained, a benefit that compensates for small differences in operating energy demand. Further, portable buildings are often “distress purchases”, and the constraints imposed by the time in which a working building must be delivered mean that additional considerations apply.

Modular and portable buildings with a planned life of more than 2 years

4.19d Compliance with the energy efficiency regulations should be demonstrated by showing that satisfactory performance has been achieved against each of the five compliance criteria set out in this Approved Document. However, if more than 70% of the external envelope of the building is to be created from sub-assemblies manufactured prior to the date this Approved Document comes into force, the Target Emissions Rate should be adjusted by the factor set out in Table 3.

Table 3: TER multiplying factor for modular and portable buildings with a planned life of more than 2 years

Date of manufacture of 70% of modules making up the external envelope	TER multiplying factor
Post <<coming-into-force (cif) date>>	1.00
April 2006 – <<cif date>>	1.33
April 2002 – March 2006	1.75

If the units are to be refurbished as part of the process, then the guidance in ADL2B should be followed in terms of the standards to be achieved, e.g. for replacement windows and new lighting. This means that the standard achieved would be in advance of the minimum standards set out above.

This means that a specific TER/BER calculation will be done for each building, thereby complying with regulation 17C. It is felt that allowing buildings that have a significant life to be created from sub-assemblies built before 2002 would be unreasonable given the drive to reduce CO₂ emissions. Any pre-2002 sub-assemblies should be upgraded or could be used for short term hire (see para 4.19f).

Modular and portable buildings with a planned life of less than 2 years

4.19e Portable buildings with an intended service life of less than 2 years are often “distress purchases” (e.g. following a fire), and the buildings must be up and operational in a matter of days. In such cases, different arrangements for demonstrating compliance with regulation 17C apply, as set out in the following paragraph. An example of the evidence that the planned life is less than 2 years would be the hire agreement for the unit.

Note that a building is exempt from the requirements of the Building Regulations if:

- a) *the intended life of the building is not more than 28 days, or*
- b) *it is detached, is less than 30 m² floor area, contains no sleeping accommodation, and is constructed substantially of non-combustible material, and no part of the building is less than 1 m from the boundary of its curtilage.*

4.19f In the case of a modular or portable building intended to be sited for less than two years, a **TER/BER** calculation specific to the actual building is not required. However, in order to satisfy the requirements of regulation 17C, a notice shall be given to the local authority specifying the **TER** and the **BER** for a standard generic configuration of the module types used in the actual building, along with written confirmation from the supplier that the modules as provided meet or exceed the elemental energy standards of the modules used in the configuration on which the calculation was based. Satisfactory performance would be achieved if the **BER** was no worse than the **TER** adjusted by the factor set out in Table 4.

Table 4: TER multiplying factor for modular and portable buildings with a planned life of less than 2 years

Date of manufacture of 70% of modules making up the external envelope	TER multiplying factor
Post <<cif date>>	1.00
April 2006 – <<cif date>>	1.33
April 2002 – March 2006	1.75
Pre April 2002	2.35

If a module is refurbished between hires, then the guidance in ADL2B should be followed in terms of the standards to be achieved, e.g. for replacement windows and new lighting. This means that the standard achieved would be in advance of the minimum standards set out above.

Shell and core developments

4.19g If a building is offered to the market for sale or let as a shell for subsequent specific **fit-out** by the incoming occupier, the developer should demonstrate via the **TER/BER** submission how the building shell as offered could meet the **energy efficiency requirements**. For those parts of the building where certain systems are not installed at the point the building is to be offered to the market, the model that is used to derive the **BER** will have to assume efficiencies for those services that will be installed as part of the first fit-out. The specification provided to the **BCB** (see paragraph 4.14) should identify which services have not been provided in the base build, and the efficiency values assumed for each such system in comparison with the efficiencies for that system as taken for the notional building.

This will enable prospective tenants to understand the relative energy efficiency standards of the new shell and core relative to other opportunities that may be available in the market.

4.19h When an incoming occupier does a first **fit-out** on all or part of the building through the provision or extension of any of the fixed services for heating, hot water, air conditioning or mechanical ventilation, then a revised **TER/BER** submission should be made to the **BCB** to demonstrate compliance for the part of the building covered by the **fit-out** work. This submission should be based on the building shell as constructed and the fixed building services as actually installed. If the fit-out work does not include the provision or extension of any of the fixed services for heating, hot water, air conditioning or mechanical ventilation, then reasonable provision would be to demonstrate that any lighting systems that are installed are at least as efficient as those assumed in the shell developer's initial submission.

Since the fit-out is specific to the needs of the particular tenant and is, by definition, uniquely controlled by him for his benefit, this is creating a new "part designed or altered for separate use", and under regulation 17E a new EPC is required for that part of the physical building covered by the fit-out.

CRITERION 2: LIMITS ON DESIGN FLEXIBILITY

4.20 Whilst the approach to complying with Criterion 1 allows considerable design flexibility, paragraph L1(a)(i) of Schedule 1 to the Building Regulations requires that reasonable provision should 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** and effective controls be provided.

4.20a Reasonable provision for showing that the requirement has been satisfied is to demonstrate that the fabric elements and the **fixed building services** all satisfy minimum energy efficiency standards as specified in the following paragraphs.

*Note that in order to satisfy the **TER**, the building specification will need to be considerably better than these minima in many aspects of the design.*

Fabric standards

4.22 U-values shall be calculated using the methods and conventions as set out in BR 443¹⁴.

4.23 Table 5 sets out the worst acceptable standards for fabric properties. The stated value represents the area weighted average value for all elements of that type.

The fabric longstops have been left unchanged from the values established in 2006. This is because improving plane element U-values may not always be the most cost effective way to improve energy efficiency, particularly in heat gain dominated buildings, where better system efficiency improvements can have a big impact.

¹⁴ BR 443 Conventions for U-value calculations, BRE, 2006.

Table 5: Limiting fabric parameters	
Roof	0.25 W/m ² .K
Wall	0.35 W/m ² .K
Floor	0.25 W/m ² .K
Windows, roof windows, rooflights, curtain walling & pedestrian doors	2.2 W/m ² .K ^{1,2,3}
Vehicle access and similar large doors	1.5 W/m ² .K
High usage entrance doors	3.5 W/m ² .K
Roof ventilators (inc. smoke vents)	3.5 W/m ² .K
Air permeability	10.0 m ³ /(h.m ²) at 50 Pa
<p>¹ Excluding display windows and similar glazing. There is no limit on design flexibility for these exclusions but their impact on CO₂ emissions must be taken into account in calculations.</p> <p>² The U-values for roof windows and rooflights in this table are based on the U-value having been assessed with the roof window or rooflight 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.</p> <p>³ In buildings with high internal heat gains, a less demanding area weighted average U-value for the glazing may be an appropriate way of reducing overall CO₂ emissions and hence the BER. If this case can be made, then the average U-value for windows can be relaxed from the values given above. However values should be no worse than 2.7 W/m².K.</p>	

Approved Document C gives limiting values for individual elements to minimise condensation risk.

<text deleted>.

- 4.24 When comparing against the values in Table 5, the U-value of a window, roof window or rooflight or personnel door can be taken as the value for either:
- the smaller of the two standard windows defined in BS EN 14351-1¹⁵;
 - the standard configuration set out in BR 443; or
 - the particular size and configuration of the actual unit. In either case, the U-value should be determined with the unit in the vertical plane.

¹⁵ EN 14351-1 *Windows and doors – Product standard, performance characteristics, 2006.*

For domestic type construction, SAP 2009¹⁶ Table 6e gives values for different window configurations that can be used in the absence of test data or calculated values.

<text deleted>.

Design limits for building services

4.28 This section sets out the design limits for **fixed building services** to meet the requirements of Part L1(b).

Controls

- 4.29 Systems should be provided with appropriate controls to enable the achievement of reasonable standards of energy efficiency in use. In normal circumstances, the following features would be appropriate for heating, ventilation and air conditioning system controls:
- a. the systems should be sub-divided into separate control zones to correspond to each area of the building that has a significantly different solar exposure, or pattern or type of use; and
 - b. each separate control zone should be capable of independent timing and temperature control and, where appropriate, ventilation and air recirculation rate; and
 - c. the provision of the service should respond to the requirements of the space it serves. If both heating and cooling are provided, they should be controlled so as not to operate simultaneously; and
 - d. central plant should only operate as and when the zone systems require it. The default condition should be off.
- 4.30 In addition to these general control provisions, the systems should meet specific control and efficiency standards as set out in the paragraphs below.

System efficiencies

4.30a Each **fixed building service** should be at least as efficient as the worst acceptable value for the particular type of appliance as set out in the *Non-Domestic Building Services Compliance Guide*¹⁶. If the type of appliance is not covered by the Guide, then reasonable provision would be to demonstrate that the proposed system is not less efficient than a comparable system that is covered by the Guide.

To not inhibit innovation.

¹⁶ SAP 2009 – see DECC consultation at www.bre.co.uk/sap2009

4.30b The efficiency claimed for the **fixed building service** should be based on the appropriate test standard as set out in the NDBSCG and the test data should be certified by a notified body. It would be reasonable for **BCBs** to accept such data at face value. In the absence of such quality assured data, the **BCB** should satisfy themselves that the claimed performance is justified.

Energy meters

4.31 Reasonable provision for energy meters would be install energy metering systems that enable:

- a. at least 90% of the estimated annual energy consumption of each fuel to be assigned to the various end-use categories (heating, lighting etc.). Detailed guidance on how this can be achieved is given in CIBSE TM 39¹⁷; and
- b. the output of any renewable energy system to be separately monitored; and
- c. in buildings with a total useful floor area greater than 1000 m², automatic meter reading and data collection facilities.

4.31a The metering provisions should be designed such as to facilitate the benchmarking of energy performance as set out in TM 46¹⁸.

Centralised switching of appliances

4.31b Consideration should be given to the provision of centralised switches to allow the facilities manager to switch off appliances when they are not needed (e.g. overnight and at weekends).

A centralised switch would be more reliable than depending on each individual occupant to switch off their (e.g.) computer.

Such provision cannot be recognised in the BER calculation because appliances are not fixed building services, and therefore their energy demand sits outside the TER/BER process. Consultees' views on the merits of such a provision would be welcome.

<text deleted>.

CRITERION 3: LIMITING THE EFFECTS OF SOLAR GAINS IN SUMMER

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

<text deleted>.

¹⁷ TM 39 *Building energy metering*, CIBSE, 2006.

¹⁸ TM 46 *Energy benchmarks*, CIBSE, 2008.

- 4.53a The following guidance applies to all buildings, irrespective of whether they are air conditioned or not. The intention is to limit solar gains during the summer period to either:
- a) reduce the need for air conditioning; or
 - b) reduce the installed capacity of any air conditioning system that is installed.
- 4.53b If the criterion set out below is satisfied in the context of a naturally ventilated building, this is NOT evidence that the internal environment of the building will be satisfactory, since many factors that are not covered by the compliance assessment procedure will have a bearing on the incidence of overheating (incidental gains, thermal capacity, ventilation provisions etc). Therefore the developer must work with the design team to specify what constitutes an acceptable indoor environment in the particular case, and carry out the necessary design assessments to develop solutions that meet the agreed brief.
- 4.53c For the purposes of Part L, reasonable provision for limiting solar gain through the building fabric would be demonstrated by showing that, for each occupied space in the building, the solar gains through the glazing aggregated over the period from April to September inclusive are no greater than would occur through one of the following reference glazing systems with a defined total solar energy transmittance (g-value) calculated according to BS EN 410¹⁹:
- a) for every space that is predominantly side lit, the reference case is an east facing façade of the same total area that is 40% glazed as viewed from the inside out and having window units that have a framing factor of 10% and a solar energy transmittance (g-value) of 0.46;
 - b) for every space that is predominantly top lit, the reference case is a horizontal roof of the same total area that is 15% glazed as viewed from the inside out and having rooflights that have a framing factor of 25% and solar energy transmittance (g-value) of 0.46.
- 4.53d For the purpose of this specific guidance, an occupied space means a space that is intended to be occupied by the same person for a substantial part of the day. This excludes circulation spaces, and other areas of transient occupancy like toilets, as well as spaces that are not intended for occupation (e.g. display windows).

¹⁹ BS EN 410 *Glass in building: Determination of luminous and solar characteristics of glazing*, BSI, 1998.

Section 5: Quality of construction and commissioning

CRITERION 4 – BUILDING PERFORMANCE CONSISTENT WITH BER

5.1 Buildings should be constructed and equipped so that performance is consistent with the predicted **BER**. As indicated in paragraph 4.11, a final calculation of the **BER** is required to take account of:

- a. any changes in performance between design and construction; and
- b. the achieved air permeability, ductwork leakage and commissioned fan performance.

*The following paragraphs in this section set out what in normal circumstances would be reasonable provision to ensure that the actual performance of the building is consistent with the **BER**.*

*The results referred to in paragraph 4.14 would assist **BCBs** in checking that the key features of the design are included as specified during the construction process.*

Building fabric

5.2 The building fabric should be constructed to a reasonable quality so that:

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

Continuity of insulation

5.3 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.

5.3b Significant reductions in thermal performance can occur where the air barrier and the insulation layer are not contiguous and the cavity between them is subject to air movement. To avoid this problem, either the insulation layer should be contiguous with the air barrier at all points in the building envelope, or the space between them should be filled with solid material such as in a masonry wall.

5.4 Linear thermal transmittances and temperature factors should be calculated following the guidance set out in BR 497²⁰. Reasonable provision would be to demonstrate that the specified details deliver a level of performance no worse than the standards set out in BRE IP 1/06²¹.

<text deleted>.

5.5a Ways of demonstrating that reasonable provision has been made are:

- a) to adopt an accredited construction details approach²². The details published via such scheme(s) have accredited linear thermal transmittance values associated with them, and these values can be used directly in the **BER** calculation;

Such scheme(s) also accredit details in terms of buildability, and have an associated quality assurance regime scheme that inspects a sample of sites to confirm that the details are being implemented correctly.

- b) to use the builder's own details. In this case, the linear thermal transmittances should be calculated by a person with suitable expertise and experience following the guidance set out in BR 497. When used in the **BER** calculation, the values so calculated should be increased by 25% because there is no independent assessment of robustness, and no historical evidence that the expected performance will be realised in practice. To assist with buildability, builders following this route must also provide a process flow sequence, indicating the way in which the detail should be constructed.

Consultees' views on the appropriateness of the proposed 25% margin would be particularly welcome. CLG would also welcome independent scheme(s) whereby modellers of thermal bridge performance could be formally accredited.

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. Builders following this route will inevitably add to the burden of checking required of the BCB. Possible changes to the local authority building control charging regime²³ could mean that adopting this route may attract higher building control fees than the alternative approaches.

²⁰ BR 497 Conventions for calculating linear thermal transmittance and temperature factors, BRE 2007.

²¹ IP 1/06 Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings, BRE, 2006.

²² For details of this approach, see Volume 1, Chapter 3 of this consultation paper.

²³ See separate CLG consultation on building control charges at www.communities.gov.uk/consultations

- c) to use unaccredited details, with no specific quantification of the thermal bridge values. In such cases, the generic linear thermal bridge values as given in IP 1/06 increased by 50% must be used in the **BER** calculation.

5.5b The alternative approaches a) and b) above are not mutually exclusive. For example, a builder could use accredited construction details for the majority of the junctions, but use a bespoke detail for (e.g.) the window head. In this case, the 25% margin would apply only to the thermal transmittance of the window head detail.

Air permeability and pressure testing

5.6 In order to demonstrate that the specified **air permeability** has been achieved, Regulation 20B states:

- 20B.–(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 17C 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 British Institute of Non-destructive Testing 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.

- 5.7 The approved circumstances under which the Secretary of State requires pressure testing to be carried out are set out in paragraph 5.9.
- 5.8 The approved procedure for pressure testing is given in the ATTMA publication *Measuring air permeability of building envelopes*²⁴, and specifically, the method that tests the building envelope. The manner approved for recording the results and the data on which they are based is given in Section 4 of that document.

Note that the main change arising from the change in the preferred test method is that trickle ventilators should now be sealed rather than just closed.

- 5.9 All buildings that are not **dwelling**s (including extensions which are being treated as new buildings for the purposes of complying with Part L) must be subject to pressure testing, with the following exceptions:
- a. Buildings less than 500 m² total useful floor area; in this case the developer may choose to avoid the need for a pressure test provided that the **air permeability** used in the calculation of the **BER** is taken as 15 m³/(h.m²) at 50 Pa.

*Compensating improvements in other elements of the building fabric and building services will be needed to keep the **BER** no worse than the **TER**.*

- b. A factory-made modular building of less than 500 m² floor area, which has a planned life of less than two years, and where no site assembly work is needed other than making linkages between standard modules using standard link details. Compliance with regulation 20B can be demonstrated by giving a notice to the local authority confirming that the building as installed conforms to one of the standard configurations of modules and link details for which the installer has pressure test data from a minimum of five in-situ measurements incorporating the same module types and link details as utilised in the actual building. The test data must be certified by an approved pressure testing firm, and the results must indicate that the average test result is better than the **design air permeability** as specified in the **BER** calculation by not less than 1.0 m³/(h.m²) at 50 Pa.
- c. Large extensions (whose compliance with Part L is being assessed as if they were new buildings – see Approved Document L2B) where sealing off the extension from the existing building is impractical. The ATTMA publication gives guidance both on how extensions can be tested and on situations where pressure tests are inappropriate. Where it is agreed with the **BCB** that testing is impractical, the extension should be treated as a large, complex building, with the guidance in paragraph 5.9d applying.

²⁴ *Measuring air permeability of building envelopes*, ATTMA, 2006. A new edition will be published to reflect the proposed changes to the test method (see paragraph 5.8 and commentary).

- d. Large complex buildings, where due to building size or complexity it may be impractical to carry out pressure testing of the whole building. The ATTMA publication indicates those situations where such considerations might apply. Before adopting this approach developers must produce in advance of construction work in accordance with the approved procedure a detailed justification of why pressure testing is impractical. This should be endorsed by a suitably qualified person such as a competent person approved for pressure testing. In such cases, a way of showing compliance would be to appoint a suitably qualified person to undertake a detailed programme of design development, component testing and site supervision to give confidence that a continuous air barrier will be achieved. It would not be reasonable to claim air permeability better than $5.0 \text{ m}^3/(\text{h.m}^2)$ at 50 Pa has been achieved.

One example of a suitably qualified person would be an ATTMA member. The $5.0 \text{ m}^3/(\text{h.m}^2)$ at 50 Pa limit has been set because at better standards the actual level of performance becomes too vulnerable to single point defects in the air barrier.

- e. Compartmentalised buildings; where buildings are compartmentalised into self-contained units with no internal connections it may be impractical to carry out whole building pressure tests. In such cases reasonable provision would be to carry out a pressure test on a representative area of the building as detailed in the ATTMA guidance. In the event of a test failure, the provisions of paragraphs 5.10 and 5.11 would apply, but it would be reasonable to carry out a further test on another representative area to confirm that the expected standard is achieved in all parts of the building.

5.10 Compliance with the requirement in Paragraph L1(a)(i) would be demonstrated if:

- a. the measured **air permeability** is not worse than the **limiting value of $10 \text{ m}^3/(\text{h.m}^2)$ at 50 Pa**; and
- b. the **BER** calculated using the measured **air permeability** is not worse than the **TER**.

*If it proves impractical to meet the **design air permeability**, any shortfall must be compensated through improvements to subsequent fit-out activities. Builders may therefore wish to schedule pressure tests early enough to facilitate remedial work on the building fabric, e.g. before false ceilings are up*

Consequences of failing a pressure test

- 5.11 If satisfactory performance is not achieved, then remedial measures should be carried out on the building and new tests carried out until the building achieves the criteria set out in paragraph 5.10.

*If the measured **air permeability** on retest is greater than the **design air permeability** but less than the limiting value of $10 \text{ m}^3/(\text{h} \cdot \text{m}^2)$ then other improvements may be required to achieve the **TER**. This means that builders would be unwise to claim a **design air permeability** better than 10 unless they are confident of achieving the improved value.*

COMMISSIONING OF THE BUILDING SERVICES SYSTEMS

- 5.12 Paragraph L1(b)(iii) of Schedule 1 to the Building Regulations imposes a requirement that **fixed building services** are 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 20C states:

20C Commissioning

- (1) 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.
- (2) Where this regulation applies the person carrying out the work shall, for the purpose of ensuring compliance with paragraph L1(b) of Schedule 1, 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.
- (3) The notice shall be given to the local authority—
 - (a) not later than the date on which the notice required by regulation 15(4) is required to be given; or
 - (b) where that regulation does not apply, not more than 30 days after completion of the work.

- 5.14 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 ventilation 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.

- 5.15 Where **commissioning** is carried out it must be done in accordance with procedures approved by the Secretary of State comprising:
- a. the CIBSE Commissioning Code M: *Commissioning management*²⁵; and

*This provides guidance on the overall process and includes a schedule of all the relevant guidance documents relating to the **commissioning** of specific building services systems.*
 - b. the procedures for leakage testing of ductwork given in paragraphs 5.23 and 5.24.
- 5.15a Reasonable provision would be to prepare a commissioning plan, identifying the systems that need to be tested and the tests that will be carried out. This should be provided with the design stage **TER/BER** calculation so that the **BCB** can check the **commissioning** is being done as the work proceeds
- 5.16 **Commissioning** must be carried out in such a way as not to prejudice compliance with any applicable health and safety requirements.
- 5.17 **Commissioning** is often carried out by the person who installs the system. Sometimes it may be carried out by a subcontractor or even by a specialist firm. It is important that whoever carries it out follows the relevant approved procedure.

Notice of Completion

- 5.18 The Building Regulations (regulation 20C(2)) and the Building (Approved Inspectors etc) Regulations (regulation 12C(2)) require that a notice be given to the relevant **BCB** that **commissioning** has been carried out according to a procedure approved by the Secretary of State.
- 5.19 The notice should include a declaration confirming that:
- a. a commissioning plan has been followed so that every system has been inspected and commissioned in an appropriate sequence and to a reasonable standard; and
 - b. the results of tests confirm that the performance is reasonably in accordance with the actual building design, including written commentaries where excursions are proposed to be accepted.

²⁵ CIBSE Code M: *Commissioning management*, CIBSE, 2003.

*It would be helpful to **BCBs** if such declarations were to be signed by someone suitably qualified by relevant training and experience. A way of achieving this would be to employ a member of the Commissioning Specialists Association or the Commissioning Group of the HVCA in respect of HVAC systems, or a member of the Lighting Industry Commissioning Scheme in respect of fixed internal or external lighting.*

- 5.20 Where a building notice or full plans have been given to a local authority the notice should be given 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 (see paragraphs 3.10 to 3.14), it must be given within 30 days.
- 5.21 Where an approved inspector is the **BCB** the notice should generally be given within 5 days of the completion of the **commissioning** work. However, where the work is carried out by a person registered with a competent person scheme (see paragraph 3.10 to 3.14) 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.
- 5.22 Where the **BCB** does not receive the notice within the required period, the **BCB** cannot be reasonably satisfied that Part L has been complied with and consequently is unlikely to be able to give a completion/final certificate.

Air leakage testing of ductwork

- 5.23 Ductwork leakage testing should be carried out in accordance with the procedures set out in HVCA DW/143²⁶ on systems served by fans with a design flow rate greater than 1 m³/s and for those sections of ductwork where:
- a. the pressure class is such that DW/143 recommends testing; or
 - b. the **BER** calculation assumes a leakage rate for a given section of ductwork that is better than the standard for its particular pressure class. In such cases, any low pressure ductwork should be tested using the DW/143 testing provisions for medium pressure ductwork. The pressure classes are set out in Table 6.

*DW/143 does not call for any testing of low pressure ductwork. However, where the builder is claiming the low pressure ductwork will be less leaky than the normal low pressure class allowance to achieve an improved **BER**, this better standard should be demonstrated by testing using the procedures set out for medium pressure ductwork.*

²⁶ DW/143 A Practical Guide to Ductwork Leakage Testing, HVCA, 2000.

Table 6: Ductwork pressure classes

Pressure class	Design static pressure (Pa)		Maximum air velocity (m/s)	Air leakage limit (l/(s.m ²) of duct surface area)
	Maximum positive	Maximum negative		
Low pressure (class A)	500	500	10	0.027 $\Delta P^{0.65}$
Low pressure (class B)	1000	750	20	0.009 $\Delta P^{0.65}$
Low pressure (class C)	2000	750	40	0.003 $\Delta P^{0.65}$

Membership of the HVCA specialist ductwork group or the Association of Ductwork Contractors and Allied Services could be a way of demonstrating suitable qualifications for this testing work.

- 5.24 If a ductwork system fails to meet the leakage standard, remedial work should be carried out as necessary to achieve satisfactory performance in re-tests and further ductwork sections should be tested as set out in DW/143.

Section 6: Providing information

CRITERION 5 – PROVISIONS FOR ENERGY EFFICIENT OPERATION OF THE BUILDING

- 6.1 In accordance with paragraph L1(c) of Schedule 1, the owner of the building 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.

Building log book

- 6.2 A way of showing compliance with the requirement would be to produce information following the guidance in CIBSE TM 31 Building Log Book Toolkit²⁷. The information should be presented in templates as or similar to those in the TM. The information could draw on or refer to information available as part of other documentation, such as the Operation and Maintenance Manuals and the Health and Safety file required by the CDM Regulations.
- 6.3 The data used to calculate the **TER** and the **BER** should be included in the log book. *The occupier should also be provided with the recommendations report generated in parallel with the “on-construction” Energy Performance Certificate. This will inform the occupier how the energy performance of the building might be further improved.*

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

²⁷ TM 31 *Building log book toolkit*, CIBSE, 2006.

Section 7: Model designs

- 7.1 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 achieve compliant overall performance within certain constraints. The construction industry may develop model designs for this purpose and make them available on the Internet at: www.modeldesigns.info
- 7.2 It will still be necessary to demonstrate compliance in the particular case by going through the procedures described in paragraphs 3.28 to 3.33.

Volume 2, Chapter 4

Proposed Approved Document L2B 2010 Edition

Approved Document L2B (2010)

Introduction

- 1 This document contains the proposed text of the 2010 Approved Document L2B: *Conservation of fuel and power in existing buildings other than dwellings* (ADL2B), and is based on the Approved Document issued for consultation in 2008. The style and formatting of that consultation draft were strongly supported by consultees, and so have been retained for this consultation.
- 2 The regulatory guidance is shown in normal font, but the [proposed amendments to the 2008 consultation text are shown in blue](#). Places where paragraphs have been deleted are shown by *<text deleted>*. To facilitate comparison with the 2008 consultation text, we have retained the same paragraph numbers as that version; where new paragraphs have been inserted, these have been given letter suffixes. Where paragraphs have been deleted, subsequent paragraphs have not been renumbered. A complete revision of the numbering will be carried out when documents are finally published.
- 3 As with the 2006 editions, *commentary text is included to help understanding and to provide pointers to useful information, but is not part of the technical guidance. This is shown in italics*. Finally, *some further text has been added as explanations of the proposed changes. These are shown in plum italicised text* and are only included to assist the consultation process.
- 4 Please note that where changes to the Regulations are proposed, changes to the legal text have not been drafted. In these instances, the intent of the proposals is summarised in the explanatory text.

Main changes in the 2010 edition

- 5 The main strategic changes to ADL2B proposed are:
 - emphasise the distinction between requirements set out in the Building Regulations 2000 and guidance as set out in the AD;
 - remove the exemptions from the energy efficiency requirements (regulations 9(3) to 9(6)), but include specific guidance on what is reasonable provision with respect to the building work currently listed there (e.g. in historic buildings, buildings with low levels of heating);

- clarify that the energy efficiency requirements apply not just to spaces that use energy for the purposes of providing human comfort, but to any building space where energy is used to condition the indoor climate (e.g. computer rooms, cold stores etc);
- de-exempt conservatories from the need to comply with Part L;
- revise the definition of renovation;
- define standards for swimming pool basins in buildings;
- revise guidance on the first fit-out of shell and core developments;
- raise standards generally.

Additional clarifications are given in the commentary accompanying the proposed changes.

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Section 1: Introduction

WHAT IS AN APPROVED DOCUMENT?

- 1.1 This document has been approved and issued by the Secretary of State to provide practical guidance on ways of complying with the **energy efficiency requirements** (see Section 2) and regulation 7 of the Building Regulations 2000 (SI 2000/2531) for England and Wales, as amended. The Building Regulations 2000 are referred to throughout the remainder of this Document as “the Building Regulations”.
- 1.2 The intention of issuing Approved Documents is to provide guidance about compliance with specific aspects of building regulations in some of the more common building situations. They set out what, in ordinary circumstances, would be accepted as reasonable provision for compliance with the relevant requirement(s) of building regulations to which they refer.
- 1.3 If guidance in an Approved Document is followed there will be a presumption of compliance with the requirement(s) covered by the guidance. However, this presumption can be overturned, so simply following guidance does not guarantee compliance; *for example, if the particular case is unusual in some way, then “normal” guidance may not be applicable.* It is also important to note that there may well be other ways of achieving compliance with the requirements. **There is therefore no obligation to adopt any particular solution contained in this Approved Document if you would prefer to meet the relevant requirement in some other way. Persons intending to carry out building work should always check with their building control body, either the local authority or an approved inspector, that their proposals comply with building regulations.**
 - 1.3a It is important to note that this Approved Document, as well as containing guidance, also contains extracts from the Regulations. Such regulatory text must be complied with as stated. For example, the requirement that the **fixed building services** must be commissioned (Regulation 20C) is a regulatory requirement. There is therefore no flexibility to ignore this requirement; neither can compliance with this particular regulation be demonstrated via any route other than that set out in Regulation 20C.

To emphasise the important distinction between regulations and guidance.

- 1.4 The guidance contained in this Approved Document relates only to the particular requirements of the Building Regulations that the document addresses (set out in Section 2). However, building work may be subject to more than one requirement of building regulations. In such cases the work will also have to comply with any other applicable requirements of building regulations.
- 1.5 There are Approved Documents that give guidance on each of the Parts of Schedule 1 and on regulation 7. A full list of these is provided at the back of this document.

CONSIDERATION OF TECHNICAL RISK

- 1.6 In relation to the construction of new buildings other than dwellings, building work must satisfy all the technical requirements set out in regulations 17C and 17E of, and Schedule 1 to, the Building Regulations. When considering the incorporation of energy efficiency measures in dwellings, attention should be paid in particular to the need to comply with Part B (fire safety), Part C (site preparation and resistance to contaminants and moisture), Part E (resistance to the passage of sound), Part F (ventilation), paragraph G3 (hot water storage), Part J (combustion appliances and fuel storage systems) and Part P (electrical safety), as well as Part L. [The adoption of any particular energy efficiency measure should not involve unacceptable technical risk of, for instance, excessive condensation.](#) Designers and builders should refer to the relevant Approved Documents and to other generally available good practice guidance to help minimise these risks.

ADs cannot expect to cover all aspects of good design practice. If thought appropriate, a list of relevant good practice information could be listed on the planning portal, but these would be third party publications. The difficulty of maintaining such a list is that it could never be exhaustive and, by its nature, a selective list may favour one particular system or technology. It may therefore be appropriate just to provide links to other information providers, such as the professional institutions and trade bodies.

HOW TO USE THIS APPROVED DOCUMENT

- 1.7a This Approved Document is subdivided into seven sections as detailed below. These main sections are followed by a number of supporting appendices.

This **introductory** section sets out the general context in which the guidance in the AD must be considered.

Section 2 sets out the relevant legal requirements as published in the Building Regulations.

- c. **Section 3** contains general guidance, including the definition of key terms, the types of building work covered by this Approved Document, the types of building work that are exempt, procedures for notifying work, materials and workmanship and health and safety issues, an overview of the routes to compliance, and how to deal with “special” areas of buildings that contain ***dwellings*** .
- d. **Section 4** details the considerations that apply to demonstrating that the building work will meet the ***energy efficiency requirements***. This section begins the detailed technical guidance relating to showing compliance with the ***energy efficiency requirements***.
- e. **Section 5** details the considerations that apply when providing or renovating ***thermal elements***.
- f. **Section 6** gives guidance in support of the requirement for ***consequential improvements***.
- g. **Section 7** describes the information that should be provided to occupiers to help them achieve reasonable standards of energy efficiency in practice.

1.8 In this document the following conventions have been adopted to assist understanding and interpretation:

- a. texts shown **against a green background** are extracts from the Building Regulations or Building (Approved Inspectors) Regulations, both as amended, and set out the legal requirements that relate to compliance with the ***energy efficiency requirements*** of building regulations. *As stated previously, there is no flexibility in respect of such text; it defines a legal requirement, not guidance for typical situations.* It should also be remembered that, as noted above, building works must comply with all the other applicable requirements of building regulations;

To clarify the distinction between regulations and guidance.

- b. key terms are defined in paragraph 3.1 and are printed in ***bold italic text***;
- c. details of technical publications referred to in the text of this Approved Document will be given in footnotes and repeated as end notes. A reference to a publication is likely to be made for one of two main reasons. The publication may contain additional or more comprehensive technical detail, which it would be impractical to include in full in the Approved Document but which is needed to fully explain ways of meeting the requirements; or it is a source of more general information. The reason for the reference will be indicated in each case.

The reference will be to a specified edition of the document. The Approved Document may be amended from time to time to include new references or to refer to revised editions where this aids compliance;

- 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, but is not part of the technical guidance itself.

WHERE YOU CAN GET FURTHER HELP

1.9 If you do not understand the technical guidance or other information set out in this Approved Document and the additional detailed technical references to which it directs you, there are a number of routes through which you can seek further assistance:

- the CLG website: www.communities.gov.uk;
- the Planning Portal website: www.planningportal.gov.uk;
- if you are the person undertaking the building work, you can seek assistance either from your local authority building control service or from your approved inspector (depending on which building control service you are using, or intend to use, to certify compliance of your work with the requirements of the Building Regulations);
- businesses registered with a competent person self-certification scheme may be able to get technical advice from their scheme operator;
- if your query is of a highly technical nature, you may wish to seek the advice of a specialist, or industry technical body, in the area of concern.

RESPONSIBILITY FOR COMPLIANCE

1.10 It is important to remember that if you are the person (e.g. designer, builder, installer) carrying out building work to which any requirement of building regulations applies you have a responsibility to ensure that the work complies with any such requirement. The building owner may also have a responsibility for ensuring compliance with building regulation requirements and could be served with an enforcement notice in cases of non-compliance.

Section 2: The Requirements

2.1 This Approved Document, which takes effect on xx xx 2010, deals with the **energy efficiency requirements** in the Building Regulations (as amended by SI). The **energy efficiency requirements** relevant to existing buildings other than dwellings are those of regulations 4A, 17D and 17E of, and Part L of Schedule 1 to, those Regulations, as set out below.

Requirements relating to thermal elements

Regulation 4A.

- (1) Where a person intends to renovate a thermal element, such work shall be carried out as is necessary to ensure that the whole thermal element complies with the requirements of paragraph L1(a)(i) of Schedule 1.
- (2) Where a thermal element is replaced, the new thermal element shall comply with the requirements of paragraph L1(a)(i) of Schedule 1.

Consequential improvements to energy performance

Regulation 17D.

- (1) Paragraph (2) applies to an existing building with a total useful floor area over 1000 m² where the proposed building work consists of or includes—
 - (a) an extension;
 - (b) the initial provision of any fixed building services; or
 - (c) an increase to the installed capacity of any fixed building services.
- (2) Subject to paragraph (3), where this paragraph applies, such work, if any, shall be carried out as is necessary to ensure that the building complies with the requirements of Part L of Schedule 1.
- (3) Nothing in paragraph (2) requires work to be carried out if it is not technically, functionally or economically feasible.

Regulation 17J defines “building” in regulation 17D as follows:

Regulation 17J Interpretation.

In this Part—

“building” means the building as a whole or parts of it that have been designed or altered to be used separately.

Energy performance certificates

Regulation 17E.

- (1) This regulation applies where—
 - (a) a building is erected; or
 - (b) a building is modified so that it has a greater or fewer number of parts designed or altered for separate use than it previously had, where the modification includes the provision or extension of any of the fixed services for heating, hot water, air conditioning or mechanical ventilation.
- (2) The person carrying out the work shall—
 - (a) give an energy performance certificate for the building to the owner of the building; and
 - (b) give to the local authority notice to that effect, including the reference number under which the energy performance certificate has been registered in accordance with regulation 17F(4).
- (3) The energy performance certificate and notice shall be given not later than five days after the work has been completed.
- (4) The energy performance certificate must be accompanied by a recommendation report containing recommendations for the improvement of the energy performance of the building, issued by the energy assessor who issued the energy performance certificate.

Regulation 17E (*continued*).

- (5) An energy performance certificate must—
- (a) express the asset rating of the building in a way approved by the Secretary of State under regulation 17A;
 - (b) include a reference value such as a current legal standard or benchmark;
 - (c) be issued by an energy assessor who is accredited to produce energy performance certificates for that category of building; and
 - (d) include the following information—
 - (i) the reference number under which the certificate has been registered in accordance with regulation 17F(4);
 - (ii) the address of the building;
 - (iii) an estimate of the total useful floor area of the building;
 - (iv) the name of the energy assessor who issued it;
 - (v) the name and address of the energy assessor’s employer, or, if he is self-employed, the name under which he trades and his address;
 - (vi) the date on which it was issued; and
 - (vii) the name of the approved accreditation scheme of which the energy assessor is a member.
- (6) Certification for apartments or units designed or altered for separate use in blocks may be based—
- (a) except in the case of a dwelling, on a common certification of the whole building for blocks with a common heating system; or
 - (b) on the assessment of another representative apartment or unit in the same block.
- (7) Where —
- (a) a block with a common heating system is divided into parts designed or altered for separate use; and
 - (b) one or more, but not all, of the parts are dwellings,
- certification for those parts which are not dwellings may be based on a common certification of all the parts which are not dwellings.

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; and
 - (c) providing 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.

It is proposed that (iii) should be amended to include the objective that fixed building services should deliver their specified functional performance as well as using no more fuel and power than is necessary.

LIMITATION ON REQUIREMENTS

- 2.2 In accordance with regulation 8, the requirements in Parts A to D, F to K and N (except for paragraphs H2 and J6) of Schedule 1 to the Building Regulations do not require anything to be done except for the purpose of securing reasonable standards of health and safety for persons in or about buildings (and any others who may be affected by buildings or matters connected with buildings).
- 2.3 Paragraphs H2 and J6 are excluded from regulation 8 because they deal directly with prevention of the contamination of water. Parts E and M (which deal, respectively, with resistance to the passage of sound, and access to and use of buildings) are excluded from regulation 8 because they address the welfare and convenience of building users. Part L is excluded from regulation 8 because it addresses the conservation of fuel and power.

Section 3: General guidance

KEY TERMS

3.1 The following are key terms used in this document:

BCB means Building Control Body: a local authority or an approved inspector.

Change to a building's energy status means any change which results in a building becoming a building to which the energy efficiency requirements of the Building Regulations apply, where previously it was not.

For example, this could occur where a previously unheated building was to be heated in future, or where a previously exempt building was no longer within the exempted categories.

Commissioning means the advancement of a **fixed building service** following installation, replacement or alteration of the whole or part of the system, from the state of static completion to working order by testing and adjusting as necessary to ensure the system as a whole uses no more fuel and power than is reasonable in the circumstances, without prejudice to the need to comply with health and safety requirements. For each system **commissioning** includes setting-to-work, regulation (that is testing and adjusting repetitively) to achieve the specified performance, the 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.

Consequential improvements means those energy efficiency improvements required by regulation 17D.

Conservatory is an extension to a building:

- a) which is thermally separated from the attached building by walls, windows and doors with U-value and draught-stripping provisions no worse than provided elsewhere in the building, and if a heating system is provided, that system has independent temperature and on/off controls; and
- b) where the area of transparent or translucent material in its external envelope parts is more than 150% of its floor area.

It is suggested that the definition should be included in the Regulations.

Controlled service or fitting means a service or fitting in relation to which Part G (hygiene), 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.

<text deleted>

Display window means an area of glazing, including glazed doors, intended for the display of products or services on sale within the building, positioned at the external perimeter of the building, at an access level and immediately adjacent to a pedestrian thoroughfare. There should be no permanent workspace within one glazing height of the perimeter. Glazing that extends beyond 3 m above such an access level is not part of a **display window** except:

- a. where the products on display require a greater height of glazing;
- b. in existing buildings, when replacing display windows that already extend to a greater height;
- c. in cases of building work involving changes to the façade and glazing and requiring planning consent, where planners have discretion to require a greater height of glazing, e.g. to fit in with surrounding buildings or to match the character of the existing façade.

It is expected that **display windows** will be found in buildings in Planning Use Classes A1, A2, A3 and D2 as detailed in Table 1.

Table 1: Planning Use Classes

Class	Use
A1	Shops: including retail-warehouse, undertakers, showrooms, post offices, hairdressers, shops for sale of cold food for consumption off premises
A2	Financial and professional services: banks, building societies, estate and employment agencies, betting offices
A3	Food and drink: restaurants, pubs, wine bars, shops for sale of hot food for consumption off premises
D2	Assembly and leisure: cinemas, concert halls, bingo halls, casinos, sports and leisure uses

Dwelling means a self-contained unit, including a house or flat, designed to be used separately to accommodate a single household. (**Rooms for residential purposes** are not **dwellings** so Approved Document L2B applies to work in such buildings.)

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

Energy efficiency requirements means the requirements of regulations 4A, 17C, 17D and 17E of, and Part L of Schedule 1 to, the Building Regulations.

In respect of existing buildings the applicable requirements consist of Part L and regulations 4A and 17D.

Fit-out work means that work needed to complete the internal layout and servicing of the building shell to meet the specific needs of an incoming occupier. The building shell is the structural and non-structural envelope of a building provided as a primary stage (usually for a speculative developer) for a subsequent project to fit out with internal accommodation works.

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

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

It is proposed that the definition of fixed building services should be amended to include (renewable) energy generation equipment and (natural) ventilation components.

High usage entrance door means a door to an entrance primarily for the use of people that is expected to experience large traffic volumes, and where robustness and/or powered operation is the primary performance requirement. To qualify as a **high usage entrance door**, the door should be equipped with automatic closers and, except where operational requirements preclude, be protected by a lobby.

Principal works means the work necessary to achieve the client's purposes in extending the building and/or increasing the installed capacity of any **fixed building services**. The value of the **principal works** is the basis for determining a reasonable provision of **consequential improvements**.

Renovation in relation to a thermal element means the provision of a new layer in the thermal element or the replacement of an existing layer, but excludes decorative finishes, and "renovate" shall be construed accordingly.

It is proposed to amend the definition of renovation to make the application of the guidance easier. The following gives the current working proposals.

Definition: "Renovation in relation to a thermal element means the process of stripping down the element to expose the basic structural components (brick/blockwork, timber/metal frame, joists, rafters etc.) and then rebuilding to achieve all the necessary performance requirements. Renovation only applies where the area to be refurbished is greater than one of the following limits (smaller proportions being regarded as repairs):

- a) 50% of the surface of the individual element or*
- b) 25% of the total building envelope [to be consistent with the EPBD requirement]."*

Guidance: "When assessing the area proportion, the area of the element should be taken as that of the individual element, not all the elements of that type in the building. The area of the element should also be interpreted in the context of whether the element is being stripped down from inside or outside, i.e. if removing all the plaster finish from the inside of a solid brick wall, the area of the element is the area of external wall in the room. If removing external render, it is the area of the elevation in which that wall sits.

This means that if all the roofing on the flat roof of an extension is being stripped down, the area of the element is the roof area of the extension, not the total roof area of the dwelling. If plaster is being removed from a bedroom wall, the relevant area is the area of the external wall in the room, not the area of the elevation which contains that wall section. This is because the marginal cost of dry-lining with insulated plasterboard rather than plain plasterboard is small."

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, whether or not the room is separated from or arranged in a cluster group with other rooms, but does not include a room in a hospital, or other similar establishment, used for patient accommodation and, for the purposes of this definition, a "cluster" is a group of rooms for residential purposes which is:

- a. separated from the rest of the building in which it is situated by a door which is designed to be locked; and
- b. not designed to be occupied by a single household.

Simple payback means the amount of time it will take to recover the initial investment through energy savings, and is calculated by dividing the marginal additional cost of implementing an energy efficiency measure by the value of the annual energy savings achieved by that measure taking no account of VAT. When making this calculation, the following guidance should be used:

- a. the marginal additional cost is the additional cost (materials and labour) of incorporating (e.g.) additional insulation, not the whole cost of the work;
- b. the cost of implementing the measure should be based on prices current at the date the proposals are made known to the **BCB** and be confirmed in a report signed by a suitably qualified person;
- c. the annual energy savings should be estimated using an energy calculation tool approved by the Secretary of State pursuant to regulation 17A; and
- d. for the purposes of this Approved Document, the energy prices that are current [at the time of the application to building control](#) should be used when evaluating the annual energy savings. [Current energy prices can be obtained from the BERR website¹](#).

<text deleted>

Thermal element is defined in regulation 2A as follows.

(2A) In these Regulations “thermal element” means a wall, floor or roof (but does not include windows, doors, roof windows or roof-lights) which separates a thermally conditioned part of the building (“the conditioned space”) from:

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

and includes all parts of the element between the surface bounding the conditioned space and the external environment or other part of the building as the case may be.

(2B) Paragraph (2A)(b)(iii) only applies to a building which is not a dwelling, where the other part of the building is used for a purpose which is not similar or identical to the purpose for which the conditioned space is used.

Note that this definition encompasses the walls and floor of a swimming pool basin.

Total useful floor area is the total area of all enclosed spaces measured to the internal face of the external walls, that is to say it is the gross floor area as measured in accordance with the guidance issued to surveyors by the RICS. In this convention:

- a. the area of sloping surfaces such as staircases, galleries, raked auditoria, and tiered terraces should be taken as their area on plan; and

¹ See www.berr.gov.uk/energy/statistics/publications/prices/index.html. The relevant average gas and electricity prices can be found in Table 3.4.1.

- b. areas that are not enclosed such as open floors, covered ways and balconies are excluded.

This equates to the gross floor area as measured in accordance with the guidance issued to surveyors by the RICS.

TYPES OF WORK COVERED BY THIS APPROVED DOCUMENT

- 3.2 This Approved Document is intended to give guidance on what, in ordinary circumstances, would be reasonable provision for compliance with the requirements of regulations 4A and 17D of, and Part L of Schedule 1 to, the Building Regulations when carrying out work on existing buildings that are not **dwelling**s. In addition it gives guidance on compliance with regulations 20B, 20C and 20D of the Building Regulations and 12B, 12C and 12D of the Building (Approved Inspectors etc) Regulations 2000 (SI 2000/2532) (“the Approved Inspectors Regulations”).

*It should be noted that **dwelling**s are defined as self-contained units. **Rooms for residential purposes** are not **dwelling**s, and so this Approved Document applies to them.*

- 3.3 In particular, this Approved Document gives guidance relating to the following activities:
- a. an extension (see paragraphs 4.3 to 4.13);
 - b. a material change of use (see paragraphs 4.14 to 4.16);
 - c. a material alteration (see paragraphs 4.17 to 4.18);
 - d. the provision or extension of a **controlled fitting** or **controlled service** (see paragraphs 4.19 to 4.65);
 - e. the replacement or **renovation** or retention of a **thermal element** (see paragraphs 5.1 to 5.10);
 - f. **consequential improvements** (see paragraphs 6.1 to 6.10).
- 3.4 For certain types of work in relation to an existing building, it may be more appropriate to use the guidance from the other Approved Documents L, or only to follow a limited amount of the guidance in this Approved Document. The following sub-paragraphs identify some of the circumstances in which this might be appropriate.

- a. **fit-out works** in buildings erected in compliance with the Building Regulations in force before xx xx 2010 must comply with the **energy efficiency requirements** that came into effect on that date and ways of doing so are given in this Approved Document. However, [first](#) fit-out works in buildings such as shell and core office buildings or business park units built in compliance with the **energy efficiency requirements** that came into effect on xx xx 2010 need to be approached differently. [Reasonable provision in these cases would be to follow the guidance in ADL2A covering first fit-out \(see paragraphs 4.19g et seq in that document\)](#);
- b. large extensions (as defined in paragraph 4.4) should be carried out in accordance with the guidance in Approved Document L2A. However, regulation 17D (**consequential improvements** to energy performance) would apply and the guidance in relation to that regulation set out in this Approved Document would be relevant.
- c. where the work involves [the construction of](#) subassemblies that have been obtained from a centrally held stock or from the disassembly or relocation of buildings at other premises, the guidance in Approved Document L2A should be followed but regulation 17D (**consequential improvements** to energy performance) would also apply [if the work was to extend an existing building](#). In that context, the guidance in relation to that regulation as set out in this Approved Document would be relevant;

Note that erecting a separate unit on a site with an existing building is not extending that existing building, but is the creation of a new building, unless the new unit is to be permanently linked to the existing building.

- d. where the work involves a building that either before the work or after the work is completed contains one or more **dwelling**s, the guidance in Approved Document L1B would apply to each **dwelling**.

*It should be noted that **dwelling**s are defined as self-contained units. **Rooms for residential purposes** are not **dwelling**s, and so this Approved Document applies to them.*

BUILDINGS EXEMPT FROM THE ENERGY EFFICIENCY REQUIREMENTS

- 3.5 The provisions for exempting buildings and building work from the Building Regulations requirements have changed and the new provisions are given in regulation 9 of the Building Regulations.

- 9 —.(3) The energy efficiency requirements of these Regulations apply to:
- a. the erection of any building of a kind falling within this paragraph;
 - b. the extension of any such building, other than an extension falling within class VII in Schedule 2; and
 - c. the carrying out of any work to or in connection with any such building or extension.
- (4) A building falls within paragraph (3) if it:
- a. is a roofed construction having walls;
 - b. uses energy to condition the indoor climate; and
 - c. does not fall within the categories listed in paragraph (5).
- (5) The categories referred to in paragraph (4)(c) are:
- a. buildings which are:
 - i. listed in accordance with section 1 of the Planning (Listed Buildings and Conservation Areas) Act 1990;
 - ii. in a conservation area designated in accordance with section 69 of that Act; or
 - iii. included in the schedule of monuments maintained under section 1 of the Ancient Monuments and Archaeological Areas Act 1979,
where compliance with the energy efficiency requirements would unacceptably alter their character or appearance;
 - b. buildings which are used primarily or solely as places of worship;
 - c. temporary buildings with a planned time of use of two years or less, industrial sites, workshops and non-residential agricultural buildings with low energy demand;
 - d. stand-alone buildings other than dwellings with a total useful floor area of less than 50 m².
- (6) In this regulation:
- a. “building” means the building as a whole or parts of it that have been designed or altered to be used separately; and
 - b. the following terms have the same meaning as in European Parliament and Council Directive 2002/91/EC on the energy performance of buildings:
 - i. “industrial sites”;
 - ii. “low energy demand”;
 - iii. “non-residential agricultural buildings”;
 - iv. “places of worship”;
 - v. “stand-alone”;
 - vi. “total useful floor area”;
 - vii. “workshops”.

The current exemptions from the energy efficiency requirements were copied out from the EPBD, and are optional. It is proposed that some, perhaps all, of these exemptions be deleted, because they overlap with the general exemptions to the Regulations (see Schedule 2) and this has caused confusion. It is proposed that the special considerations that apply in the different classes of building (e.g. historic buildings) be covered through guidance. Note that the existing exemption for historic buildings is conditional on the nature of the work, i.e. historic buildings are currently not exempt per se. It is proposed that the exemption be removed, but specific guidance be provided in the AD as to where special considerations apply, and how to arrive at an appropriate balance between heritage and energy conservation.

SCHEDULE 2

Exempt building and work

Class VII

Extensions

The extension of a building by the addition at ground level of —

- (a) a conservatory, porch, covered yard or covered way; or
- (b) a carport open on at least two sides.

where the floor area of that extension does not exceed 30 m², provided that in the case of a conservatory or porch which is wholly or partly glazed, the glazing satisfies the requirements of Part N of Schedule 1.

It is proposed that the exception for conservatories be removed from Part L, but that work on conservatories be included in the list of building work that is not notifiable to building control (Schedule 2B). This Approved Document gives guidance on appropriate standards for conservatories (see paragraph 4.12 to 4.13), and outlines the evidence that should be provided to local authorities should they wish to satisfy themselves that reasonable provision for the conservation of fuel and power has indeed been made.

- 3.6a The **energy efficiency requirements** apply to buildings that use energy to condition the indoor climate. This does not limit the application to spaces that are only heated or cooled to provide thermal comfort for occupants. It also applies where the space is conditioned for the benefit of processes going on inside the space, e.g. computer rooms and cold stores.

Special considerations

- 3.6b Special considerations apply to certain classes of non-exempt building. These building types are:
- a) historic buildings and buildings used primarily or solely as places of worship; the considerations that apply to such existing buildings are given in paragraphs 3.10 to 3.11;
 - b) buildings with low energy demand; the guidance specific to such buildings is given in paragraphs 3.11a to 3.11d ;
 - c) modular and portable buildings; the erection of such buildings is always regarded as a new building, even if it only involves moving an existing module to a new site. As such, ADL2A applies.

Historic and traditional buildings and places of worship

- 3.9 When establishing reasonable provision for the conservation of fuel and power, special considerations apply to the following classes of building:
- a) listed buildings;
 - b) buildings in conservation areas;
 - c) designated ancient monuments;
 - d) buildings which are of architectural and historical interest and which are referred to as a material consideration in a local authority's development plan;
 - e) buildings which are of architectural and historical interest within national parks, areas of outstanding natural beauty, registered historic parks and gardens, registered battlefields, the curtilages of scheduled ancient monuments, and world heritage sites;
 - f) buildings of traditional construction with permeable fabric that both absorbs and readily allows the evaporation of moisture;
 - g) buildings used primarily or solely as places of worship.
- 3.10 When undertaking work on or in connection with a building **that falls within one of the classes listed in paragraph 3.9**, the aim should be to improve energy efficiency where and to the extent that it is reasonable and practically possible. The work should not prejudice the character of the host building or increase the risk of long-term deterioration of the building fabric or fittings. The guidance given by

English Heritage² should be taken into account in determining appropriate energy performance standards for such building works. Particular issues relating to work in historic buildings that warrant sympathetic treatment and where advice from others could therefore be beneficial include:

- a. restoring the historic character of a building that has been subject to previous inappropriate alteration, e.g. replacement windows, doors and rooflights;
- b. rebuilding a former building (e.g. following a fire or filling a gap site in a terrace);
- c. making provisions enabling the fabric of historic buildings to “breathe” to control moisture and potential long term decay problems.

3.11 In arriving at a balance between historic building conservation and reasonable provision for energy efficiency improvements, it would be appropriate to take into account the advice of the local authority’s conservation officer.

Buildings with low energy demand

3.11a For the purposes of this Approved Document, buildings with low energy demand are taken to be those buildings or parts thereof where:

- a) **fixed building services** are used to heat or cool only a localised area rather than the entire enclosed volume of the space concerned (e.g. localised radiant heaters at a workstation in a generally unheated space); or
- b) **fixed building services** are used to heat to space temperatures substantially lower than those normally provided for human comfort (e.g. to provide condensation or frost protection in a warehouse); or
- c) the intended use of the space is such that it is likely to be conditioned for less than 15 hours per week. Such buildings are only likely to be found under Planning Use Class D1, *Non-residential institutions*, and then only associated with non-commercial activities such as village and church halls.

Is it appropriate to include c) as a building with low levels of heating? The problem is that there is no mechanism to require an improvement should the hours of use increase significantly. Consultees’ views on this are particularly welcome.

² *Building Regulations And Historic Buildings*, English Heritage, 2002 (revised 2004)

- 3.11b In such situations, it is not reasonable to expect the entire building envelope to be insulated to the standard expected for more typical buildings. Therefore if an existing building with low levels of heating is extended or parts of the fabric renovated, the new or renovated building envelope should only be insulated to a degree that is reasonable in the particular case. If some general heating is provided (case b) or c) above), then it would be reasonable that no part of the opaque fabric had a U-value worse than 0.7 W/m².K. In addition, reasonable provision would be for every **fixed building service** that is installed to meet the energy efficiency standards set out in the *Non-Domestic Building Services Compliance Guide*³.
- 3.11c If a part of a building with low energy demand is partitioned off and heated normally (e.g. an office area in an unheated warehouse), the separately heated area should be treated as a separate “building” and the normal procedures for demonstrating compliance should be followed in respect of the enclosure.
- 3.11d If a building with low energy demand subsequently changes such that the space is generally conditioned, then this is likely to involve the initial provision or an increase in the installed capacity of a **fixed building service**. Such activities are covered by Regulation 17D. The guidance in Section 6 of this Approved Document would require the building envelope to be upgraded and **consequential improvements** to be made. Alternatively, if the building shell was designed as a building with low energy demand and the first occupier of the building wanted to install (e.g.) heating, this would be a first **fit-out**, and ADL2A would apply.

NOTIFICATION OF WORK COVERED BY THE ENERGY EFFICIENCY REQUIREMENTS

- 3.12 In most instances in order to comply with the Building Regulations it will be necessary to notify a **BCB** before the work commences, either in the form of a deposit of full plans or by a building notice. In certain situations however other procedures apply.

These include:

- a. where the work is being carried out by a person registered with a relevant competent person self-certification scheme listed in Schedule 2A to the Building Regulations no advance notification to the **BCB** is needed (see paragraphs 3.13 to 3.16);
- b. where the work involves an emergency repair, e.g. to a failed boiler or a leaking hot water cylinder. In these cases, in accordance with regulation 12(7) of the Building Regulations, there is no need to delay making the repair in order to make an advance notification to the **BCB**. However, in such cases it will still be necessary for the work to comply with the relevant requirements and to give a

³ *Non-Domestic Building Services Compliance Guide* – see Volume 2, Chapter 7 of this consultation document.

notice to the **BCB** at the earliest opportunity, unless an installer registered under an appropriate competent person scheme carries out the work. A completion certificate can then be issued in the normal way;

- c. where the work is of a minor nature as described in the schedule of non-notifiable work (Schedule 2B to the Building Regulations), the work must still comply with the relevant requirements but need not be notified to the **BCB** (see paragraphs 3.17 to 3.18).

Competent person self-certification schemes

- 3.13 It is not necessary to notify a **BCB** in advance of carrying out work which is to be carried out by a person registered with a competent person self-certification scheme listed in Schedule 2A to the Building Regulations. In order to join such a scheme, a person must demonstrate competence to carry out the type of work the scheme covers, and also the ability to comply with all relevant requirements in the Building Regulations.
- 3.14 Where work is carried out by a person registered with a competent person scheme, regulation 16A of the Building Regulations and regulation 11A of the Building (Approved Inspectors etc) Regulations 2000 require that the occupier of the building be given, within 30 days of the completion of the work, a certificate confirming that the work complies fully with all applicable building regulation requirements. There is also a requirement that the **BCB** be given a notice of the work carried out, again within 30 days of the completion of the work. These certificates and notices are usually made available through the scheme operator.
- 3.15 **BCBs** are authorised to accept these certificates and notices as evidence of compliance with the requirements of the Building Regulations. However, local authority inspection and enforcement powers remain unaffected, although they are normally used only in response to a complaint that work does not comply.
- 3.16 A list of the self-certification schemes relating to the **energy efficiency requirements** in existing buildings which are currently authorised can be found at www.communities.gov.uk

Work which need not be notified

- 3.17 Schedule 2B to the Building Regulations sets out types of work where there is no requirement to notify a **BCB** that work is to be carried out. These types of work are mainly of a minor nature where there is no significant risk to health, safety or energy efficiency. Note that the health, safety and **energy efficiency requirements** continue to apply to these types of work, and that only the need to notify a **BCB** has been removed. In addition, where only non-notifiable work is carried out by a member of a competent person self-certification scheme there is no requirement for a certificate of building regulations compliance to be given to the occupier or the **BCB**.

3.18 The types of non-notifiable work in Schedule 2B relevant to the **energy efficiency requirements** of the Regulations are:

- a. in a heating, hot water service, ventilation or air-conditioning system the replacement of any part which is not a combustion appliance (such as a radiator, valve or pump) or the addition of an output device (such as a radiator or fan) or the addition of a control device (such as a thermostatic radiator valve). However, the work will remain notifiable whenever **commissioning** is possible and necessary to enable a reasonable use of fuel and power (see paragraphs 4.53 to 4.65);
- b. the installation of a stand-alone, self-contained fixed heating, hot water, ventilation or air-conditioning service. Such services must consist only of a single appliance and any associated controls and must not be connected to, or form part of, any other **fixed building service**. Examples of non-notifiable services would be a fixed electric heater, a mechanical extractor fan in a kitchen or bathroom, and a room air-conditioning unit. However, if any of the following apply, the work will remain notifiable building work:
 - i. the service is a combustion appliance;
 - ii. **commissioning** is possible and would affect the service's energy efficiency (see paragraphs 4.53 to 4.65);
 - iii. in the case of a ventilation appliance, the appliance is installed in a room containing a natural draught open-flued combustion appliance or service such as a gas fire which uses a chimney as its flue.
- c. the construction of a conservatory.

3.19 *<text deleted>*

MATERIALS AND WORKMANSHIP

3.20 Any building work which is subject to the requirements imposed by Schedule 1 to the Building Regulations should, in accordance with regulation 7, be carried out with proper materials and in a workmanlike manner.

3.21 You may show that you have complied with regulation 7 in a number of ways. These include demonstrating the appropriate use of:

- a product bearing CE marking in accordance with the Construction Products Directive (89/106/EEC)⁴ as amended by the CE Marking Directive (93/68/EC)⁵, the Low Voltage Directive (2006/95/EC)⁶ and the EMC Directive (2004/108/EC)⁷;
- a product complying with an appropriate technical specification (as defined in those Directives mentioned above), a British Standard, or an alternative national technical specification of a Member State of the European Union or Turkey⁸, or of another State signatory to the Agreement on the European Economic Area (EEA) that provides an equivalent level of safety and protection;
- a product covered by a national or European certificate issued by a European Technical Approval Issuing body, provided the conditions of use are in accordance with the terms of the certificate.

3.22 You will find further guidance in the Approved Document which specifically supports regulation 7 on materials and workmanship.

Independent certification schemes

- 3.23 There are many UK product certification schemes. Such schemes certify compliance with the requirements of a recognised standard that is appropriate to the purpose for which the material is to be used. Materials which are not so certified may still conform to a relevant standard.
- 3.24 Many certification bodies that approve products under such schemes are accredited by the United Kingdom Accreditation Service (UKAS). [Such bodies can only issue certificates for the categories of product covered under the terms of their accreditation.](#)
- 3.25 **BCBs** may accept the certification of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Similarly, **BCBs** may accept the certification of the installation or maintenance of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Nonetheless, before accepting that certification constitutes compliance with building regulations, a **BCB** should establish in advance that the relevant scheme is adequate for that purpose.

⁴ As implemented by the Construction Products Regulations 1991 (SI 1991/1620).

⁵ As implemented by the Construction Products (Amendment) Regulations 1994 (SI 1994/3051).

⁶ As implemented by the Electrical Equipment (Safety) Regulations 1994 (SI 1994/3260).

⁷ As implemented by the Electromagnetic Compatibility Regulations 2006 (SI 2006/3418).

⁸ Decision No 1/95 of the EC-Turkey Association Council of 22 December 1995.

Standards and technical specifications

- 3.26 Building regulations are made for specific purposes including securing the health, safety, welfare and convenience of people in or about buildings; furthering the conservation of fuel and power; furthering the protection or enhancement of the environment; and facilitating sustainable development. Guidance contained in standards and technical approvals is relevant to the extent that it relates to those purposes. However, the guidance may also address other aspects of performance such as serviceability, or aspects which, although they relate to health and safety, are not covered by building regulations.
- 3.27 When an Approved Document makes reference to a named standard or document, the relevant version of the standard or document is the one listed at the end of the Approved Document. If this version has been revised or updated by the issuing body, the latest version may be used as a source of guidance provided it continues to address the relevant requirements of the Building Regulations. However, until the reference in the Approved Document is revised, the standard or document listed remains the approved source.
- 3.28 The appropriate use of a product that complies with a European Technical Approval as defined in the Construction Products Directive will meet the relevant requirements.
- 3.29 The Department intends to issue periodic amendments to its Approved Documents to reflect emerging harmonised European Standards. Where a national standard is to be replaced by a European harmonised standard, there will be a co-existence period during which either standard may be referred to. At the end of the coexistence period the national standard will be withdrawn.

THE WORKPLACE (HEALTH, SAFETY AND WELFARE) REGULATIONS 1992

- 3.30 The Workplace (Health, Safety and Welfare) Regulations 1992, as amended, apply to the common parts of flats and similar buildings if people such as cleaners, wardens and caretakers are employed to work in these common parts. These Regulations contain some requirements which affect building design. The main requirements are now covered by the Building Regulations, but for further information see *Workplace health, safety and welfare, Workplace (Health, Safety and Welfare) Regulations 1992, Approved Code of Practice and guidance*, HSE publication L24, 1996.
- 3.31 Where the requirements of the Building Regulations that are covered by this Approved Document do not apply to **dwelling**s, the provisions may still be required in the situations described above in order to satisfy the Workplace Regulations.

Section 4: Guidance relating to building work

CALCULATION OF THERMAL PERFORMANCE OF BUILDING FABRIC

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EXTENSIONS

- 4.3 The construction of an extension triggers the requirement for **consequential improvements** in buildings with a total useful floor area greater than 1000 m². In such cases, the guidance in Section 6 should be followed in addition to the following specific guidance.

Large extensions

- 4.4 Where the proposed extension has a total useful floor area that is both:
- a. greater than 100 m²; and
 - b. greater than 25% of the total useful floor area of the existing building,
- the work should be regarded as a new building and the guidance in Approved Document L2A followed. The requirement for **consequential improvements** should also be met by following the guidance in Section 6 of this Approved Document.

Other extensions – Reference method

Envelope standards

- 4.5 Reasonable provision would be for the proposed extension to incorporate the following:
- a. **doors, windows, roof windows, rooflights and smoke vents** that meet the standards set out in paragraphs 4.20 to 4.23;
 - b. newly constructed **thermal elements** that meet the standards set out in paragraphs 5.1 to 5.6;
 - c. existing opaque fabric which becomes a **thermal element** where previously it was not should be upgraded so that it meets the standards in paragraphs 5.7 to 5.10.

Opening areas

- 4.6 The area of windows and rooflights in the extension should **generally** not exceed the values given in Table 2. However, where a greater proportion of glazing is present in the part of the building to which the extension is attached, reasonable provision would be to limit the proportion of glazing in the extension so that it is no greater than the proportion that exists in the part of the building to which it is attached.

Table 2: Opening areas in the extension

Building type	Windows and personnel doors as % of exposed wall	Rooflights as % of area of roof
Residential buildings where people temporarily or permanently reside	30	20
Places of assembly, offices and shops	40	20
Industrial and storage buildings	15	20
Vehicle access doors and display windows and similar glazing	As required	N/A
Smoke vents	N/A	As required

Building services systems in the extension

4.7 Where **fixed building services** are provided or extended as part of constructing the extension, reasonable provision would be to follow the guidance in paragraphs 4.23a to 4.65.

Optional approaches with more design flexibility

4.7a The approach set out in paragraphs 4.4 to 4.7 is somewhat prescriptive. The following paragraphs offer more flexible approaches to demonstrating reasonable provision has been made. These alternative approaches allow some elements of the design to be relaxed through compensating measures elsewhere.

Area weighted U-value method

4.8 The U-values given in paragraph 4.5 and the opening areas given in paragraph 4.6 may be varied provided that:

- a. the area-weighted U-value of all the elements in the extension is no greater than that of an extension of the same size and shape that complies with the U-value standards referred to in paragraph 4.5 and the opening area standards in paragraph 4.6. Any **fixed building service** provided or extended as part of constructing the extension should follow the guidance in paragraphs 4.23a to 4.65.

The area-weighted U-value is given by the following expression:

$$\{(U1 \times A1) + (U2 \times A2) + (U3 \times A3) + \dots\} \div \{(A1 + A2 + A3 + \dots)\}$$

<text deleted>

Whole building calculation method

- 4.10 Where even greater design flexibility is required, reasonable provision would be to use an approved calculation tool to demonstrate that the calculated CO₂ emissions from the building and proposed extension are no greater than for the building plus a notional extension complying with the standards of paragraphs 4.5 to 4.7.
- 4.10a The specification of the existing building used in conjunction with the notional extension as the basis of setting the CO₂ target for the building work shall include all upgrades that will be included in fulfilment of the requirement for **consequential improvements** (see Section 6).

Otherwise all the low cost measures would have been taken by the compensatory measures, leaving little leeway for overall improvement.

- 4.11 Where additional upgrades **over and above the consequential improvements** are proposed in the actual building to compensate for lower performance in the extension, then such upgrades should be implemented to a standard that is no worse than set out in the relevant guidance contained in this Approved Document. The relevant standards for upgrading retained thermal elements are as set out in column (b) of Table 5.

Where it is proposed to upgrade, the standards set out in this Approved Document are cost effective and should be implemented in full. It will be worthwhile implementing them even if the improvement is greater than necessary to achieve compliance. In some cases, therefore, the standard of the extended building may be better than that required by paragraph 4.10 alone.

Conservatories

- 4.12 Where the extension is a **conservatory**, reasonable provision would be to provide:

It is proposed that conservatories should no longer be exempt from Part L.

- a. glazed elements that comply with the standards given in Table 3 and **thermal elements** that have U-values no worse than the standards given in Table 4;
- b. **fixed building services** that meet the minimum standards in the *Non-Domestic Building Services Compliance Guide* and have automatic on/off controls;

Automatic controls would mean that the conservatory heating need not default to the same schedule as the main house.

- c. secure ventilation openings totalling 5% of the combined area of the **conservatory** and the room to which it is attached, with a minimum of 0.5 m² free opening area at high level (minimum of 2 m above the floor level).

4.12a Although the construction of a **conservatory** is not notifiable, the local authority may check that any **conservatory** that has been constructed has made reasonable provision for the conservation of fuel and power. The person responsible for constructing the **conservatory** should therefore produce a schedule that details the provisions that have been made to satisfy the requirements, and provide this to the owner so that it can be used as evidence of compliance if this is called for by the local authority. This document should include details of:

- a. the provisions made for maintaining thermal separation and, in particular, the details of the door separating the building from the **conservatory** and its closing mechanism;
- b. a schedule of elemental performance standards for each element of construction, compared with the values referred to in paragraph 4.12 sub-paragraph a;
- c. details of the heating system, with specific guidance on how the occupier should adjust the controls to match the intended use of the **conservatory** (see sub-paragraph e. below);
- d. details of the ventilation provisions intended to limit summer overheating;
- e. a copy of the guidance given to the occupier, explaining how different patterns of use will influence energy consumption and running costs.

This is the first stage of a proposed progressive tightening of conservatory standards, such that after two further revisions of Part L (scheduled for 2013 and 2016) conservatories would be treated exactly the same as any other extension.

Substantially glazed extensions

4.13 If a substantially glazed extension fails to qualify as a **conservatory** because it has less than the minimum qualifying amounts of transparent or translucent material, reasonable provision would be to follow the guidance in paragraph 4.10 to 4.11.

<text deleted>

This approach would need to demonstrate that the extension provides a real energy benefit.

Swimming pool basins

4.13a Where a swimming pool is being provided in a building, the U-value of the basin (walls and floor) should be not worse than $0.25 \text{ W/m}^2 \cdot \text{K}$ as calculated according to BS EN ISO 13370⁹.

MATERIAL CHANGE OF USE AND CHANGE OF ENERGY STATUS

4.14 Material change of use is defined in regulation 5 as follows:

For the purposes of paragraph 8(1)(e) of Schedule 1 to the Act and for the purposes of these Regulations, there is a material change of use where there is a change in the purposes for which or the circumstances in which a building is used, so that after that change:

- a. the building is used as a dwelling, where previously it was not;
- b. the building contains a flat, where previously it did not;
- c. the building is used as an hotel or a boarding house, where previously it was not;
- d. the building is used as an institution, where previously it was not;
- e. the building is used as a public building, where previously it was not;
- f. the building is not a building described in Classes I to VI in Schedule 2, where previously it was;
- g. the building, which contains at least one dwelling, contains a greater or lesser number of dwellings than it did previously;
- h. the building contains a room for residential purposes, where previously it did not;
- i. the building, which contains at least one room for residential purposes, contains a greater or lesser number of such rooms than it did previously; or
- j. the building is used as a shop where previously it was not.

4.14a A change to a building's energy status is defined in regulation 2(1) as

any change which results in a building becoming a building to which the energy efficiency requirements of these Regulations apply, where previously it was not.

If we define material change of use here, we should also define change to a building's energy status.

⁹ BS EN ISO 13370 *Thermal performance of buildings – Heat transfer via the ground – Calculation methods.*

- 4.15 In normal circumstances, reasonable provision when there is a material change of use or a change of energy status would be:
- a. where **controlled services or fittings** are being provided or extended, to meet the standards set out in paragraphs 4.20 to 4.65;
 - b. where the work involves the provision of a **thermal element**, to meet the standards set out in paragraphs 5.1 to 5.6;

For the purposes of the Building Regulations provision means both new and replacement elements.

<text deleted>

- d. where any **thermal element** is being retained, to upgrade it following the guidance given in paragraphs 5.9 and 5.10. [This guidance should also be followed in respect of any existing element that becomes part of the thermal envelope of the building where previously it was not;](#)

As an example, this would include the party wall between units in a terrace of industrial units which originally were unheated, but heating is to be provided to one of the units.

- e. where an existing window (including roof window or rooflight) or door which separates a conditioned space from an unconditioned space or the external environment has a U-value that is worse than 3.3 W/m².K, to follow the guidance in paragraphs 4.20 to 4.23 unless it is a display window or high usage entrance door. It would be reasonable in these latter cases to make some lesser provision for energy efficiency.

4.15a [As well as satisfying the energy efficiency requirements in respect of the material change of use or change in energy status, such building work may be one of the triggers for consequential improvements – see regulation 17D and Section 6.](#)

Option providing more design flexibility

- 4.16 To provide more design flexibility, an approved calculation tool can be used to demonstrate that the CO₂ emissions from the building as it will become are no worse than if the building had been improved following the guidance set out in paragraph 4.15.

MATERIAL ALTERATION

4.17 Material alterations are defined in regulation 3(2) and 3(3) of the Building Regulations as follows:

3(2) An alteration is material for the purposes of these Regulations if the work, or any part of it, would at any stage result:

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

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

Part A (structure)

paragraph B1 (means of warning and escape)

paragraph B3 (internal fire spread – structure)

paragraph B4 (external fire spread)

paragraph B5 (access and facilities for the fire service)

Part M (access to and use of buildings).

4.17a As well as the need to satisfy the **energy efficiency requirements** in respect of the material alteration, such building work may be one of the triggers for **consequential improvements** – see regulation 17D and Section 6.

4.18 When carrying out a material alteration, reasonable provision would be:

- a. where the work involves the provision of a **thermal element**, to follow the guidance in paragraphs 5.1 to 5.6;

For the purposes of the Building Regulations, provision means both new and replacement elements.

- b. when renovating a **thermal element**, to follow the guidance in paragraphs 5.7 and 5.8;
- c. where an existing element becomes part of the thermal envelope of the building whereas previously it was not, to follow the guidance in paragraphs 5.9 and 5.10. Any existing window (including roof window or rooflight) or door which becomes part of the thermal envelope where previously it was not and which has a U-value that is worse than 3.3 W/m².K, should be replaced following the

guidance in paragraphs 4.20 to 4.23 unless they are display windows and high usage entrance doors. It would be reasonable in these cases to make some lesser provisions for energy efficiency;

Sub-paragraph c) is to satisfy Regulation 4, i.e. the building is no more unsatisfactory in relation to a requirement than before the work was carried out. This is intended to cover situations that apply when converting existing unheated spaces into living accommodation (e.g. loft and garage conversions). Consideration is being given to making such alterations material changes of use. Consultees' views on such a change would be welcome.

- d. when providing a **controlled fitting**, to follow the guidance on **controlled fittings** given in paragraphs 4.20 to 4.23;
- e. when providing or extending a **controlled service**, to follow the guidance on **controlled services** given in paragraphs 4.23a to 4.65.

WORK ON CONTROLLED FITTINGS AND SERVICES

4.19 A **controlled service or fitting** is defined in Regulation 2(1) as follows:

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

4.19a In the context of this Approved Document, the application of the term **controlled fitting** to a window, roof window, rooflight or door applies to the whole unit, i.e. including the frame. Consequently, replacing the glazing whilst retaining an existing frame is not providing a **controlled fitting**, and so such work is not notifiable and does not have to meet the Part L standards, although where practical it would be sensible if it did meet the Part L standards.

Controlled fittings

4.20 Where windows, roof windows, rooflights or doors are to be provided, reasonable provision would be draught-proofed units whose area-weighted average performance is no worse than that given in Table 3. **In addition, insulated cavity closers should be installed where appropriate.** If a window, pedestrian door or rooflight is enlarged or a new one created, then the area of windows and pedestrian doors and of rooflights expressed as a percentage of the total floor area of the building should not exceed the relevant value from Table 2, **or be compensated for in some other way.**

Table 3: Standards for controlled fittings	
Fitting	Standard
Windows, roof windows and glazed rooflights ¹	1.5 W/m ² .K for the whole unit; or 1.2 W/m ² .K for centre pane
Alternative option for windows in buildings that are essentially domestic in character ² ,	A window energy rating ³ of Band C
Plastic rooflight	1.8 W/m ² .K
Curtain walling	See paragraph 4.23
Pedestrian doors where the door has more than 50% of its internal face area glazed	1.8 W/m ² .K for the whole unit
High usage entrance doors for people	3.5 W/m ² .K
Vehicle access and similar large doors	1.5 W/m ² .K
Other doors	1.8 W/m ² .K
Roof ventilators (including smoke extract ventilators)	3.5 W/m ² .K
Notes: ¹ Display windows are not required to meet the standard given in this table. ² For example, student accommodation, care homes and similar uses where the occupancy levels and internal gains are essentially domestic in character. ³ See BFRC website www.bfrc.org	

4.20a U-values of windows, roofwindows, rooflights and doors shall be calculated using the methods and conventions set out in BR 443¹⁰ and paragraph 4.21. The U-values for roof windows and rooflights given in this Approved Document are based on the particular U-value having been assessed with the roof window or rooflight 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 a U-value adjustment following the guidance given in BR 443.

The stated standard for a replacement plastic rooflight as given in Table 3 is 1.8 W/m².K. This is for the unit assessed in the vertical plane. If the performance of a triple skin rooflight was assessed in the horizontal plane, then based on the guidance given in BR 443, the standard would be adjusted by 0.3 W/m².K (the value from BR 443 for a horizontal triple skin rooflight), requiring the rooflight as assessed in the horizontal plane to achieve a standard of 1.8 + 0.3 = 2.1 W/m².K.

¹⁰ BR 443 Conventions for U-value calculations, BRE, 2006

4.21 The U-value or Window Energy Rating for windows can be taken as that for:

- a. the smaller of the two standard windows defined in BS EN 14351-1¹¹;
- b. the standard configuration referred to in BR 443; or
- c. the specific size and configuration of the actual window.

For domestic type construction, SAP 2009¹² Table 6e gives values for different window configurations that can be used in the absence of test data or calculated values.

4.22 In certain classes of building with high internal gains, a less demanding U-value for glazing may be an appropriate way of reducing overall CO₂ emissions. If this case can be made, then the average U-value for windows, doors and rooflights can be relaxed from the values given in Table 3, but the value should not exceed 2.7 W/m².K.

4.23 The overall U-value of curtain walling should be no greater than $0.8 + 1.2X$, where X is the fraction of the curtain wall that is glazed.

This means that if the area of curtain walling is to be 60% glazed and 40% opaque, the U-value standard should be $0.8 + 1.2 \times 0.6 = 1.5$ W/m².K.

Controlled services

4.23a Where the work involves the provision or extension of **controlled services**, reasonable provision would be demonstrated by following the guidance set out in the *Non-Domestic Building Services Compliance Guide*³. The Guide covers the following services:

- a) heating and hot water systems (including insulation of pipes, ducts and vessels);
- b) mechanical ventilation;
- c) mechanical cooling/ air conditioning;
- d) fixed internal lighting;
- e) renewable energy systems.

¹¹ EN 14351-1, *Windows and doors – Product standard, performance characteristics*, 2006.

¹² See separate DECC consultation at www.bre.co.uk/sap2009

4.24 In general terms, the aim should be to:

- a. provide new **fixed building services** that meet reasonable standards of energy efficiency, which in normal circumstances would be:
 - i. an efficiency not less than set out in the *Non-Domestic Building Services Compliance Guide*. The efficiency claimed for the **fixed building service** should be based on the appropriate test standard as set out in the Guide and the test data should be certified by a notified body. It would be reasonable for **BCBs** to accept such data at face value. In the absence of such quality assured data, **BCBs** should satisfy themselves that the claimed performance is justified. If a particular technology is not covered in the Guide, reasonable provision would be demonstrated by showing that the proposed technology gives a performance that is no worse than a reference system of the same type whose details are given in the Guide; and
 - ii. an efficiency not less than that of the controlled service being replaced. If the new service uses a different fuel, then before making this check the efficiency of the new appliance should be multiplied by the ratio of the CO₂ emission factor of the fuel used in the appliance being replaced to that of the fuel used in the new appliance.

This will prevent an existing low carbon component being replaced by a lesser provision when fuel switching. For example, if an existing electric chiller with a CoP of 2.5 is replaced by an absorption chiller with a CoP of 0.8 but fired by waste heat, the equivalent efficiency of the absorption chiller would be $0.8 \times (0.591/0.058)=8.15$, and so test (ii) would be satisfied. 0.591 and 0.058 kgCO₂/kWh are the emission factors for electricity and waste heat respectively¹³.

- b. provide new HVAC systems with appropriate controls to achieve reasonable standards of energy efficiency. In normal circumstances reasonable provision would be to provide the following control features on each system in addition to the system specific controls detailed in subsequent paragraphs:
 - i. the **fixed building services** systems should be sub-divided into separate control zones to correspond to each area of the building that has a significantly different solar exposure, occupancy period, or type of use;
 - ii. each separate control zone should be capable of independent switching and control of set-point;

¹³ STP09/CO201 Revised emission factors for the National Calculation Methodologies, BRE, 2009. Available at www.bre.co.uk/sap2009

- iii. the provision of the service should respond to the requirements of the space it serves. If both heating and cooling are provided, they should be controlled so they do not operate simultaneously;
 - iv. central plant serving the zone-based systems should only operate as and when required. The default condition should be off;
 - v. in addition to these general control requirements, the systems should meet the specific control requirements and [general energy efficiency criteria](#) as set out in the *Non-Domestic Building Services Compliance Guide*.
- d. demonstrate the new service has been effectively commissioned (see paragraphs 4.53 to 4.65);
 - e. demonstrate that reasonable provision of energy meters has been made for effective monitoring of the performance of newly installed plant (see paragraphs 4.50 to 4.52);
 - f. demonstrate that the relevant information has been recorded in a new log book or incorporated into an update of the existing one as described in Section 7.

4.25 If a renewable energy generator such as a wind turbine or PV array is being replaced, the new system should have an electrical output that is not significantly less than the original installation.

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Energy meters

- 4.50 The aim for buildings as a whole is to enable building occupiers to assign at least 90% of the estimated annual energy consumption of each fuel to the various end-use categories (heating, lighting etc).
- 4.51 Reasonable provision for energy meters in existing buildings would be to install energy metering systems in the building service systems provided as part of the works in accordance with the recommendations in CIBSE TM 39¹⁴.
- 4.52 In addition to this:
- a. meters should be provided to enable the performance of any [renewable energy](#) system provided as part of the works to be separately monitored;
 - b. in buildings with a total useful floor area greater than 1000 m², the metering system should enable automatic meter reading and data collection;

¹⁴ TM 39 *Building energy metering*, CIBSE, 2006.

- c. the metering provisions should be designed such as to facilitate the benchmarking of energy performance as set out in TM 46¹⁵.

Following implementation of the Energy Services Directive, there are likely to be legal obligations for persons commissioning building work on existing buildings with floor areas in excess of 1000 m² to notify their intentions to the energy supply companies.

COMMISSIONING OF FIXED BUILDING SERVICES

4.53 Regulation 20C (Commissioning) states:

20C (1) This regulation applies to building work in relation to which paragraph L1(b) of Schedule 1 imposes a requirement, but does not apply 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.

(2) Where this regulation applies the person carrying out the work shall, for the purpose of ensuring compliance with paragraph L1(b) of Schedule 1, 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.

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

- (a) not later than the date on which the notice required by regulation 15(4) is required to be given; or
- (b) where that regulation does not apply, not more than 30 days after completion of the work.

4.54a Reasonable provision would be to prepare a commissioning plan, identifying the systems that need to be tested and the tests that will be carried out. The notice required by regulation 20C should confirm that the commissioning plan has been followed and that every system has been inspected in an appropriate sequence and to a reasonable standard and that the test results confirm that performance is reasonably in accordance with the design requirements.

4.55 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.

¹⁵ TM 46 Energy benchmarks, CIBSE, 2008.

- 4.56 **Commissioning** must be carried out in such a way as not to prejudice compliance with any applicable health and safety requirements.
- 4.57 In existing buildings other than **dwelling**s, **commissioning** is most often carried out by the person who installs the system. Sometimes 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.

Notice of completion of commissioning

- 4.58 The Building Regulations (regulation 20C(2)) and the Building (Approved Inspectors etc) Regulations (regulation 12C(2)) require that a notice be given to the relevant **BCB** that **commissioning** has been carried out according to a procedure approved by the Secretary of State.
- 4.59 The procedure approved by the Secretary of State is set out in:
- a. CIBSE Commissioning Code M on commissioning management¹⁶; and

*This provides guidance on the overall process and includes a schedule of all the relevant guidance documents relating to the **commissioning** of specific building services systems.*
 - b. paragraph 4.64 and 4.65 for leakage testing of ductwork.
- 4.60 Where a building notice or full plans have been given to a **BCB**, the notice should be given within 5 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.
- 4.61 Where an approved inspector is the **BCB** the notice should generally be given within five days of the completion of the **commissioning** work. However, where the work is carried out by a person registered with a competent person scheme (see paragraph 3.13 to 3.16) the notice must be given within 30 days.
- 4.62 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.
- 4.63 Until the **BCB** receives the commissioning notice it is unlikely to be able to be reasonably satisfied that Part L has been complied with and consequently is unlikely to be able to give a completion/ final certificate.

¹⁶ CIBSE Commissioning Code M: *Commissioning management*, CIBSE, 2003.

Membership of the Commissioning Specialists Association or the Commissioning group of the HVCA may be a way of demonstrating suitability to sign the report in respect of the HVAC systems. For lighting control systems, suitability may be demonstrated by accreditation under the Lighting Industry Commissioning Scheme.

- 4.64 Ductwork leakage testing should be carried out on new or refurbished ducting where practicable in accordance with the procedures set out in HVCA DW/143¹⁷ on systems served by fans with a design flow rate greater than 1 m³/s and for those sections of ductwork where the pressure class is such that DW/143 recommends testing.

Membership of the HVCA specialist ductwork group or the Association of Ductwork Contractors and Allied Services could be a way of demonstrating suitable qualifications for this testing work.

- 4.65 If a ductwork system fails to meet the leakage standard, remedial work should be carried out as necessary to achieve satisfactory performance in re-tests and further ductwork sections should be tested as set out in DW/143.

¹⁷ DW/143 A Practical Guide to Ductwork Leakage Testing, HVCA, 2000.

Section 5: Guidance on thermal elements

THE PROVISION OF THERMAL ELEMENTS

- 5.1 New **thermal elements** must comply with paragraph L1(a)(i) of Schedule 1 to the Building Regulations. Work on existing **thermal elements** must comply with regulation 4A of the Building Regulations.

4A.–(1) Where a person intends to renovate a thermal element, such work shall be carried out as is necessary to ensure that the whole thermal element complies with the requirements of paragraph L1(a)(i) of Schedule 1.

(2) Where a thermal element is replaced, the new thermal element shall comply with the requirements of paragraph L1(a)(i) of Schedule 1.

U-values

- 5.1a [U-values shall be calculated using the methods and conventions set out in BR 443¹⁰.](#)
- 5.3 Reasonable provision for newly constructed **thermal elements** such as those constructed as part of an extension would be to meet the standards set out in Table 4.
- 5.4 Reasonable provision for those **thermal elements** constructed as replacements for existing elements would be to meet the standards set out in Table 4.

Table 4: Standards for new thermal elements

Element ¹	Standard (W/m ² .K)
Wall	0.28 ²
Pitched roof – insulation at ceiling level	0.16
Pitched roof – insulation at rafter level	0.16
Flat roof or roof with integral insulation	0.16
Floors ³	0.22 ⁴
Swimming pool basin	0.25 ⁵

Notes:

- ¹ “Roof” includes the roof parts of dormer windows, and “wall” includes the wall parts (cheeks) of dormer windows.
- ² A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall.
- ³ The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged building.
- ⁴ A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels.
- ⁵ [See paragraph 4.13a.](#)

*Curtain walling is treated as a **controlled fitting** and guidance is given in paragraph 4.23.*

Continuity of insulation and airtightness

- 5.5 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. Reasonable provision should also be made to reduce unwanted air leakage through the new envelope parts.
- 5.5a Significant reductions in thermal performance can occur where the air barrier and the insulation layer are not contiguous and the cavity between them is subject to air movement. To avoid this problem, either the insulation layer should be contiguous with the air barrier at all points in the building envelope, or the space between them should be filled with solid material such as in a masonry wall.
- 5.6 A suitable approach to showing the requirement has been achieved would be to submit a report signed by a suitably qualified person confirming that appropriate design details and building techniques have been specified, and that the work has been carried out in ways that can be expected to achieve reasonable conformity with the specifications. Reasonable provision would be to:
- a. adopt design details published on the Accredited Construction Details website¹⁸; or
 - c. demonstrate that the specified details provide adequate protection against surface condensation using the guidance in IP 1/06¹⁹ and BR 497²⁰.

RENOVATION OF THERMAL ELEMENTS

- 5.7 Where a **thermal element** is subject to **renovation**, the performance of the whole element should be improved to achieve or better the relevant U-value set out in column (b) of Table 5. The definition of **renovation** is given in paragraph 3.1.
- 5.8 If achievement of the relevant U-value set out in column (b) of Table 5 is not technically or functionally feasible or would not achieve a **simple payback** of 15 years or less, the element should be upgraded to the best standard that is technically and functionally feasible and which can be achieved within a **simple payback** of no greater than 15 years. Guidance on this approach is given in Appendix A in ADL1B.

¹⁸ See Volume 1, Chapter 3 of this consultation document.

¹⁹ IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings*, BRE 2006.

²⁰ BRE Report BR 497 *Conventions for calculating linear thermal transmittance and temperature factors*, 2007.

RETAINED THERMAL ELEMENTS

- 5.9 Part L of Schedule 1 to the Building Regulations applies to **thermal elements** in the following circumstances:
- a. where an existing **thermal element** is part of a building subject to a material change of use;
 - b. where an existing element is to become part of the thermal envelope, [where previously it was not](#);
 - c. where an existing element is being upgraded as a **consequential improvement** (regulation 17D) in accordance with paragraphs 6.1 to 6.10.
- 5.10 Reasonable provision would be to upgrade those **thermal elements** whose U-value is worse than the threshold value in column (a) of Table 5 to achieve the U-value given in column (b) of Table 5, provided this is technically, functionally and economically feasible. A reasonable test of economic feasibility is to achieve a **simple payback** of 15 years or less. Where the standard given in column (b) is not technically, functionally or economically feasible, then the element should be upgraded to the best standard that is technically and functionally feasible and which meets a **simple payback** criterion of 15 years or less. [Generally, this lesser standard should not be worse than 0.7 W/m².K.](#)

Examples of where lesser provision than column (b) might apply are where the thickness of the additional insulation might reduce usable floor area by more than 5% or create difficulties with adjoining floor levels, or where the weight of the additional insulation might not be supported by the existing structural frame.

Table 5: Upgrading retained thermal elements		
Element¹	U-value W/m².K	
	(a) Threshold	(b) Improved
Wall – cavity insulation	0.70	0.55 ²
Wall – external or internal insulation	0.70	0.30 ³
Pitched roof – insulation at ceiling level	0.35	0.16
Pitched roof – insulation at rafter level	0.35	0.16
Flat roof or roof with integral insulation	0.35	0.16
Floors ^{4,5}	0.70	0.25

Notes:

¹ “Roof” includes the roof parts of dormer windows, and “wall” includes the wall parts (cheeks) of dormer windows.

² This only applies in the case of a cavity wall capable of accepting insulation. Where this is not the case it should be treated as for “wall – external or internal insulation”.

³ A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall.

⁴ The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged building.

⁵ A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels.

Section 6: Consequential improvements

- 6.1 Regulation 17D of the Building Regulations may require additional work to be undertaken to make an existing building more energy efficient when certain types of building work are proposed.
- 6.2 This requirement arises where the proposed work consists of:
- a. an extension;
 - b. the initial provision of any **fixed building service** (other than a renewable energy generator);
 - c. an increase to the installed capacity of any **fixed building service** (other than a renewable energy generator);
 - d. an increase in the conditioned or habitable area.

Via d) it is proposed to extend Reg 17D to pick up such work as loft and garage conversions which are not extensions in the strict application of the term.

- 6.3 Where regulation 17D applies, **consequential improvements**, in addition to the proposed building work (the **principal works**), should be made to ensure that the building complies with Part L, to the extent that such improvements are technically, functionally and economically feasible. Paragraphs 6.4 to 6.10 below set out guidance on what will constitute technically, functionally and economically feasible **consequential improvements** in various circumstances.

*The **principal works** must comply with the **energy efficiency requirements** in the normal way.*

- 6.3a Where improvement works other than the “trigger activities” listed in regulation 17D (1) are planned as part of the building work, owners can use these as contributing to the **consequential improvements**. The exception to this is if additional work is being done to the existing building to compensate for a poorer standard of an extension (see paragraph 4.10a).

*For example, if as well as extending the building, the proposals included total window replacement, then the window replacement work would satisfy the requirement for **consequential improvements**, provided the cost was at least 10% of the cost of the extension.*

- 6.4 Measures such as those listed in Table 6 that achieve a **simple payback** not exceeding 15 years will be economically feasible unless there are unusual circumstances.

For example, if the remaining life of the building is less than 15 years it would only be economic to carry out improvements with payback periods within that life.

Table 6: Improvements that in ordinary circumstances are practical and economically feasible

Items 1 to 7 will usually meet the economic feasibility criterion set out in paragraph 6.4. A shorter payback period is given in item 8 because such measures are likely to be more capital intensive or more risky than the others.

No.	Improvement measure
1	Upgrading heating systems more than 15 years old by the provision of new plant or improved controls.
2	Upgrading cooling systems more than 15 years old by the provision of new plant or improved controls.
3	Upgrading air-handling systems more than 15 years old by the provision of new plant or improved controls.
4	Upgrading general lighting systems that have an average lamp efficacy of less than 40 lamp-lumens per circuit-watt and that serve areas greater than 100 m ² by the provision of new luminaires or improved controls.
5	Installing energy metering following the guidance given in CIBSE TM 39.
6	Upgrading thermal elements which have U-values worse than those set out in column (a) of Table 5 following the guidance in paragraphs 5.9 and 5.10.
7	Replacing existing windows, roof windows or rooflights (but excluding display windows) or doors (but excluding high usage entrance doors) which have a U-value worse than 3.3 W/m ² .K following the guidance in paragraphs 4.20 to 4.23.
8	Increasing the on-site low and zero carbon (LZC) energy-generating systems if the existing on-site systems provide less than 10% of on-site energy demand, provided the increase would achieve a simple payback of seven years or less.
9	Measures specified in the Recommendations Report produced in parallel with a valid Energy Performance Certificate.

Consequential improvements on extending a building

Constructing a new free-standing building on an existing site (e.g. a new out-patients building at an existing hospital site, or a new classroom block at a school) is not an extension. These should be treated as new buildings.

- 6.5 Where a building is extended, [or the habitable area is increased](#), a way of complying with regulation 17D would be to adopt measures such as those in Table 6 to the extent that their value is not less than 10% of the value of the **principal works**. The value of the **principal works** and the value of the **consequential improvements** should be established using prices current at the date the proposals are made known to the **BCB**. They should be made known by way of a report signed by a suitably qualified person as part of the initial notice or deposit of plans.

An example of a suitably qualified person would be a chartered quantity surveyor.

Consequential improvements on installing building services

6.6 Where it is proposed to install a **fixed building service** as a first installation, or as an installation which increases the installed capacity per unit area of an existing service, reasonable provision would be to:

- a. firstly improve **the fabric of** those parts of the building served by the service, where this is economically feasible; and

*This means for example that if heating systems are to be installed for the first time in a building or part thereof, or the installed heating capacity per unit area of an existing system is to be increased, the fabric should be improved. The aim in these cases is to make cost-effective improvements to the performance of the fabric so that the installed capacity (and the initial cost) of the **fixed building services** and their subsequent energy consumption are not excessive.*

- b. additionally, make improvements in line with the guidance in paragraph 6.3. The cost of any improvement made as a result of following the guidance in sub-paragraph a. above cannot be taken as contributing to the value of the **consequential improvements** specified in paragraph 6.3.

If only the improvements under a) were made, then the CO₂ emissions from the building might well increase as a result of the higher level of servicing. By also requiring the general improvements in b), an overall improvement should be achieved.

6.7 For the purposes of this Approved Document, the installed capacity of a **fixed building service** is defined as the design output of the distribution system output devices (the terminal units) serving the space in question, divided by the **total useful floor area** of that space.

This means that if (e.g.) the size of central boiler plant is increased to serve a new extension rather than to increase the heating provision in the existing building, the consequential improvements in paragraph 6.5 would be required but those in the following paragraphs would not apply.

6.8 Reasonable provision for improving **the fabric of** those parts of the building served by the service in line with 6.6 sub-paragraph a. above would be to follow the guidance in paragraphs 6.9 and 6.10 to the extent that the work is technically, functionally and economically feasible. The extent of such work is not limited by the 10% threshold. The following paragraphs give guidance on what in normal circumstances would be economically feasible.

6.9 Where the installed capacity per unit area of a heating system is increased:

- a. the **thermal elements** within the area served which have U-values worse than those set out in column (a) of Table 5 should be upgraded following the guidance in paragraphs 5.9 and 5.10; and
- b. existing windows, roof windows or rooflights (but excluding display windows) or doors (but excluding high usage entrance doors) within the area served and which have U-values worse than $3.3 \text{ W/m}^2 \cdot \text{K}$ should be replaced following the guidance in paragraphs 4.20 to 4.23.

6.10 Where the installed capacity per unit area of a cooling system is increased:

- a. **thermal elements** within heated areas which have U-values worse than those set out in column (a) of Table 5 should be upgraded following the guidance in paragraphs 5.9 and 5.10; and
- b. if the area of windows, roof windows (but excluding display windows) within the area served exceeds 40% of the façade area or the area of rooflights exceeds 20% of the area of the roof and the design solar load exceeds 25 W/m^2 , then the solar control provisions should be upgraded such that at least one of the following three criteria is met:
 - i. the solar gain per unit floor area averaged over the period 0630 to 1630 GMT is not greater than 25 W/m^2 when the building is subject to solar irradiancies for July as given in the table of design irradiancies in CIBSE Design Guide A;
 - ii. the design solar load is reduced by at least 20%;
 - iii. the effective g-value is no worse than 0.3; and

This will reduce the solar gain and hence the space cooling demand. Section 5.1 of TM 37²¹ gives guidance on calculating solar gains, and Sections 4.4 and 4.5 give guidance on the effective g-value.

- c. any general lighting system within the area served by the relevant **fixed building service** which has an average lamp efficacy of less than 45 lamp-lumens per circuit watt should be upgraded with new luminaires and/or controls following the guidance in the [Non-Domestic Building Services Compliance Guide](#).

This will the reduce the lighting load and hence the space cooling demand.

²¹ TM 37 *Design for improved solar shading control*, CIBSE, 2006.

Section 7: Providing information

- 7.1 On completion of the work, in accordance with paragraph L1(c) of Schedule 1, the owner of the building should be provided with sufficient information about the building, the **fixed building services** and their operating and 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. [This requirement only applies to the work that has actually been carried out – e.g., if the work involves replacing windows, there is no obligation on the contractor to provide details on the operation of the heating system.](#)

Building log book

- 7.2 A way of showing compliance [with the requirement](#) would be to produce the necessary information following the guidance in CIBSE TM 31 *Building log book toolkit*²², or to add it to an existing log book. If an alternative guidance document is followed in preparing the log book, then the information conveyed and the format of presentation should be equivalent to TM 31.
- 7.3 The information should be presented in templates as or similar to those in TM 31. The information should be provided in summary form, suitable for day-to-day use. It could draw on or refer to information available as part of other documentation, such as the Operation and Maintenance Manuals and the Health and Safety file required by the CDM Regulations .
- 7.4 The new or updated log book should provide details of:
- a. any newly provided, renovated or upgraded **thermal elements** or **controlled fittings**;
 - b. any newly provided **fixed building services**, their method of operation and maintenance;
 - c. any newly installed energy meters; and
 - d. any other details that collectively enable the energy consumption of the building and building services constituting the works to be monitored and controlled.

²² TM 31 *Building log book toolkit*, CIBSE, 2006.

Volume 2, Chapter 5

Proposed changes to the National Calculation Methodology

Introduction

1. This chapter of the consultation document summarises the key changes to the National Calculation Methodology (NCM). The full details of the NCM are available on line¹ for those who want to explore all the detail. The web reference given below contains versions of the government produced compliance tools as well as user and technical documentation.
2. The consultation considers two main approaches to setting the new build targets in 2010: the “flat 25%” approach and the “aggregate 25%” approach. There is also a hybrid option to apply the “flat 25%” approach to new dwellings and the “aggregate 25%” to new non-domestic buildings, which is the Government’s preferred option.

The “flat 25%” approach

3. In this approach, the 2010 target is defined as a further 25% improvement compared to a 2006 compliant building. The energy performance of the 2006 building would be determined as currently. For new homes, this approach is based on level 3 in the Code for Sustainable Homes energy section, and therefore represents a target with which many developers and housebuilders will be familiar.
4. As well as familiarity, this approach has an advantage of simplicity, although an intermediate step is necessary as the 2006 value would have to be recalculated using the 2010 emission factors and then this revised value reduced by 25%.
5. We also need to re-define the notional dwelling to account for the fact that a party wall between connected dwellings is not a zero heat loss wall. A particular problem is that the party wall with non-zero U-value should be introduced at the 2006 standard (since the effect was not identified/quantified until after 2006, and so all the benefit should be taken at 2010). However, it is impractical to develop a 2006 notional dwelling as part of the algorithm to be built into SAP 2009. Consequently, the non-zero party wall must be included in the 2002 notional dwelling, and an adjustment made in relation to its impact².

¹ See www.2010ncm.bre.co.uk for SAP and SBEM consultation software, user guides, NCM modelling guide etc.

² The problem is that the benefit of improving the party wall will be reduced because of the 2006 improvement factor. To compensate for this effect, we have increased the party wall U-value on the 2002 notional dwelling to be 0.4 W/m².K. The derivation of the flat 25% solutions for the Impact Assessment was done manually, and was based on developing a 2006 compliant dwelling, where the party wall had a U-value of 0.3 W/m².K (the average assumed for the stock as a whole).

6. The flat 25% approach has some methodological disadvantages compared to the aggregate approach for all sectors:
 - a) for dwellings, it may not eliminate the so-called “code 4 loophole”, whereby electric heat pump solutions can achieve the TER using fabric solutions that are less demanding than for a gas heated dwelling³;
 - b) for non-dwellings, it does not eliminate the unintended consequence of the 2006 standard, whereby developers apparently chose to install air conditioning because it was easier to meet the target than to adopt less energy intensive strategies like natural ventilation.

The “aggregate 25%” approach

7. In the 2006 edition of Part L, the target was set in terms of a specified improvement on the performance of a 2002 compliant notional building. The “aggregate” approach achieves an aggregate 25% improvement⁴ across all types of building that largely equalises the marginal abatement cost. This means that the target for each building type has similar marginal cost per tonne of carbon dioxide (CO₂) saved, but some buildings will deliver more than 25% improvement, others less. The approach is described in more detail in the Impact Assessment that forms part of this consultation package.
8. This approach has merit in that as we make further improvements in standards, there will need to be a move from further increases in energy efficiency into renewables. Marginal abatement cost is a good indicator of the point at which this transition should occur.
9. Under this approach, the 2010 target would be set via the definition of a notional building whose specification is based on approximately equal marginal abatement costs. This means that there is no longer any improvement factor; the performance of the notional building as specified represents the CO₂ target. As far as designers and builders are concerned, the use of compliance tools will appear no different. For the building under consideration, the software will generate a Target Emission Rate (TER) as before, with the only difference being in the algorithms that generate the TER. Consequently, the change in approach would principally affect those involved in developing compliance tools, rather than the users of those tools.

³ The proposed change to the CO₂ emission factors will help to ameliorate this problem.

⁴ Separate 25% aggregate targets have been set for dwellings and for buildings other than dwellings.

10. For both dwellings and buildings other than dwellings multiple notional buildings would be used:
- a) a common specification for most dwelling types, from flats to detached houses. The specification is essentially the same for all fuels, the only exception being the heating system efficiency, which is varied if other than the conventional fossil fuels are used. However, since flats that use electric resistance heating are a significant proportion of the current market, a specific analysis has been made for that sector, and a specific notional dwelling derived⁵. This has significantly more demanding fabric standards than the notional dwelling specified for non-electric resistance heating. Note that for Part L 2010, under this approach electric heat pumps would use the same notional dwelling as all other fuels – only electric resistance heating uses the more demanding notional specification (see Table 1);
 - b) for non-dwellings, the most significant design variant is the amount and disposition of glazing, and this tends to be markedly different between different built forms. Three notional buildings have therefore been defined:
 - i) sidelit through vertical windows (offices, halls of residence etc);
 - ii) toplit through rooflights (warehouses, industrial, retail sheds etc);
 - iii) no glazing (theatres, cinemas etc).

Note that the building used to generate the TER for an actual building is likely to be made up of zones to which differing notional specifications will apply. For example, in a distribution warehouse the main storage area will have the toplit specification, with the office areas taking the sidelit specification.

11. Another change in the approach to target setting is the basis on which the target is varied by fuel. This means that for dwellings, the fuel factor is no longer included in the target setting process. Two issues have led to this different approach:
- a) concerns that the more demanding energy efficiency standards for buildings that use higher carbon content fuels (as adopted in 2006) was disadvantaging rural communities that are off the gas grid and therefore do not have the option to use mains gas;
 - b) a concern that the target could be achieved by utilising low carbon heating fuels in buildings with relatively poor energy efficiency. Because of the need to secure energy supplies, the view is that the target should ensure reasonable energy efficiency in all cases. Although the limits on design flexibility offer a way of preventing the worst excesses of this problem, relying solely on these long stops could not constrain the design of biomass heated homes without placing excessive constraints on conventionally heated dwellings.

⁵ This separate electric resistance specification is intended to be temporary with the electric heating option eventually having the same fabric specification as other fuels and being based on a heat pump solution. This change would be progressive to allow the electric heating industry time to diversify into new product areas and remain in the marketplace.

12. These considerations have led to the concept of varying the TER based on the fuel used for space heating. The TER is still based on the performance of a notional building whose specifications are largely fixed. The only variants (within a given sector) are the efficiencies taken for the heating systems (space and hot water) and the CO₂ emission factor associated with those heating systems. The net result is that most buildings have comparable energy efficiency standards irrespective of fuel. The exception is those dwellings that adopt electric resistance heating, which have to meet a more demanding energy efficiency standard. Also, buildings that use solid mineral fuels will have to meet higher energy efficiency standards.
13. In general, the heating fuel used for the space heating in the actual building is applied to all the heating demands (both space and water heating) in the notional building, and a standard efficiency associated with that fuel is then applied⁶. The one exception to this general rule is where space heating is provided by biomass (taken as having a CO₂ emission factor <0.075 kgCO₂/kWh); in this case, water heating should be taken as being provided by either the same fuel as used in the actual building or oil⁷, whichever fuel has the lower emission factor.
14. The heating demand of the notional building (space and hot water) would be calculated in the normal way, and the associated emissions are then obtained by multiplying the heating demand by the ratio of the emission factor of the fuel used in the actual dwelling to the appropriate heating system efficiency. Emission factors and heating system efficiencies are given in Table 1 for dwellings and in Table 2 for buildings that are not dwellings.
15. To illustrate, if a dwelling is heated by a gas-fired boiler providing space heating and stored hot water, then the total heat demand in the notional dwelling is converted to emissions by multiplying by 0.206/0.90. If a dwelling has a woodchip-fired boiler serving the space heating, but the water is heated by an electric immersion heater, the space heating demand in the notional dwelling is converted to emissions by multiplying by 0.015/0.70 (0.015 is the value for woodchip), and the hot water demand is multiplied by 0.284/0.90 (0.284 is the value for heating oil).

⁶ These efficiencies are based on the minimum for that fuel as given in the building services compliance guides.

⁷ Heating oil for dwellings, fuel oil for non-dwellings

Table 1: Dwellings – seasonal heating system efficiencies and emission factors to be used in the notional dwelling

Fuel in actual dwelling	Heating system used in notional dwelling to calculate the TER	
	Efficiency	CO ₂ emission factor kgCO ₂ /kWh
Biomass (i.e. fuels with an emission factor <0.075 kgCO ₂ /kWh)	70% + standard fabric spec.	The factor for the particular biomass fuel as taken from DECC consultation table ⁸
Natural gas	90% + standard fabric spec.	0.206
Lpg	90% + standard fabric spec.	0.251
Heating oil	90% + standard fabric spec.	0.284
Electric heat pump	270% + standard fabric spec.	0.591
Electric resistance	100% + more demanding fabric spec.	0.591
Other fuels with an emission factor >0.284 kgCO ₂ /kWh	90% + standard fabric spec.	0.284

Note: For mixed fuels (e.g. kerosene/biofuel, coal/wood) and heat supplied from district heating/CHP schemes, the emission factor should be taken as being the same as calculated for the actual dwelling. The heating system efficiency should be taken as:

70% if the emission factor is less than or equal to 0.15 kgCO₂/kWh
90% if the emission factor is greater than or equal to 0.20 kgCO₂/kWh
If 0.15 <emission factor < 0.20, the heating system efficiency can be calculated by linear interpolation; e.g. if the emission factor is 0.16, the efficiency would be 74.0%.

⁸ STP09/CO201 Revised emission factors for the National Calculation Methodologies, BRE, 2009, available at www.bre.co.uk/sap2009

Table 2: Buildings other than dwellings – seasonal heating system efficiencies and emission factors to be used in the notional building

Main heating fuel in actual building	Heating system used in notional building to calculate the TER	
	Efficiency	CO ₂ emission factor kgCO ₂ /kWh
Biomass (i.e. fuels with an emission factor <0.075 kgCO ₂ /kWh)	70%	The factor for the particular biomass fuel as taken from DECC consultation table ⁸ .
Natural gas	88%/82% *	0.206
Lpg	88%/82% *	0.251
Fuel oil	88%/82% *	0.306
Electric heat pump	270%	0.591
Electricity (direct)	100%	0.306
Other fuels with an emission factor >0.306 kgCO ₂ /kWh	88%/82% *	0.306

* 88% should be used for the heating system in sidelit/no glazing specifications, with 82% being used in the toplit specifications⁹. 88% should be used for hot water generation in all cases.

For the notional building, the worst acceptable standard of carbon intensity of heating (emission factor divided by efficiency) is equivalent to that for oil-fired heating – hence when electric resistance heating is specified in the actual building, the efficiency and emission factor used in the notional building are based on oil, not electricity. The net result is that if electric resistance heating is specified, the design will have to compensate for the higher emissions by increased energy efficiency elsewhere.

Note: For mixed fuels (e.g. kerosene/biofuel, coal/wood) and heat supplied from district heating/CHP schemes, the emission factor should be taken as being the same as calculated for the actual dwelling. The heating system efficiency should be taken as:

70% if the emission factor is less than 0.15 kgCO₂/kWh
88% if the emission factor is greater than 0.20 kgCO₂/kWh
If 0.15 <emission factor < 0.20, the heating system efficiency can be calculated by linear interpolation; e.g. if the emission factor is 0.16, the efficiency would be 73.6%.

Combined Heat and Power (CHP)/Trigeneration

16. The convention adopted in the treatment of emission factors is to assume all electricity used or generated has an emission factor equivalent to the grid average (0.591 kgCO₂/kWh). If the system consumes F kWh of fuel in generating H kWh of heat, C kWh of cooling and E kWh of electricity, then the emission factor for the heat and the coolth shall be taken as being the same, i.e. the emissions attributed to heating and cooling are in proportion to the thermal outputs. The emission factors are given by the following expression:

$$CO_{2H} = CO_{2C} = \frac{1}{(H+C)} * (F * CO_{2F} - E * CO_{2E})$$

⁹ These figures correspond to expected efficiencies for the type of heating systems commonly adopted for the different types of space, i.e. a wet central heating installation and unit radiant heaters respectively.

17. Note that it is possible for the emission factor for heating (and cooling where applicable) to be negative if the system is fired by a low carbon content fuel such as biomass. Although negative emission factors may initially seem illogical, the overall carbon accounting is satisfactory, provided all electricity used in the building is also charged at the grid average, and NOT at a specific factor associated with the particular CHP installation.

Key specification details

18. The following tables detail the key parameters that define the performance of the notional buildings.

Dwellings

19. Other than the changes specified in the table below, the specification is as per Appendix R of SAP 2005:

Element	Standard specification	Electric resistance heating specification
Roof U-value (W/m ² .K)	0.19	0.16
Wall U-value (W/m ² .K)	0.29	0.23
Floor U-value (W/m ² .K)	0.24	0.21
Window & door U-value (W/m ² .K)	1.7	1.5
Party wall U-value (W/m ² .K)	0	0
Thermal bridging (y-value)	0.04	0.04
Thermal mass parameter (KJ/m ² .K)	250	250
Air permeability (m ³ /h.m ²) at 50 Pa)	7.0	7.0
Heating system efficiency (%)	90	100
Secondary heating	None	None
Hot water cylinder insulation thickness (mm)	100	100
Ventilation system	Natural	Natural
Lighting (% CFL)	100	100

Buildings other than dwellings

20. For non-dwellings, three notional “building” specifications have been derived that vary depending on the dominant form of daylighting. The generic forms are:
- sidelit through vertical windows (offices, halls of residence etc). These have 40% glazing with 10% framing factor;
 - toplit through rooflights (warehouses, industrial buildings etc). These are 12% glazed with 30% framing factor;
 - no glazing (theatres, cinemas etc).

21. The NCM activity database is being revised to:

- a) include a key that determines which of the above specifications should be selected. This will be a function of the use of the space;
- b) limit the choice users have over the allocation of activity areas. There is anecdotal evidence that some users have been “tweaking” the selection of activities to make compliance easier to achieve. As part of improving consistency of application and compliance, we propose that the activities be restricted and driven by the Planning Use Class appropriate to the building.

It should be noted that the 25% aggregate specification was derived using activity definitions based on the current “live” version of the activity database. The consultation version of SBEM will include the revised database, and this may have some impact on results. Other improvements to SBEM are being made which will also impact on results. These changes are detailed in Appendix A.

22. As previously, the notional building will contain the same amount of display glazing and vehicle access doors as in the actual building. Thus by varying the generic notional specification, the specific mix of activities and the proportions of display glazing and vehicle access doors, a specific but equitable target can be derived for each building.

23. The other main changes to the specification of the notional buildings are as given in the following table:

Element	Sidelit/No glazing	Toplit specification
Roof U-value (W/m ² .K)	0.15	0.24
Wall U-value (W/m ² .K)	0.18	0.30
Floor U-value (W/m ² .K)	0.21	0.22
Window & door U-value (W/m ² .K)	1.6	1.8
Air permeability (m ³ /h.m ²) at 50 Pa)	5.0	5.0
Space heating system efficiency (%)	88	82
Hot water heating system efficiency (%)	88	88
Central mechanical ventilation system SFP (W/l.s ⁻¹)	1.8	1.8
Heat recovery (sensible effectiveness)	75%	75%
Lighting (lumens/W)	65	75
Cooling seasonal energy efficiency ratio (-)	3.5	3.5

Appendix A: Changes to SBEM

1. In addition to the new method of setting the target emission rate, other changes to SBEM are being implemented as explained below.

NCM activity database

2. The current NCM activity database has around 500 activities, many of which are replicated. There are also around 10,000 individual daily profiles. It was therefore thought advisable to rationalise the number of activities and daily profiles to make the database more manageable. The rationalisation of activity types in some cases will result in the consolidation of various activities. It is anticipated that the number of activities will be reduced from around 500 to around 300, while the 10,000 daily profiles will be reduced to around 3,000.
3. In addition to the rationalisation, the database is being upgraded to accommodate the new notional building recipes and the Planning Use classes. Also, some activities such as frozen/chilled storage and car parks¹⁰ are being added to the activity areas for relevant building types.

Psi-value calculation

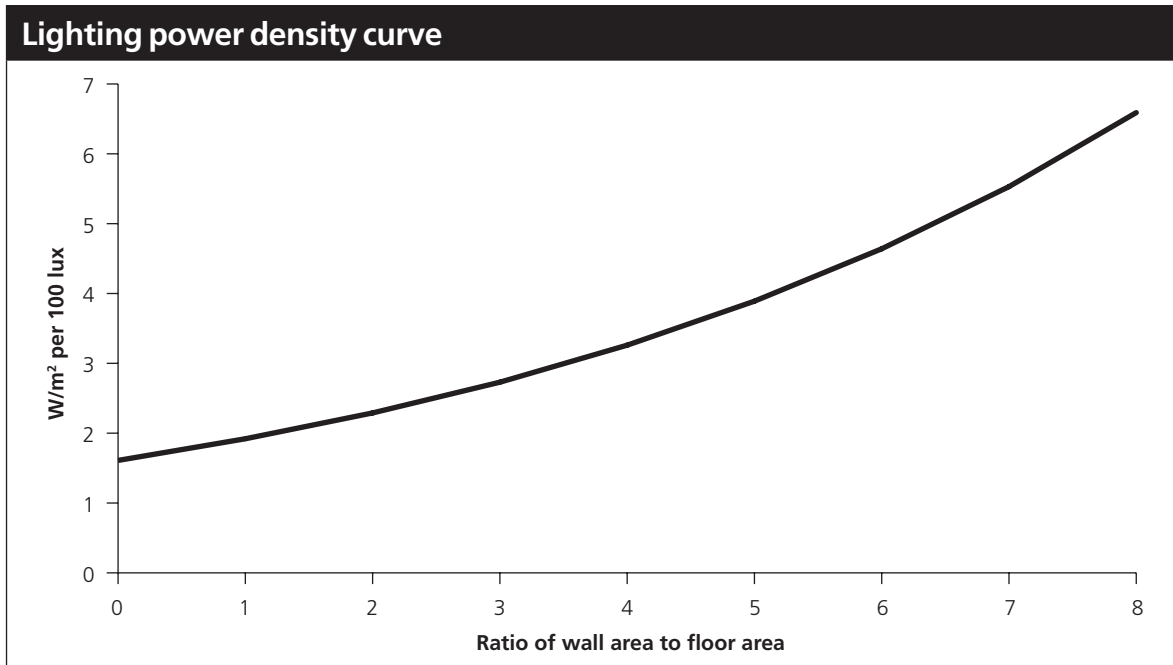
4. Currently the Psi value calculation is only applied to the actual building, whereas the notional building gets a fixed Alpha value of 10%. As building size reduces, the relative importance of thermal bridging due to junctions increases. Therefore using a fixed Alpha-value has greater impact the smaller the building. In the 2010 version, the thermal bridges will be based on a specific assessment of thermal bridge length so that an equitable allowance is made for this increasingly important parameter.

Lighting power density for the notional building

5. The lighting power density currently used for the notional building is based on just two values: 3.75 W/m²/100 lux for office/storage/industrial spaces, and 5.2 W/m²/100 lux for everything else. In reality for a given luminaire efficacy, the lighting power density can vary considerably depending on the size and shape of the space it is applied to. This means that 3.75 W/m²/100 lux is very easy to achieve for a large open plan office, but much more difficult in a small cellular office.

¹⁰ Although an activity such as a car park does not have heating or cooling, it does have lighting and may also include mechanical ventilation.

6. The proposed upgrade for 2010 is to calculate the lighting power density based on and the ratio of wall area to floor area. A curve that describes this relationship is provided below:



Calculation of auxiliary energy for both actual and notional building

7. Currently the auxiliary energy for the actual building (i.e. fans/pumps/controls) is based only on the type of HVAC system used, and does not take account of the type of activity it is applied to. The problem is that the fan energy element in air-conditioned systems currently only applies to the fresh air component of the air supply. In all air systems, the air volumes are increased to offset the overall cooling load, and for some activities the internal gains mean that the required airflow is significantly greater than the fresh air rate. This was not reflected in the auxiliary energy demand.
8. Similarly for the notional building, the proposed changes really only affect the auxiliary energy for air conditioning systems. Currently the auxiliary energy is the greater of either a fixed value of 8.5 W/m² or the product of the appropriate SFP with the minimum fresh air rate set by the activity. In practice the 8.5 W/m² is always used, which in some situations leads to buildings with inappropriate systems getting an easy pass, while for others it unfairly penalises HVAC systems that are in practice most suitable for the type of activity.

9. The proposed method is for SBEM to calculate the fan energy for air conditioning systems taking account of the peak heating/cooling loads, the internal gains defined by the activity type, and the solar/fabric gains/losses. This method would be applied to both the actual and notional building. The method also accommodates the new method of determining the lighting power density described in the previous section.

Volume 2, Chapter 6

**Proposed Domestic Building Services
Compliance Guide**

2010 Edition

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Section 1: Introduction

Note: Any reference to building regulations in this guide is to building regulations in England and Wales, Scotland and Northern Ireland.

1.1 Scope

This guide provides detailed guidance for persons installing **fixed building services** in new and existing dwellings to help them comply with building regulations. It covers work on both **new systems** and **replacement systems**, identifying the differing requirements where these exist.

This edition of the guide covers conventional means of providing primary and secondary space heating, domestic hot water, mechanical ventilation, cooling and lighting. In addition, it covers microgeneration of heat and electricity by heat pumps, solar thermal panels, combined heat and power (micro-CHP), wind turbines and solar photovoltaic (PV) panels.

It is important to note that this guide covers a range of frequently occurring situations but alternative means of achieving compliance with the functional requirements of building regulations may be possible.

The guide also refers to publications which include information on good practice for design and installation over and above the minimum standards in this guide.

1.2 Status of guide

Building regulations contain functional requirements (called standards in Scotland), such as requirements that buildings must be structurally stable, must be constructed and fitted to ensure reasonable levels of fire protection, and must be reasonably energy efficient. These functional requirements are often drafted in broad terms, and so it may not always be immediately clear to a person carrying out work how to comply with the relevant requirements. Consequently, documents are often issued which provide practical guidance on ways of complying with specific aspects of building regulations in some of the more common building situations. Those documents are called Approved Documents in England and Wales, Technical Handbooks in Scotland and Technical Booklets in Northern Ireland.

Approved Documents, Technical Handbooks and Technical Booklets are intended to provide practical guidance but they are not intended to be comprehensive. Consequently, they may contain references to other documents which will provide more detailed information and assistance on parts of the guidance. This guide is one of those documents. It provides more detailed information on the guidance about compliance with the energy efficiency requirements which apply when installing **fixed building services** in new and existing buildings contained in Approved Documents L1A and L1B, Section 6 of the Domestic Technical Handbook, and Technical Booklet F1.

Note: Following guidance in an Approved Document, Technical Handbook or Technical Booklet does not guarantee compliance with building regulations. If you follow the guidance in an Approved Document, Technical Handbook or Technical Booklet and in any document referred to (such as this guide) which provides additional information to help you follow that guidance, there is a legal presumption that you have complied with building regulations. However, in every case it is for the building control body to decide whether work complies with building regulations. So, you should always check with the building control body before you start work what they consider it is necessary for you to do to comply with building regulations.

1.3 How to use this guide

The guide comprises four self-contained fuel-based sections, and eleven technology-specific sections:

- Fuel-based sections:
 - Section 2: Gas-fired primary and secondary space heating and hot water
 - Section 3: Oil-fired primary and secondary space heating and hot water
 - Section 4: Electric primary and secondary space heating and hot water
 - Section 5: Solid fuel primary and secondary space heating and hot water
- Technology-specific sections:
 - Section 6: Community heating
 - Section 7: Underfloor heating
 - Section 8: Mechanical ventilation
 - Section 9: Heat pumps
 - Section 10: Comfort cooling
 - Section 11: Solar water heating
 - Section 12: Lighting
 - Section 13: Micro-combined heat and power
 - Section 14: Wind turbines
 - Section 15: Photovoltaic panels
 - Section 16: Heating system circulators

For any particular application, reference may need to be made to more than one section.

“Supplementary information” that may help with interpreting the minimum energy efficiency provisions needed to comply with the Building Regulations is in *italic font with a yellow background*. In some cases there are links to best practice guidance that goes beyond the minimum requirements.

Key terms are shown in ***italic bold font***.

1.4 Key terms

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

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

New system means fixed building services installed in a new building or for the first time in an existing building.

Replacement system means fixed building services installed as a replacement for a system in an existing building.

Seasonal efficiency means the SEDBUK¹ value of a heating appliance.

1.5 Replacement of primary heating appliances

When replacing an existing appliance, the efficiency of the new appliance should not be significantly less than the efficiency of the appliance being replaced. If the replacement involves a fuel switch, then the relative carbon emissions associated with the new and existing fuels should be considered when assessing the reasonableness of the proposed new appliance. The aim is to discourage replacement of an existing appliance by a significantly less carbon efficient one.

The minimum requirements are:

Replacement not involving fuel or energy switch

Where the primary heating appliance is replaced by one using the same fuel or energy supply, the seasonal efficiency of the new equipment should be:

- a. as stated in the relevant fuel-based section of this guide; and
- b. not worse than two percentage points lower than the seasonal efficiency of the controlled service being replaced. If the efficiency of the appliance to be replaced is not known, efficiency values may be taken from Table 4a or 4b of SAP 2009.

¹ www.boilers.org.uk

Replacement involving fuel or energy switch

If the new heating appliance uses a different fuel, the efficiency of the new service should be multiplied by the ratio of the CO₂ emission factor of the fuel used in the service being replaced to that of the fuel used in the new service, to obtain the “carbon equivalent efficiency”. The checks described in paragraphs (a) and (b) above should then be made. The CO₂ emission factors should be taken from Table 12 of SAP 2009.

Examples

1. An old oil-fired boiler with a seasonal efficiency of 72% is to be replaced by a dual solid fuel boiler. The new dual solid fuel boiler should have:
 - a. a seasonal efficiency not less than 65% (from Table 18 in this guide); and
 - b. a carbon equivalent efficiency not less than 70%.

A dual solid fuel boiler with a seasonal efficiency of 65% will meet condition (b) as its carbon equivalent efficiency is:

$$65\% \times (0.284 \div 0.243) = 76.0\%$$

where 0.284 and 0.243 kgCO₂/kWh are the emission factors for oil and dual solid fuels respectively.

2. An LPG-fired boiler of 83% efficiency is to be replaced with an oil boiler. The new oil boiler should have:
 - a. a seasonal efficiency not less than 90% (from Table 9); and
 - b. a carbon equivalent efficiency not less than 81%.

To meet condition (b), the seasonal efficiency of the proposed new oil boiler should therefore be at least:

$$81\% \div (0.251 \div 0.284) = 91.6\%$$

where 0.251 and 0.284 kgCO₂/kWh are the emission factors of LPG and oil respectively.

Section 2: Gas-fired space heating and hot water systems

2.1 Scope of guidance

This section provides guidance on the specification of gas-fired space heating and hot water systems² in dwellings to meet minimum energy efficiency standards in building regulations. The guidance applies to systems fuelled by natural gas and liquid petroleum gas (LPG) and covers:

- Wet central heating systems
- Range cookers with integral central heating boilers
- Warm air heating systems
- Fixed independent space heating devices

2.2 Gas-fired wet central heating systems

Gas-fired wet central heating systems for dwellings should meet the minimum standards for:

- a. boiler efficiency, system circulation, hot water storage, system preparation and commissioning in Table 1;
- b. boiler interlock, zoning, and time and temperature control of the heating and hot water circuits in Table 2; and
- c. pipework insulation in Table 3.

² All gas appliances must be installed by a competent person in accordance with the current issue of the Gas Safety (Installation and Use) Regulations. The installation should follow the manufacturer's instructions and should comply with all relevant parts of the Building Regulations and, for wet systems, the Water Regulations.

Table 1: Minimum provisions for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems

Gas-fired wet heating	Standards for new systems	Standards for replacement systems	Supplementary information
1.0 Efficiency	<ul style="list-style-type: none"> a. The boiler efficiency should be not less than 90% (SEDBUK Band A). b. In existing dwellings, in the exceptional circumstances defined in Appendix A, the boiler efficiency (SEDBUK value) should be not less than 78% if natural gas-fired, or not less than 80% if LPG-fired. c. The boiler efficiency for heating boilers that are combined with range cookers should be as defined in Section 2.3 <i>Gas-fired range cookers with integral central heating boiler</i>. 	<p>Replacements not involving a fuel or energy switch</p> <ul style="list-style-type: none"> a. The boiler efficiency should be not less than 90% (SEDBUK Band A); and b. not worse than two percentage points lower than the seasonal efficiency of the controlled service being replaced. If the efficiency of the system or appliance to be replaced is not known, efficiency values may be taken from Table 4a or 4b of SAP 2009. <p>Replacements involving fuel or energy switch</p> <ul style="list-style-type: none"> a. If the new heating system or heat generating appliance uses a different fuel, the efficiency of the new service should be multiplied by the ratio of the CO₂ emission factor of the fuel used in the service being replaced to that used in the new service before making the checks in a and b above. The CO₂ emission factors should be taken from Table 12 of SAP 2009. 	<p>Guidance on identifying the SEDBUK efficiency for an appliance</p> <p><i>The Boiler Efficiency Database is available online at www.boilers.org.uk. It provides regularly updated information on most available boilers as well as many which are no longer in production.</i></p> <p><i>Manufacturers' literature provides SEDBUK values in an agreed form of words to avoid confusion with other efficiency values. Manufacturers will supply SEDBUK values for their products on request.</i></p> <p><i>Appendix A gives the approved procedure for establishing the exceptional circumstances in which boilers may be of the non-condensing type, as set out in the "Guide to the condensing boiler installation assessment procedure for dwellings".</i></p>
2.0 System circulation	<ul style="list-style-type: none"> a. Space heating systems and domestic hot water primary circuits should have fully pumped circulation. b. If the boiler manufacturer's instructions advise installation of a bypass, an automatic bypass valve should be provided and the manufacturer's instructions on minimum pipe length followed. 	<ul style="list-style-type: none"> a. As for new systems. b. When boilers are replaced, existing systems with semi-gravity circulation should be converted to fully pumped circulation. 	

Table 1: Minimum provisions for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems (*continued*)

Gas-fired wet heating	Standards for new systems	Standards for replacement systems	Supplementary information
<p>3.0 Hot water storage</p>	<p>a. Vented copper hot water storage cylinders should comply with the heat loss and heat exchanger requirements of BS 1566:2002 Part 1.</p> <p>b. Copper hot water storage combination units should comply with BS 3198:1981.</p> <p>c. Primary storage systems should meet the insulation requirements of the Hot Water Association <i>Performance specification for thermal stores</i>.</p> <p>d. Unvented hot water storage system products should comply with BS EN 12897:2006 or an equivalent standard as set by an accredited test body such as the British Board of Agrément, the Water Research Council, or KIWA.</p> <p>e. The standing heat loss for all hot water storage vessels in a, b, c and d above should not exceed $Q = 1.15 \times (0.2 + 0.051V^{2/3})$ kWh/day, where V is the volume of the cylinder.</p> <p>f. All hot water vessels should carry a label with the following information:</p> <ul style="list-style-type: none"> i. type of vessel (vented, unvented, combination unit or thermal store); ii. nominal capacity in litres; iii. standing heat loss in kWh/day; iv. heat exchanger performance in kW; v. reference to product compliance with relevant standard (eg BS 1566, BS 12897) and logos of accreditation bodies as required. <p>For labelling requirements for other heat inputs, see relevant sections (eg Section 11 for solar).</p>	<p>a. As for new systems, but</p> <p>b. for replacement copper vented cylinders and combination units, the standing loss should not exceed $Q = 1.28 \times (0.2 + 0.051V^{2/3})$ kWh/day, where V is the volume of the cylinder.</p>	<p><i>If a vented cylinder is made from an alternative material to copper then the heat loss and heat exchange characteristics should be tested in accordance with BS EN 12897:2006.</i></p> <p><i>The HWA thermal storage specification is available for free download from www.hotwater.org.uk</i></p> <p>British Standards</p> <p><i>BS 1566: 2002 "Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods".</i></p> <p><i>BS EN 12897 "Water supply. Specification for indirectly heated unvented (closed) storage water heaters".</i></p> <p><i>BS 3198 "Copper hot water storage combination units for domestic purposes".</i></p>

Table 1: Minimum provisions for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems (*continued*)

Gas-fired wet heating	Standards for new systems	Standards for replacement systems	Supplementary information
<p>4.0 System preparation and water treatment</p>	<ul style="list-style-type: none"> a. Central heating systems should be thoroughly cleaned and flushed out before installing a new boiler. b. During final filling of the system, a chemical water treatment inhibitor meeting the manufacturer’s specification or other appropriate standard should be added to the primary circuit to control corrosion and the formation of scale and sludge. c. Installers should also refer to the boiler manufacturer’s installation instructions for appropriate treatment products and special requirements for individual boiler models. d. Where the mains total water hardness exceeds 200 parts per million, provisions should be made to treat the feed water to water heaters and the hot water circuit of combination boilers to reduce the rate of accumulation of limescale. e. For solar thermal systems, see Section 11. 	<ul style="list-style-type: none"> a. As for <i>new systems</i>. 	<p>British Standards <i>BS 7593:2006 “Code of practice for treatment of water in domestic hot water central heating systems”.</i> <i>Note should also be made of advice in the manufacturer’s instructions.</i> <i>Inhibitors should as a minimum be BuildCert approved.</i> <i>Limescale can be controlled by the use of chemical limescale inhibitors, combined corrosion and limescale inhibitors, polyphosphate dosing, electrolytic scale reducers or water softeners.</i> <i>It is advisable to install valves which will isolate both the radiators and the heating circuit when removing radiators for service or maintenance. Avoiding the need to drain down the system will help to retain the circulating fluid and prevent loss of water treatment.</i></p>

Table 1: Minimum provisions for efficiency, system circulation, hot water storage, system preparation and commissioning for gas-fired wet central heating systems (*continued*)

Gas-fired wet heating	Standards for new systems	Standards for replacement systems	Supplementary information
<p>5.0 Commissioning</p>	<p>a. On completion of the installation of a boiler or hot water storage system, together with associated equipment such as pipework, pumps and controls, the equipment should be commissioned in accordance with the manufacturer’s instructions. These instructions will be specific to the particular boiler or hot water storage system.</p> <p>b. The installer should give a full explanation of the system and its operation to the user, including the manufacturer’s User Manual where provided.</p>	<p>a. As for new systems.</p>	<p>The Benchmark System</p> <p><i>The Benchmark Commissioning Checklist can be used to show that commissioning has been carried out satisfactorily. Benchmark licence-holders provide a checklist with the appliance for completion by the persons commissioning the system so that they can record that all the checks have been made and the results show efficient operation of the equipment in compliance with building regulations. The Benchmark checklist should be provided to the builder, or the householder in the case of work in existing dwellings, an appointed agent, or the end user.</i></p> <p><i>A Benchmark Commissioning Checklist will be included in all HHIC gas boiler manufacturer members’ installation manuals to help installers record information about the installation in order to assist with servicing and repairs. For example, details of system cleaners and inhibitors can be recorded.</i></p> <p><i>Only manufacturing companies who hold a Benchmark licence will be eligible to use the Benchmark logo and the approved log book wording and layout. (Benchmark is registered as a European Collective Mark by the Heating and Hotwater Information Council Ltd and the content is copyright.)</i></p>

Table 2: Minimum provisions for control of gas-fired wet central heating systems

Gas-fired wet heating	Standards for new systems	Standards for replacement systems
1.0 Boiler interlock	<ul style="list-style-type: none"> a. Boiler-based systems should have a boiler control interlock in which controls are wired so that when there is no demand for either space heating or hot water, the boiler and pump are switched off. b. The use of thermostatic radiator valves (TRVs) alone does not provide interlock. 	<ul style="list-style-type: none"> a. As for <i>new systems</i>.
2.0 Space heating zones	<ul style="list-style-type: none"> a. Dwellings with a total usable floor area up to 150 m² should be divided into at least two space heating zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m² should be provided with at least two space heating zones, each having separate timing and temperature controls. c. For single-storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate. 	<ul style="list-style-type: none"> a. As for <i>new systems</i>, except where the boiler only is replaced reasonable provision for a space heating system would be to control as one zone.
3.0 Water heating zones	<ul style="list-style-type: none"> a. All dwellings should have a separate hot water zone in addition to space heating zones. b. A separate hot water zone is not required if the hot water is produced instantaneously, such as with a combination boiler. 	<ul style="list-style-type: none"> a. As for <i>new systems</i>.
4.0 Time control of space and water heating	<ul style="list-style-type: none"> a. Time control of space and water heating should be provided by: <ul style="list-style-type: none"> i. a full programmer with separate timing to each circuit; or ii. two or more separate timers providing timing control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of the hot water circuit. b. For dwellings with a total usable floor area greater than 150 m², timing of the separate space heating zones can be achieved by: <ul style="list-style-type: none"> i. multiple heating zone programmers; or ii. a single multi-channel programmer; or iii. programmable room thermostats; or iv. separate timers to each circuit; or v. a combination of (iii) and (iv) above. c. Where the hot water is produced instantaneously, such as with a combination boiler, time control is only required for space heating zones. 	<ul style="list-style-type: none"> a. As for <i>new systems</i> unless only the hot water cylinder is being replaced and separate time control for the hot water circuit is not present. In this case it is acceptable to have a single timing control for both space heating and hot water.

Table 2: Minimum provisions for control of gas-fired wet central heating systems (*continued*)

Gas-fired wet heating	Standards for new systems	Standards for replacement systems
5.0 Temperature control of space heating	a. Separate temperature control of zones within the dwelling should be provided using: <ul style="list-style-type: none"> i. room thermostats or programmable room thermostats in all zones; and ii. individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators other than in reference rooms (with a thermostat) and bathrooms. 	a. As for new systems .
6.0 Temperature control of domestic hot water	a. Domestic hot water systems should be provided with a cylinder thermostat and a zone valve or three-port valve to control the temperature of stored hot water. b. In dwellings with a total floor area greater than 150 m ² it would be reasonable to provide more than one hot water circuit, each with separate timing and temperature controls. This can be achieved by: <ul style="list-style-type: none"> i. multiple heating zone programmers; or ii. a single multi-channel programmer; or iii. separate timers to each circuit. c. Non-electric hot water controllers should not be used. Also, in some circumstances, such as with thermal stores, a zone valve is not appropriate; a second pump could be substituted for the zone valve.	a. As for new systems for planned replacement of hot water cylinders on all fully pumped installations, and on gravity circulation installations. b. In exceptional circumstances, such as emergency replacement or where the cylinder or installation is of a type that precludes the fitting of electric controls, either a wireless hot water cylinder thermostat or a thermo-mechanical cylinder thermostat.

Supplementary information

More details on control systems can be found in manufacturers' literature and on the The Association of Controls Manufacturers (TACMA) website at www.heatingcontrols.org.uk.

Controls may be provided by any boiler management control system that meets the specified zoning, timing and temperature and boiler interlock control requirements. If an individual component – such as the room thermostat – of a control system is being replaced, it is not necessary to upgrade the whole system.

Table 3: Minimum provisions for insulation of pipework in gas-fired wet central heating systems

Standards for new systems	Supplementary information	
<p>a. Pipes should be insulated to comply with the maximum permissible heat loss indicated in the Supplementary Information column, and labelled accordingly, as follows:</p> <ol style="list-style-type: none"> i. Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces. ii. Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements. iii. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed). iv. If secondary circulation is used, all pipes kept hot by that circulation should be insulated. 	<p>Insulation of pipework in unheated areas</p> <p>Extra provision may need to be made to protect central heating and hot water pipework in unheated areas against freezing. Guidance is available in:</p> <ul style="list-style-type: none"> • BS 5422:2001 "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C". • BRE Report No 262 "Thermal insulation: avoiding risks", 2002 Edition. 	
Standards for replacement systems	<p>Where insulation is labelled as complying with this guide, it must not exceed the following heat loss levels:</p>	
<p>b. Whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes that are exposed as part of the work or are otherwise accessible should be insulated as recommended above – or to some lesser standard where practical constraints dictate.</p>	Pipe outside diameter	Maximum heat loss*
	8 mm	7.06 W/m
	10 mm	7.23 W/m
	12 mm	7.35 W/m
	15 mm	7.89 W/m
	22 mm	9.12 W/m
	28 mm	10.07 W/m
	35 mm	11.08 W/m
	42 mm	12.19 W/m
54 mm	14.12 W/m	
<p>*In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 60°C in still air at 15°C. Further guidance on converting heat loss limits to insulation thickness for specific thermal conductivities is available in TIMSA "HVAC guidance for achieving compliance with Part L of the Building Regulations".</p>		

2.3 Gas-fired range cookers with integral central heating boiler

Gas-fired range cookers with integral central heating boiler provided as **new systems** and **replacement systems** should meet the following minimum requirements:

- a. The appliance should have two independently controlled burners (one for the cooking function and one for the boiler).
- b. The integral boiler should have a seasonal efficiency (SEDBUK value) in excess of 75%. The manufacturer's declaration of appliance performance and SEDBUK value should include the following words:
 - i. *Seasonal efficiency (SEDBUK) = xx %*
 - ii. *Case heat emission value = yy kW*
 - iii. *Heat transfer to water at full load = zz kW*
 - iv. *The values are used in the UK Government's Standard Assessment Procedure (SAP) for the energy rating of dwellings. The test data from which the values have been calculated have been certified by {insert name and/or identification of Notified body}. See www.rangeefficiency.org.uk*
- c. The integral boiler should meet the minimum standards for system circulation, hot water storage, system preparation, commissioning, controls and insulation in Tables 1, 2 and 3 (gas-fired central heating systems).

2.4 Gas-fired warm air heating

Gas-fired warm air heating systems provided as **new systems** and **replacement systems** should meet the minimum standards for:

- a. efficiency and installation in Table 4; and
- b. zoning, time control and temperature control for space heating in Table 5a, and for space heating combined with water heating in Table 5b.

Table 4: Minimum provisions for efficiency and installation for gas-fired warm air heating systems

Gas-fired warm air heating	Standards for new and replacement systems	Supplementary information
1.0 Efficiency	<p>a. Gas-fired warm air units should meet the requirements, as appropriate to the design of the appliance, of:</p> <ul style="list-style-type: none"> i. BS EN 778: 2009; or ii. BS EN 1319: 2009. <p>b. If a gas-fired circulator is incorporated in the warm air unit to provide domestic hot water, it should be able to deliver full and part load efficiency at least equal to that prescribed by BS EN 483:2000.</p> <p>c. The manufacturer's declaration of appliance performance should include the following words:</p> <ul style="list-style-type: none"> i. Combined warm air unit and circulator <i>This product has been assessed against the test methods set out in BS EN 778:2009*/BS EN 1319:2009*/BS EN 483* and certified as meeting those minimum requirements by {insert name or identification of Notified Body}.</i> ii. Warm air unit alone <i>This product has been assessed against the test method set out in BS EN 778: 2009* or BS EN 1319: 2009* and certified as meeting the minimum requirements by {insert name and/or identification of Notified Body}.</i> *Delete as appropriate 	<p>British standards</p> <p><i>BS EN 778:2009 "Domestic gas-fired forced convection air heaters for space heating not exceeding a net heat input of 70 kW, without a fan to assist transportation of combustion air and/or combustion products".</i></p> <p><i>BS EN 1319:2009 "Domestic gas-fired forced convection air heaters for space heating, with fan-assisted burners not exceeding a net heat input of 70 kW".</i></p> <p><i>BS EN 483:2000 "Gas-fired central heating boilers. Type C boilers of nominal heat input not exceeding 70 kW".</i></p>
2.0 Installation	<p>a. The system should be installed in accordance with BS 5864:2004.</p> <p>b. Ductwork that is newly installed or replaced should be insulated in accordance with the recommendations of BS 5422:2001.</p>	<p><i>BS 5864:2004 "Installation and maintenance of gas-fired ducted air heaters of rated input not exceeding 70 kW net (second and third family gases). Specification".</i></p> <p><i>BS 5422:2001 "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range of -40°C to +700°C".</i></p>

Table 5a: Minimum provisions for control of gas-fired warm air heating without water heating

Gas fired warm air heating without hot water	Standards for new and replacement systems
1.0 Time and temperature control	<ul style="list-style-type: none"> a. Controls external to heater: time switch/programmer and room thermostat, or programmable room thermostat; or b. controls integrated in the heater: time-switch/programmer and room temperature sensor linked to heater firing and fan speed control.
2.0 Zoning	<ul style="list-style-type: none"> a. New dwellings with a total usable floor area up to 150 m² should be divided into at least two space heating zones with independent temperature controls, one of which is assigned to the living area. b. New dwellings with a total usable floor area greater than 150 m² should be provided with at least two space heating zones, each having separate timing and temperature controls. Timing of the separate space heating zones can be achieved by: <ul style="list-style-type: none"> i. multiple heating zone programmers; or ii. a single multi-channel programmer; or iii. programmable room thermostats; or iv. separate timers to each circuit; or v. a combination of iii) and (iv) above. c. The provisions for zoning for replacement systems in existing dwellings should be as for new dwellings where practical.

Table 5b: Minimum provisions for control of gas-fired warm air heating with water heating

Gas fired warm air heating & domestic hot water	Standards for new and replacement systems
1.0 System circulation	a. Pumped primary circulation to the hot water cylinder.
2.0 Time and temperature control	a. Independent time control of both the space heating and hot water circuits. b. Time control should be provided by use of either: <ol style="list-style-type: none"> i. a full programmer with separate timing to each circuit; or ii. two or more separate timers providing timing control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of the hot water; or iv. a time switch/programmer (two channel) and room thermostat. c. For new systems : Independent control of the hot water circuit should be achieved by means of a cylinder thermostat and a timing device, wired such that when there is no demand for hot water both the pump and circulator are switched off. d. For replacement systems : Independent control of the hot water circuit should be achieved, where practicable, for circulator water heaters of less than 6kW output by means of a cylinder thermostat and a timing device, wired such that when there is no demand for hot water both the pump and circulator are switched off.
3.0 Space heating zoning	a. New dwellings with a total usable floor area up to 150 m ² should be divided into at least two space heating zones with independent timing controls, one of which is assigned to the living area. b. New dwellings with a total usable floor area greater than 150 m ² should be provided with at least two space heating zones, each having separate timing and temperature controls. c. The provisions for zoning for replacement systems in existing dwellings should be as for new dwellings where practical.

2.5 Gas-fired fixed independent space heating appliances

Fixed independent space heating appliances may be installed as a means of primary or secondary space heating.

Gas-fired fixed independent appliances for primary space heating

Gas-fired fixed independent space heating appliances in new and existing dwellings which are provided as the primary heat source should meet the following standards:

- a. the appliance should be one of the types described in Table 6;
- b. the efficiency of the appliance (gross calorific value) should be not less than 58%. The appliance manufacturer's declaration of appliance performance should include the following words:

The efficiency of this appliance has been measured as specified in {insert appropriate entry from Table 6} and the result is [x] %. The gross calorific value of the fuel has been used for this efficiency calculation. The test data from which it has been calculated has been certified by {insert name and/or identification of Notified Body}. The efficiency value may be used in the UK Government’s Standard Assessment Procedure (SAP) for energy rating of dwellings.

- c. in new dwellings, each appliance should be capable, either independently or in conjunction with room thermostats or other suitable temperature sensing devices, of controlling the temperatures independently in areas that have different heating needs (eg separate sleeping and living areas). In existing dwellings, wherever practical, temperature controls should be upgraded to the standards required for new dwellings.

Table 6: Types of gas and LPG-fired fixed space heaters for primary space heating
British Standard designation (appliance type)
BS EN 1266:2002 <i>Independent gas-fired convection heaters incorporating a fan to assist transportation of combustion air and/or flue gases.</i>
BS 7977-1:2002 <i>Specification for safety and rational use of energy of domestic gas appliances. Radiant/convectors.</i>
BS EN 613:2001 <i>Independent gas-fired convection heaters.</i>
BS EN 13278:2003 <i>Open fronted gas-fired independent space heaters.</i>

Gas-fired fixed independent appliances for secondary space heating

Gas-fired fixed independent space heating appliances which are provided as the secondary heat source should meet the following standards:

- a. in new dwellings, minimum appliance efficiency based on label band (based on minimum standard of class 1 appliances);
- b. in existing dwellings, minimum appliance efficiency based on label band (based on minimum standard of class 2 appliances);
- c. the appliance should be one of the types listed in Table 7;
- d. the efficiency (gross calorific value) of the appliance should be not less than the value in Table 7 for that type of appliance. The appliance manufacturer’s declaration of appliance performance should include the following words:

The efficiency of this appliance has been measured as specified in {insert appropriate entry from Table 7} and the result is [x]%. The gross calorific value of the fuel has been used for this efficiency calculation. The test data from which it has been calculated have been certified by {insert name and/or identification of Notified Body}. The efficiency value may be used in the UK Government’s Standard Assessment Procedure (SAP) for energy rating of dwellings.

Table 7: Acceptable appliance types and minimum appliance efficiencies for independent fixed natural gas and LPG-fired space heaters used as a secondary heat source

British Standard designation (appliance type)	Minimum efficiency % (gross calorific value)	
	Gas	LPG
BS EN 1266:2002 <i>Independent gas-fired convection heaters incorporating a fan to assist transportation of combustion air and/or flue gases.</i>	72	73
All types except inset live fuel-effect BS 7977-1:2002 <i>Specification for safety and rational use of energy of domestic gas appliances. Radiant/convectors.</i>	63	64
BS EN 613:2001 <i>Independent gas-fired convection heaters.</i>	58	60
BS EN 13278: 2003 <i>Open fronted gas-fired independent space heaters.</i>	45	46
Inset live fuel effect BS 7977-1:2002 <i>Specification for safety and rational use of energy of domestic gas appliances. Radiant/convectors.</i>	40	41
Flueless BS EN 14829:2007 <i>Independent gas-fired flueless space heaters for nominal heat input not exceeding 6 kW.</i>	Thermal efficiency requirements for this type of appliance are not specified as all the heat produced by the combustion process is released into the space to be heated. In SAP 2009 the efficiency of these appliances is classed as 90% and an adjustment is made for ventilation in the space heating requirement calculation.	
BS EN 449:2002 <i>Specification for dedicated liquefied petroleum gas appliances. Domestic flueless space heaters (including diffusive catalytic combustion heaters).</i>		

2.6 Gas-fired fixed decorative fuel-effect fires

This type of appliance is intended for decorative purposes and therefore a minimum thermal efficiency is not specified. Note that for the purposes of SAP 2009 the efficiency of decorative fuel-effect fires is classed as 20% for use in the space heating requirement calculation. See Table 4a of SAP 2009.

Gas-fired decorative fires in new and existing dwellings should:

- a. meet the product standards in BS EN 509: 2000 *Decorative fuel-effect gas appliances*; and
- b. number not more than one appliance per 100 m² of dwelling floor area.

2.7 Gas fire for secondary space heating provided as part of a combined fire and back boiler unit

A combined fire and back boiler unit should only be installed as a replacement for an existing combined fire and back boiler unit, and then only when the criteria in Appendix A for assessing the case for a non-condensing boiler are satisfied.

A gas fire provided as a secondary heat source as part of a combined fire and back boiler unit, when provided as a **replacement system** in existing dwellings, should meet the following conditions:

- a. the appliance should be one of the types described in Table 8;
- b. the appliance manufacturer's declaration of appliance performance should include the following words:

The efficiency of this appliance has been measured as specified in {insert appropriate entry from Table 8} and the result is [x]%. The gross calorific value of the fuel has been used for this efficiency calculation. The test data from which it has been calculated has been certified by {insert name and/or identification of Notified Body}. The efficiency value may be used in the UK Government's Standard Assessment Procedure (SAP) for energy rating of dwellings.

- c. the efficiency (gross calorific value) of the appliance should be not less than the value in Table 8 for that type of appliance.

Table 8: Minimum appliance efficiencies for gas fires used with back boilers

British Standard designation (appliance type)	Minimum efficiency % (Gross Calorific Value)	
	Natural gas	LPG
Inset live fuel-effect BS 7977-2:2003 <i>Specification for safety and rational use of energy of domestic gas appliances. Combined appliances. Gas fire/back boiler.</i>	40	41
All types except inset live fuel-effect BS 7977-2:2003 <i>Specification for safety and rational use of energy of domestic gas appliances. Combined appliances. Gas fire/back boiler.</i>	63	64

Supplementary information – further guidance on gas-fired heating

Energy Efficiency Best Practice in Housing publications:

- CE30 “Domestic heating by gas: boiler systems”;
- CE51 “Central heating system specifications (CHeSS)”;
- CE54 “Whole house boiler sizing method for houses and flats”.

SBGI publications on gas boilers and gas fires under development at the time of writing:

- See www.sbgj.org.uk for updates.

CORGI publications:

- GID1 “Essential gas safety”;
- GID2 “Gas cookers and ranges”;
- GID3 “Gas fires and space heaters”;
- GID5 “Water heaters”;
- GID7 “Central heating – wet and dry”;
- WCH1 “Wet central heating system design guide”;
- WAH1 “Warm air heating system design guide”.

Requirements relating to various aspects of the installation of condensing boilers are given in British Standards BS 5440 Parts 1 and 2, BS 5449 and BS 6798.

Section 3: Oil-fired space heating and hot water systems

3.1 Scope of guidance

This section provides guidance on the specification of oil-fired space heating and hot water systems³ in dwellings to meet minimum energy efficiency standards in building regulations. The guidance applies to the following types of oil-fired heating system:

- wet central heating systems;
- range cookers with integral central heating boilers;
- vaporising appliances providing secondary heating or hot water;
- fixed independent space heating devices.

3.2 Oil-fired wet central heating systems

Oil-fired central heating systems which are provided as ***new systems*** or ***replacement systems*** in dwellings should meet the minimum standards for:

- a. boiler efficiency, system circulation, hot water storage, system preparation and commissioning in Table 9;
- b. boiler interlock, zoning, and time and temperature control of the heating and hot water circuits in Table 10;
- c. pipework insulation in Table 11.

³ All gas appliances must be installed by a competent person in accordance with the current issue of the Gas Safety (Installation and Use) Regulations. The installation should follow the manufacturer's instructions and should comply with all relevant parts of the Building Regulations and, for wet systems, the Water Regulations.

Table 9: Minimum provisions for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems

Oil-fired wet heating	Standards for new systems	Standards for replacement systems	Supplementary information
<p>1.0 Efficiency</p>	<p>Conventional boilers</p> <ul style="list-style-type: none"> a. The boiler should be of the condensing type. b. The boiler efficiency should be not less than 90% (SEDBUK Band A). c. In existing dwellings, compliance with the requirements for boiler efficiency can be demonstrated by following the guidance in Appendix A. <p>Combination boilers</p> <ul style="list-style-type: none"> a. The boiler efficiency should be not less than 86% (SEDBUK Band B). b. In existing dwellings, compliance with the requirements for boiler efficiency can be demonstrated by following the guidance in Appendix A. <p>Range cooker boilers</p> <ul style="list-style-type: none"> a. The boiler efficiency for heating boilers that are combined with range cookers should be as defined in Section 3.3 <i>Oil-fired cookers with integral central heating boilers</i>. 	<p>Replacements not involving a fuel or energy switch</p> <ul style="list-style-type: none"> a. The boiler efficiency should be not less than 90% (SEDBUK Band A); and b. not worse than two percentage points lower than the seasonal efficiency of the controlled service being replaced. If the efficiency of the system or appliance to be replaced is not known, efficiency values may be taken from Table 4a or 4b of SAP 2009. <p>Replacements involving fuel or energy switch</p> <ul style="list-style-type: none"> a. If the new heating system or heat generating appliance uses a different fuel, the efficiency of the new service should be multiplied by the ratio of the CO₂ emission factor of the fuel used in the service being replaced to that used in the new service before making the checks in a and b above. The CO₂ emission factors should be taken from Table 12 of SAP 2009. 	<p>Guidance on identifying the SEDBUK efficiency for an appliance</p> <p><i>The Boiler Efficiency Database is available online at www.boilers.org.uk. It provides regularly updated information on most available boilers as well as many which are no longer in production.</i></p> <p><i>Manufacturers' literature provides SEDBUK values in an agreed form of words to avoid confusion with other efficiency values. Manufacturers will supply SEDBUK values for their products on request.</i></p> <p><i>Appendix A gives the approved procedure for establishing the exceptional circumstances in which boilers may be of the non-condensing type, as set out in the "Guide to the condensing boiler installation assessment procedure for dwellings". (Note that for oil-fired appliances the qualifying period can be 5 years from the original installation date, not 3 as indicated in Box X of the declaration form.) The OFTEC exceptions form CD30 can also be used for this purpose.</i></p>
<p>2.0 System circulation</p>	<ul style="list-style-type: none"> a. Space heating systems and domestic hot water primary circuits should have fully pumped circulation. b. If the boiler manufacturer's instructions advise installation of a bypass, an automatic bypass valve should be provided and the manufacturer's instructions on minimum pipe length followed. 	<ul style="list-style-type: none"> a. As for new systems. b. When boilers are replaced, existing systems with semi-gravity circulation should be converted to fully pumped circulation. 	

Table 9: Minimum provisions for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems (*continued*)

Oil-fired wet heating	Standards for new systems	Standards for replacement systems	Supplementary information
<p>3.0 Hot water storage</p>	<p>a. Vented copper hot water storage cylinders should comply with the heat loss and heat exchanger requirements of BS 1566:2002 Part 1.</p> <p>b. Copper hot water storage combination units should comply with BS 3198:1981.</p> <p>c. Primary storage systems should meet the insulation requirements of the Hot Water Association <i>Performance specification for thermal stores</i>.</p> <p>d. Unvented hot water storage system products should comply with BS EN 12897:2006 or an equivalent standard as set by an accredited test body such as the British Board of Agrément, the Water Research Council, or KIWA.</p> <p>e. The standing heat loss for all hot water storage vessels in a, b, c and d above should not exceed $Q = 1.15 \times (0.2 + 0.051V^{2/3})$ kWh/day, where V is the volume of the cylinder.</p> <p>f. All hot water vessels should carry a label with the following information:</p> <ul style="list-style-type: none"> i. type of vessel (vented, unvented, combination unit or thermal store); ii. nominal capacity in litres; iii. standing heat loss in kWh/day; iv. heat exchanger performance in kW; v. reference to product compliance with relevant standard (eg BS 1566, BS 12897) and logos of accreditation bodies as required. <p>For labelling requirements for other heat inputs, see relevant sections (eg Section 10 for solar).</p>	<p>a. As for new systems, but</p> <p>b. for replacement copper vented cylinders and combination units, the standing loss should not exceed $Q = 1.28 \times (0.2 + 0.051V^{2/3})$ kWh/day, where V is the volume of the cylinder.</p>	<p><i>If a vented cylinder is made from an alternative material to copper then the heat loss and heat exchange characteristics should be tested in accordance with BS EN 12897:2006.</i></p> <p><i>The HWA thermal storage specification is available for free download from www.hotwater.org.uk</i></p> <p>British Standards</p> <p><i>BS 1566: 2002 "Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods".</i></p> <p><i>BS EN 12897 "Water supply. Specification for indirectly heated unvented (closed) storage water heaters".</i></p> <p><i>BS 3198 "Copper hot water storage combination units for domestic purposes".</i></p>

Table 9: Minimum provisions for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems (*continued*)

Oil-fired wet heating	Standards for new systems	Standards for replacement systems	Supplementary information
4.0 System preparation and water treatment	a. Central heating systems should be thoroughly cleaned and flushed out before installing a new boiler. b. During final filling of the system, a chemical water treatment inhibitor meeting the manufacturer's specification or other appropriate standard should be added to the primary circuit to control corrosion and the formation of scale and sludge. c. Installers should also refer to the boiler manufacturer's installation instructions for appropriate treatment products and special requirements for individual boiler models. d. Where the mains total water hardness exceeds 200 parts per million, provisions should be made to treat the feed water to water heaters and the hot water circuit of combination boilers to reduce the rate of accumulation of limescale. e. For solar thermal systems, see Section 10.	a. As for <i>new systems</i> .	British Standards <i>BS 7593:2006 "Code of practice for treatment of water in domestic hot water central heating systems".</i> <i>Note should also be made of advice in the manufacturer's instructions.</i> <i>Inhibitors should as a minimum be BuildCert approved.</i> <i>Limescale can be controlled by the use of chemical limescale inhibitors, combined corrosion and limescale inhibitors, polyphosphate dosing, electrolytic scale reducers or water softeners.</i> <i>It is advisable to install valves which will isolate both the radiators and the heating circuit when removing radiators for service or maintenance.</i> <i>Avoiding the need to drain down the system will help to retain the circulating fluid and prevent loss of water treatment.</i>

Table 9: Minimum provisions for efficiency, system circulation, hot water storage, system preparation and commissioning for oil-fired wet central heating systems (*continued*)

Oil-fired wet heating	Standards for new systems	Standards for replacement systems	Supplementary information
<p>5.0 Commissioning</p>	<p>a. On completion of the installation of a boiler or a hot water storage system, together with associated equipment such as pipework, pumps and controls, the equipment should be commissioned in accordance with the manufacturer’s instructions. These instructions will be specific to the particular boiler or hot water storage system.</p> <p>b. The installer should give a full explanation of the system and its operation to the user, including the manufacturer’s user manual where provided.</p>	<p>a. As for new systems.</p>	<p><i>Site commissioning of oil-fired appliances should always be carried out as it is critical for efficient operation. OFTEC registered commissioning engineers should use form CD11, leaving a copy on site for the householder. OFTEC registered installers should use form CD10 to signify the installation is compliant with building regulations.</i></p> <p>The Benchmark System</p> <p><i>The Benchmark Commissioning Checklist can be used to show that commissioning has been carried out satisfactorily. Benchmark licence-holders provide a checklist with the appliance for completion by the persons commissioning the system so that they can record that all the checks have been made and the results show efficient operation of the equipment in compliance with building regulations. The Benchmark checklist should be provided to the builder, or the householder in the case of work in existing dwellings, an appointed agent, or the end user.</i></p> <p><i>A Benchmark Commissioning Checklist will be included in all HHIC gas boiler manufacturer members’ installation manuals to help installers record information about the installation in order to assist with servicing and repairs. For example, details of system cleaners and inhibitors can be recorded.</i></p> <p><i>Only manufacturing companies who hold a Benchmark licence will be eligible to use the Benchmark logo and the approved log book wording and layout. (Benchmark is registered as a European Collective Mark by the Heating and Hotwater Information Council Ltd and the content is copyright.)</i></p>

Table 10: Minimum provisions for control of oil-fired wet central heating systems

Oil-fired wet heating	Standards for new systems	Standards for replacement systems
1.0 Boiler interlock	<ul style="list-style-type: none"> a. Boiler-based systems should have a boiler control interlock in which controls are wired so that when there is no demand for either space heating or hot water, the boiler and pump are switched off. b. The use of thermostatic radiator valves (TRVs) alone does not provide interlock. 	<ul style="list-style-type: none"> a. As for new systems.
2.0 Space heating zones	<ul style="list-style-type: none"> a. Dwellings with a total usable floor area up to 150 m² should be divided into at least two space heating zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m² should be provided with at least two space heating zones, each having separate timing and temperature controls. c. For single-storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate. 	<ul style="list-style-type: none"> a. As for new systems, except where the boiler only is replaced reasonable provision for a space heating system would be to control as one zone.
3.0 Water heating zones	<ul style="list-style-type: none"> a. All dwellings should have a separate hot water zone in addition to space heating zones. b. A separate hot water zone is not required if the hot water is produced instantaneously, such as with a combination boiler. 	<ul style="list-style-type: none"> a. As for new systems.
4.0 Time control of space and water heating	<ul style="list-style-type: none"> a. Time control of space and water heating should be provided by: <ul style="list-style-type: none"> i. a full programmer with separate timing to each circuit; ii. two or more separate timers providing timing control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of the hot water circuit. b. For dwellings with a total usable floor area greater than 150 m², timing of the separate space heating zones can be achieved by: <ul style="list-style-type: none"> i. multiple heating zone programmers; or ii. a single multi-channel programmer; or iii. programmable room thermostats; or iv. separate timers to each circuit; or v. a combination of (iii) and (iv) above. c. Where the hot water is produced instantaneously, such as with a combination boiler, time control is only required for space heating zones. 	<ul style="list-style-type: none"> a. As for new systems unless only the hot water cylinder is being replaced and separate time control for the hot water circuit is not present. In this case it is acceptable to have a single timing control for both space heating and hot water.

Table 10: Minimum provisions for control of oil-fired wet central heating systems (*continued*)

Oil-fired wet heating	Standards for new systems	Standards for replacement systems
5.0 Temperature control of space heating	a. Separate temperature control of zones within the dwelling should be provided using: <ol style="list-style-type: none"> i. room thermostats or programmable room thermostats in all zones; and ii. individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators other than in the reference rooms (with thermostat) and bathrooms. 	a. As for <i>new systems</i> .
6.0 Temperature control of domestic hot water	a. Domestic hot water systems should be provided with a cylinder thermostat and a zone valve or three-port valve to control the temperature of stored hot water. b. In dwellings with a total floor area greater than 150 m ² it would be reasonable to provide more than one hot water circuit, each with separate timing and temperature controls. This can be achieved by: <ol style="list-style-type: none"> i. multiple heating zone programmers; or ii. a single multi-channel programmer; or iii. separate timers to each circuit. c. Non-electric hot water controllers should not be used. Also, in some circumstances, such as with thermal stores, a zone valve is not appropriate; a second pump could be substituted for the zone valve.	a. As for <i>new systems</i> for planned replacement of hot water cylinders on all fully pumped installations, and on gravity circulation installations. b. In exceptional circumstances, such as emergency replacement or where the cylinder or installation is of a type that precludes the fitting of electric controls, either a wireless hot water cylinder thermostat or a thermo-mechanical cylinder thermostat.

Supplementary information

More details on control systems can be found in manufacturers' literature and on the The Association of Controls Manufacturers (TACMA) website at www.heatingcontrols.org.uk.

Controls may be provided by any boiler management control system that meets the specified zoning, timing and temperature and boiler interlock control requirements. If an individual component – such as the room thermostat – of a control system is being replaced, it is not necessary to upgrade the whole system.

Table 11: Minimum provisions for insulation of pipework in oil-fired wet central heating systems

Standards for new systems	Supplementary information	
<p>a. Pipes should be insulated to comply with the maximum permissible heat loss indicated in the Supplementary Information column, and labelled accordingly, as follows:</p> <ol style="list-style-type: none"> i. Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces. ii. Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements. iii. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed). iv. If secondary circulation is used, all pipes kept hot by that circulation should be insulated. 	<p>Insulation of pipework in unheated areas</p> <p>Extra provision may need to be made to protect central heating and hot water pipework in unheated areas against freezing. Guidance is available in:</p> <ul style="list-style-type: none"> • BS 5422:2001 "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C". • BRE Report No 262 "Thermal insulation: avoiding risks", 2002 Edition. 	
<p>Standards for replacement systems</p>	<p>Where insulation is labelled as complying with this guide, it must not exceed the following heat loss levels:</p>	
<p>b. Whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes that are exposed as part of the work or are otherwise accessible should be insulated as recommended above – or to some lesser standard where practical constraints dictate.</p>	<p>Pipe outside diameter</p>	<p>Maximum heat loss*</p>
	8 mm	7.06 W/m
	10 mm	7.23 W/m
	12 mm	7.35 W/m
	15 mm	7.89 W/m
	22 mm	9.12 W/m
	28 mm	10.07 W/m
	35 mm	11.08 W/m
	42 mm	12.19 W/m
54 mm	14.12 W/m	
<p>*In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 60°C in still air at 15°C. Further guidance on converting heat loss limits to insulation thickness for specific thermal conductivities is available in TIMSA "HVAC guidance for achieving compliance with Part L of the Building Regulations".</p>		

3.3 Oil-fired range cookers with integral central heating boilers

This section provides guidance on the specification of oil-fired range cookers with integral central heating boilers for space heating and hot water in dwellings.

Note that the guidance applies only to twin-burner cooker boilers which should not be confused with the type of range cooker described as a single burner “dry heat” range cooker. The latter is intended only to provide a cooking function, is not included in SAP 2009 calculations, and does not come within the scope of building regulations energy efficiency requirements.

Oil-fired range cookers with an integral central heating boiler which are provided as **new systems** and as **replacement systems** should meet the following conditions:

- a. the appliance should have two independently controlled burners (one for the cooking function and one for the boiler);
- b. the integral boiler should have a seasonal efficiency (SEDBUK value) in excess of 80%. The manufacturer’s declaration of appliance performance and SEDBUK value should include the following words:
 - i. *seasonal efficiency (SEDBUK) = xx%;*
 - ii. *case heat emission value = yy kW;*
 - iii. *heat transfer to water at full load = zz kW;*
 - iv. *the efficiency values may be used in the UK Government’s Standard Assessment Procedure (SAP) for the energy rating of dwellings. The test data from which they have been calculated have been certified by {insert name and/or identification of Notified body}. See www.rangeefficiency.org.uk.*
- c. the integral boiler should meet the minimum standards for oil-fired central heating systems in Tables 9, 10 and 11 for system circulation, hot water storage, system preparation, commissioning, controls and insulation.

3.4 Continually-burning oil-fired vaporising appliances providing secondary heating or hot water

This section provides guidance on the specification of oil-fired vaporising appliances providing heating or hot water for dwellings.

The guidance does not apply to appliances which have been converted from another fuel (for example from solid fuel to oil).

Oil-fired vaporising appliances provided as **new systems** or **replacement systems** should meet the minimum standards for controls in Table 12:

Table 12: Minimum provisions for control of continually burning oil-fired vaporising appliances

Appliance type	Standards for new and replacement systems	Supplementary information
a. Manually operated appliance, eg room heater.	The integral manual controls as provided by appliance manufacturer.	<i>Information about the use of controls should be clearly stated in the manufacturer's literature.</i>
b. Electrically operated (modulating) appliance, eg room heater.	The integral or remote thermostatic controls as provided (or specified) by the appliance manufacturer.	
Automatic ON/OFF vaporising appliances		
c. Room heater providing (secondary) room space heating.	The integral thermostatic controls as provided by appliance manufacturer.	
d. Room heater providing domestic hot water & (secondary) room space heating.	The integral or remote thermostatic controls as provided (or specified) by the appliance manufacturer.	

3.5 Oil-fired fixed independent space heating appliances

This section provides guidance on the specification of oil-fired fixed independent space heating appliances for dwellings.

Fixed independent space heating appliances may be installed as a means of primary or secondary space heating.

Oil-fired fixed independent appliances for primary heating

Oil-fired fixed independent space heating appliances in new dwellings which are provided as the primary heat source should meet the following conditions:

- a. the efficiency of the appliance (gross calorific value) should be not less than 60%. The appliance manufacturer's declaration of appliance performance should include the following words:

The net efficiency of this appliance has been measured and the result is [x]%. The test data from which the efficiency has been calculated have been certified by {insert name and/or identification of Notified Body}. The efficiency value when converted to gross by use of the appropriate conversion factor from Table E3 in SAP 2009 may be used in the UK Government's Standard Assessment Procedure (SAP) for energy rating of dwellings.

- b. each appliance should be capable, either independently or in conjunction with room thermostats or other suitable temperature sensing devices, of controlling the temperatures independently in areas that have different heating needs (eg separate sleeping and living areas).

Oil-fired fixed independent appliances for secondary heating

Oil-fired fixed independent space heating appliances in new dwellings which are provided as the secondary heat source should have a minimum efficiency (gross calorific value) of not less than 60%.

Supplementary Information

Further guidance on oil-fired heating systems is available in the following publications:

- *Energy Efficiency Best Practice in Housing publications (see www.oftec.org).*
- *CE29 "Domestic heating by oil: boiler systems".*
- *CE51 "Central heating system specifications (CHeSS)".*
- *CE54 "Whole house boiler sizing method for houses and flats".*
- *OFTEC Technical Books 2, 3, 4 and 5 (see www.oftec.org).*
- *BS EN 12828.*
- *BS 5410 Part 1.*

Section 4: Electric heating systems

This section provides guidance on the specification of fixed electric heating systems for dwellings to meet minimum energy efficiency standards in building regulations.

4.1 Scope of guidance

The guidance given in this section covers the following types of fixed electric heating systems:

- electric boilers serving central heating systems;
- electric warm air systems;
- electric panel heaters;
- electric storage systems including integrated storage/direct systems.

Portable, plug-in appliances are not covered by building regulations or by this guide.

4.2 Electric boilers serving central heating systems

Electric boilers serving wet central heating provided as **new systems** or **replacement systems** in dwellings should meet the minimum standards for:

- a. system circulation, system preparation and commissioning in Table 13;
- b. boiler interlock, zoning, and time control and temperature control of heating and hot water circuits in Table 14;
- c. hot water storage systems in Table 15; and
- d. pipework insulation in Table 16.

Table 13: Minimum provisions for system circulation, preparation and commissioning for electric wet central heating systems

Electric wet heating	Standards for new systems	Standards for replacement systems	Supplementary information
<p>1.0 System circulation</p>	<p>a. Systems for space heating and domestic hot water primary circuits in new dwellings should have fully pumped circulation.</p> <p>b. If the boiler manufacturer’s instructions advise installation of a bypass, then an automatic bypass valve should be used.</p>	<p>As <i>new systems</i>.</p> <p>When boilers are replaced, existing systems with semi-gravity circulation should be converted to fully pumped circulation.</p>	
<p>2.0 System preparation and water treatment</p>	<p>a. Central heating systems should be thoroughly cleaned and flushed before installing a new boiler.</p> <p>b. During final filling of the system a chemical water treatment formulation should be added to the primary circuit to control corrosion and the formation of scale and sludge. Reasonable provision would be to follow the guidance on how to prepare and commission systems given in BS7593:2006.</p> <p>c. Installers should also refer to the boiler manufacturer’s installation instructions for appropriate treatment products and special requirements for individual boiler models.</p> <p>d. Where the mains total water hardness exceeds 200 parts per million, provisions should be made to treat the feed water to water heaters and the hot water circuit of combination boilers to reduce the rate of accumulation of lime scale and the consequent reduction in energy efficiency.</p>	<p>As for <i>new systems</i>.</p>	<p>British Standards</p> <p><i>BS 7593:2006 “Code of practice for treatment of water in domestic hot water central heating systems”.</i></p> <p><i>Note should also be made of advice in the manufacturer’s instructions.</i></p> <p><i>Inhibitors should as a minimum be BuildCert approved.</i></p> <p><i>Limescale can be controlled by the use of chemical limescale inhibitors, combined corrosion and limescale inhibitors, polyphosphate dosing, electrolytic scale reducers or water softeners.</i></p> <p><i>It is advisable to install valves which will isolate both the radiators and the heating circuit when removing radiators for service or maintenance. Avoiding the need to drain down the system will help to retain the circulating fluid and prevent loss of water treatment.</i></p>
<p>3.0 Commissioning</p>	<p>a. Manufacturers’ instructions for commissioning should be followed and a commissioning record should be completed to show compliance.</p> <p>b. The installer should give a full explanation of the system and its operation to the user, including the manufacturer’s user manual where provided.</p>	<p>As for <i>new systems</i>.</p>	

Table 14: Minimum provisions for control of electric wet central heating systems

Electric wet heating	Standards for new systems	Standards for replacement systems
1.0 Boiler temperature control	a. The boiler should be fitted with a flow temperature control and be capable of modulating the power input to the primary water depending on space heating conditions.	As for new systems .
2.0 Boiler interlock	a. If the boiler also supplies domestic hot water, the system should have a boiler interlock in which controls are wired so that when there is no call for heat from either the space heating or hot water circuits then the boiler and pump are switched off. The use of thermostatic radiator valves (TRVs) alone does not provide interlock.	As for new systems .
3.0 Zoning	a. Dwellings with a total usable floor area up to 150 m ² should be divided into at least two space heating zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m ² should be provided with at least two space heating zones, each having separate timing and temperature controls. c. For single-storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.	As for new systems .
4.0 Temperature control of space heating	a. Separate temperature control of zones within the dwelling should be provided, using: i. room thermostats or programmable room thermostats in all zones; and ii. individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators other than in reference rooms (with a thermostat) and bathrooms.	As for new systems .
5.0 Time control of space and water heating	a. Time control of space and water heating should be provided by: i. a full programmer with separate timing to each circuit; ii. two or more separate timers providing timing control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of the hot water circuit.	As for new systems .

Supplementary information

More details on control systems can be found in manufacturers' literature and on the The Association of Controls Manufacturers (TACMA) website at www.heatingcontrols.org.uk.

Controls may be provided by any boiler management control system that meets the specified zoning, timing and temperature and boiler interlock control requirements. If an individual component – such as the room thermostat – of a control system is being replaced, it is not necessary to upgrade the whole system.

Table 15: Minimum provisions for hot water storage in electric wet central heating systems

Electric wet heating	Standards for new and replacement systems	Supplementary information
<p>1.0 Vented systems – including cylinders heated primarily by electricity</p>	<p>a. Vented copper hot water storage vessels should comply with BS 1566 or BS 3198.</p> <p>b. Vented cylinders in materials other than copper should also be labelled as complying with the heat loss requirements of BS 1566.</p> <p>c. For vented replacement systems, electrically heated combination units should be insulated such that the heat loss does not exceed the value $Q = 1.28 \times (0.2 + 0.051V^{2/3})$ kWh/day, where V is the nominal cylinder volume in litres. This applies to electrically heated combination units as well as other electrically heated cylinders.</p> <p>d. For vented new systems, electrically heated combination units should be insulated such that the heat loss does not exceed the value $Q = 1.15 \times (0.2 + 0.051V^{2/3})$ kWh/day, where V is the nominal cylinder volume in litres. This applies to electrically heated combination units as well as other electrically heated cylinders.</p>	<p>British Standards</p> <p><i>BS 1566: 2002 “Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods”.</i></p> <p><i>BS 3198: 1981 “Specification for copper hot water storage combination units for domestic purposes”.</i></p> <p><i>BS EN 12897 “Water supply. specification for indirectly heated unvented (closed) storage water heaters”.</i></p>
<p>2.0 Unvented systems – including cylinders heated primarily by electricity</p>	<p>a. Products should either comply with BS EN 12897, or be certified by the British Board of Agrément, Water Research Council or other accredited body as complying with building regulations.</p> <p>b. Cylinders heated primarily by electricity should be insulated such that their heat loss does not exceed $Q = 1.15 \times (0.2 + 0.051V^{2/3})$ kWh/day, where V is the nominal cylinder volume in litres. This applies to electrically heated combination units as well as other electrically heated cylinders.</p>	

Table 15: Minimum provisions for hot water storage in electric wet central heating systems (*continued*)

Electric wet heating	Standards for new and replacement systems	Supplementary information
3.0 Vented and unvented systems	<ul style="list-style-type: none"> a. Cylinders should either be factory fitted with, or have provision for, two thermostatically controlled electrical heating elements or immersion heaters. b. The lower element should be capable of heating up at least 85% of the cylinder contents. c. The upper element should be capable of heating at least 60 litres of water. d. The lower element should be connected to utilise the "off peak" electricity tariff and the upper for boost operation. e. The vessel should be designed such that following reheating to 60°C from the off peak element, at least 80% of the contents can be drawn off at 45°C or above at a flow rate of 0.25 l/s. 	
4.0 Primary stores	<ul style="list-style-type: none"> a. Primary storage systems should meet the insulation requirements of the Hot Water Association <i>Performance specification for thermal stores</i>. b. Unvented hot water storage system products should comply with BS EN 12897:2006 or an equivalent standard as set by an accredited test body such as the British Board of Agrément, the Water Research Council, or KIWA 	
5.0 Labelling	<ul style="list-style-type: none"> a. All hot water storage vessels should carry a label with the following information: <ul style="list-style-type: none"> i. type of vessel; ii. nominal capacity in litres; iii. standing heat loss in kWh/day; iv. heat exchanger performance in kW. b. Vented copper hot water cylinders should carry clear labelling on the product such as a BSI Kitemark, registered firm status or reference to an equivalent quality control scheme. c. Vented cylinders which are not of copper construction should be labelled as complying with the heat loss and heat exchanger requirements of BS 1566. d. For labelling of hot water storage vessels in solar thermal systems, see Section 11, <i>Solar water heating</i>. 	

Table 16: Minimum provisions for insulation of pipework in central heating systems with electric boilers

Standards for new systems	Supplementary information	
<p>a. Pipes should be insulated to comply with the maximum permissible heat loss indicated in the Supplementary Information column, and labelled accordingly, as follows:</p> <ol style="list-style-type: none"> i. Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces. ii. Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements. iii. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed). iv. If secondary circulation is used, all pipes kept hot by that circulation should be insulated. 	<p>Insulation of pipework in unheated areas</p> <p>Extra provision may need to be made to protect central heating and hot water pipework in unheated areas against freezing. Guidance is available in:</p> <ul style="list-style-type: none"> • BS 5422:2001 “Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C”. • BRE Report No 262 “Thermal insulation: avoiding risks”, 2002 Edition. 	
<p>Standards for replacement systems</p>	<p>Where insulation is labelled as complying with this guide, it must not exceed the following heat loss levels:</p>	
<p>b. Whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes that are exposed as part of the work or are otherwise accessible should be insulated as recommended above – or to some lesser standard where practical constraints dictate.</p>	<p>Pipe outside diameter</p>	<p>Maximum heat loss*</p>
	8 mm	7.06 W/m
	10 mm	7.23 W/m
	12 mm	7.35 W/m
	15 mm	7.89 W/m
	22 mm	9.12 W/m
	28 mm	10.07 W/m
	35 mm	11.08 W/m
	42 mm	12.19 W/m
54 mm	14.12 W/m	
<p>*In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 60°C in still air at 15°C. Further guidance on converting heat loss limits to insulation thickness for specific thermal conductivities is available in TIMSA “HVAC guidance for achieving compliance with Part L of the Building Regulations”.</p>		

4.3 Electric heating systems (other than electric boilers for central heating)

This section provides guidance on the following types of fixed electric heating systems:

- electric warm air systems;
- electric panel heaters;
- electric storage systems including integrated storage/direct systems.

Portable, plug-in appliances are not covered by this guide.

Fixed electric heating systems (other than electric boilers) provided as **new systems** and **replacement systems** should meet the minimum standards for time and temperature control in Table 17.

Table 17: Minimum provisions for control of primary and secondary electric heating systems (other than with electric boilers)

Electric heating systems	Standards for new and replacement systems		Supplementary information
Warm air systems	1.0 Time and temperature control, either integral to the heater or external	a. Time switch/programmer and room thermostat; or b. programmable room thermostat .	
	2.0 Zone control	a. Dwellings with a total usable floor area up to 150 m ² should be divided into at least two space heating zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m ² should be provided with at least two space heating zones, each having separate timing and temperature controls. Time control should be provided by: <ol style="list-style-type: none"> multiple heating zone programmers; or a single multi-channel programmer, or programmable room thermostats, or separate timers to each circuit, or a combination of (iii) and (iv) above. c. For single-storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.	

Table 17: Minimum provisions for control of primary and secondary electric heating systems (other than with electric boilers) *(continued)*

Panel heaters	3.0 Local time and temperature control	<ul style="list-style-type: none"> a. Time control by a programmable time switch integrated into the appliance or a separate time switch. b. Individual temperature control by integral thermostats or by separate room thermostats or programmable room thermostats. 	<i>Panel heater systems provide instantaneous heat.</i>
Storage heaters	4.0 Charge control	<ul style="list-style-type: none"> a. Automatic control of input charge. 	<i>Charge control is the ability to detect the internal temperature and adjust the charging of the heater accordingly.</i>
	5.0 Temperature control	<ul style="list-style-type: none"> a. Temperature control by adjusting the rate of heat release from the appliance, using an adjustable damper or other thermostatically-controlled method. 	

Section 5: Solid fuel heating systems

5.1 Scope of guidance

This section provides guidance on meeting the energy efficiency standards in building regulations for the following types of solid fuel heating appliances and systems used to deliver primary and secondary heating:

- batch-fed open fires;
- batch-fed and automatic-feed dry room heaters/stoves;
- batch-fed log and multi-fuel appliances;
- automatic-feed pellet stoves with and without boilers;
- batch-fed and automatic-feed room heaters with boilers;
- batch-fed cookers with boilers not exceeding 7.5kW;
- batch-fed independent boilers and automatic-feed anthracite, wood pellet, wood chip and wood log fired independent boilers;
- central heating systems using certain types of solid fuel appliances.

The guidance covers the following types of solid fuel: coal, anthracite, manufactured smokeless fuel, dual-fuel, wood logs, wood pellets and wood chips.

5.2 Solid fuel appliances for primary heating

Solid fuel appliances provided as **new systems** and **replacement systems** in dwellings for primary heating should have a minimum efficiency (gross calorific value) not less than specified in Table 18 for that category of appliance.

Table 18: Solid fuel appliance categories and minimum efficiencies

Category	Appliance description	Minimum efficiency % (gross calorific value)	Feed
B1	Simple open fire – Inset	37%	Batch
B2	Open fire – freestanding convector	47%	Batch
B3	Open fire inset convector	45% (mineral fuels) 43% (wood fuels)	
C1/2	Open fire and boiler (inset or freestanding)	50%	Batch
D1/2/3	Open fire + high output boiler (trapezium and rectangular grates)	63%	Batch
D4	Open fire + high output boiler (rectangle)	63%	Batch
E 1	Dry room heater (often known as dry stove)	65%	Batch/ Automatic
E 2	Dry room heater – logs only	65%	Batch
E 3	Dry room heater – multi-fuel	65%	Batch
E 4	Dry room heater – pellet stove	65% part load 70% nominal load	Auto
F	Room heater with boiler	67% (mineral fuels and logs) 70% (wood pellets – part load) 75% (wood pellets – nominal load)	Batch/ Automatic
G1	Cooker without boiler not exceeding 3.5 kW	65% (mineral fuels) 55% (wood fuels)	Batch
G2	Cooker with heating boiler exceeding 3.5 kW	65% (mineral fuels) 60% (wood fuels)	Batch
J2	Independent boiler (batch-fed) wood logs only	75%	Batch
J3	Independent boiler (batch-fed) multi-fuel	65% (mineral fuels) 75% (wood logs)	Batch
J4	Independent boiler – anthracite	70% up to 20.5 kW 75% above 20.5 kW	Automatic
J5	Independent boiler – wood/ pellets/ chips	75% nominal load 70% part load	Automatic
	Slow heat release appliances	65%	Batch
	One-off tiled/ mortared stoves	70%	Batch

Supplementary information on solid fuel appliances**Minimum efficiencies**

Minimum efficiencies for solid fuel appliances are published in the HETAS “Official guide to approved solid fuel products and services”, and on the website www.hetas.co.uk. Manufacturers’ efficiency figures may be higher than those indicated and should be used where independently certified against the harmonised European Standards now in place.

Carbon emission factors

Solid fuels include wood in various forms, different types of coal, and manufactured solid fuels, and consequently there is a range of associated CO₂ emission factors. These factors are as important as appliance efficiency when selecting a boiler. Table 19 shows the CO₂ emission factors for generic types of solid fuel recognised in SAP.

Table 19: CO₂ emission factors for generic types of solid fuel

Solid Fuel	CO₂ emission factors (kg CO ₂ /kWh)	Notes
House coal	0.382	Traditional British coal. It burns with smoky flame.
Anthracite	0.365	A mineral fuel with high carbon content. Burns very cleanly.
Manufactured smokeless fuel	0.404	Mineral fuel usually made from anthracite
Wood logs	0.018	Renewable wood logs either purchased or from own land.
Wood pellets in bags	0.037	Mechanically compressed sawdust
Bulk wood pellets	0.037	As above, delivered in bulk
Multi-fuel	0.243	A UK “typical blend” of logs and mineral fuel as burnt by a typical householder on a multi-fuel stove.
Wood chips	0.015	Chipped wood, processed on site.

Some appliances can only burn a single type of fuel while others may be able to burn a range of types. The “multi-fuel” category in Table 19 allows for the latter group, basing its CO₂ emissions on a typical blend of fuels used in that case.

Smoke Control Areas

Within local authority Smoke Control Areas only anthracite or other Authorised Smokeless Fuels may be used, unless the property is fitted with an Exempted Appliance.

An exempted appliance is one that has been approved by Parliamentary Statutory Instrument for installation in smoke control areas and prospective purchasers should check that the appliance and intended fuel are permitted. A list of currently authorised fuels and exempted appliances is given on the web site www.uksmokecontrolareas.co.uk.

Outside a smoke control area house coal or wood can be burnt on non-exempted appliances. Wood should always be seasoned to a moisture content appropriate to the design and performance of the appliance, for example log wood not exceeding 20% to ensure maximum performance and limit the occurrence of condensation and deposits in the chimney system.

All solid fuel appliances require appropriate soot-fire resistant chimneys discharging at high level locations as defined within building regulations. Details of HETAS’ approved chimney products independently tested and approved to accepted standards can be found on the HETAS website. The natural ventilation rates of these chimneys may be less than the default values listed within SAP 2009; the use of these more accurate values will reduce SAP values.

5.3 Central heating systems using certain types of solid fuel appliances

This section provides guidance on the following types of solid fuel appliance used to deliver primary heating as part of a central heating system:

- batch-fed open fires with high output boilers (appliance types D1 to D4 in Table 18);
- batch-fed and automatic-feed room heaters and stoves with boilers (appliance type F in Table 18);
- batch-fed cookers with boilers (appliance type G2 in Table 18);
- batch-fed independent boilers and automatic-feed anthracite, wood log, wood pellet and wood chip fired independent boilers (appliance types J1 to J5 in Table 18).

Unless stated otherwise, the guidance applies equally to appliances that burn wood, wood pellets, house coal, manufactured smokeless fuels and anthracite.

For central heating systems with a solid fuel appliance installed as a **new system** or **replacement system** in dwellings:

- a. the appliance should be from HETAS categories D, F, G and J in Table 18 and have a minimum efficiency (gross calorific value) which is not less than the value specified for its category;
- b. the ratio of room heat to water heat should be appropriate for the room and total property. This will require reference to installation practice guidelines and calculation of room and property heat loss. Advice on this is given in the HETAS Guide and website;
- c. circulation, fuel storage, hot water storage, system preparation, water treatment and commissioning should be to the standards in Table 20;
- d. control of heating and hot water circuits should be to the standards in Table 21;
- e. pipework should be insulated to the standards in Table 22.

Supplementary information**Turn-down values (ie the ratio of high to low output)**

- *Turn-down ratios are generally very good (>10:1) for automatic-feed appliances with small firebeds.*
- *Turn-down ratios are less good with large batch-fed appliances unless the latter are used in conjunction with a hot water accumulator.*
- *Automatic appliances are likely to require less frequent refuelling. Automatic (eg electric or gas) ignition is now available for certain designs and reduces energy usage at times of low demand allowing boiler interlock.*
- *Some boilers have both auto-ignition and fire-extinguishing features.*

Link-up systems

It is possible to connect together two or more heating appliances with boilers (at least one of which can be solid fuel-fired), to maximise flexibility and efficiency. For example, an oil or gas boiler could be combined with a wood burning stove with boiler sited in the living room. This combination with wood burning appliances will reduce overall carbon emissions. Both systems should be designed to appropriate installation codes.

Table 20: Minimum provisions for system circulation, fuel storage, hot water storage, system preparation and commissioning for solid fuel central heating

Solid fuel heating	Standards for new and replacement systems	Supplementary information
1.0 System circulation	<ul style="list-style-type: none"> a. Where boiler interlock is available, fully pumped circulation should be chosen. b. The manufacturer's instructions on the sizing and positioning of heat leak radiators should be followed. c. Solid fuel appliances should not be fitted to sealed heating systems with expansion vessels, except where specifically permitted by the manufacturer or where a thermal storage interface device is used. 	<p><i>Most solid fuel central heating systems require a heat leak radiator to dissipate heat from the smouldering fire bed. This is commonly the bathroom towel-rail and a thermosiphon system may be used for this circuit. In some cases a fully pumped system reduces efficiency and should not be used.</i></p>
2.0 Fuel storage	<ul style="list-style-type: none"> a. Provision should be made for storage of reasonable quantities of fuel in a convenient and dry location. The size of the storage will depend upon the requirement of the house. 	<p><i>No minimum quantity of fuel is specified for solid mineral fuel but bunkers greater than 250 kg are preferred as below this householders are likely to pay a delivery premium.</i></p>
3.0 Hot water storage	<ul style="list-style-type: none"> a. Vented copper hot water storage vessels should comply with the heat loss and heat exchanger requirements of BS 1566-1:2000 or BS 3198. b. Vented cylinders in materials other than copper should comply with the heat loss and heat exchanger requirements of BS 1566. c. Unvented hot water storage system products should: <ul style="list-style-type: none"> i. comply with BS EN 12897 ; or ii. be certified by the British Board of Agrément, the Water Research Council; or iii. be certified by another accredited body as complying with building regulations. d. Unvented systems should not be used with gravity circulation. e. Primary storage systems should meet the insulation requirements of section 4.3.1 or 4.3.2 of the Hot Water Association <i>Performance specification for thermal stores</i>. f. Combination cylinders should comply with BS 3198 and in addition have a heat loss not exceeding $1.6 \times [0.2 + 0.51V^{2/3}]$ kWh/day where V is the volume of the hot water part of the cylinder. g. All hot water storage vessels should carry a label with the following information: <ul style="list-style-type: none"> i. type of vessel; ii. nominal capacity in litres; iii. standing heat loss in kWh/day; iv. type of vessel; v. heat exchanger performance in kW. h. Vented copper hot water cylinders should carry clear labelling on the product such as a BSI Kitemark, registered firm status or reference to an equivalent quality control scheme. 	<p>Primary hot water stores</p> <p><i>These can have a major role to play in the installation of solid fuel. The main reason for their use is to store the heat generated during slumber periods but where unvented storage cylinders are used they also provide mains pressure hot water and possible frost protection (via electric immersion heaters) for the solid fuel system. Domestic hot water outlet temperature is to be controlled at a safe level. Because of the higher than normal storage temperatures it is very important that stores are well insulated.</i></p> <p><i>The HWA thermal storage specification is available for free download from www.hotwater.org.uk</i></p> <p>British Standards</p> <p><i>BS 1566: 2002 "Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods".</i></p> <p><i>BS 3198:1981 "Specification for copper hot water storage combination units for domestic purposes".</i></p> <p><i>BS EN 12897 "Water supply. Specification for indirectly heated unvented (closed) storage water heaters".</i></p>

Table 20: Minimum provisions for system circulation, fuel storage, hot water storage, system preparation and commissioning for solid fuel central heating (*continued*)

Solid fuel heating	Standards for new and replacement systems	Supplementary information
4.0 System preparation and water treatment	<ul style="list-style-type: none"> a. Central heating systems should be thoroughly cleaned and flushed out before installing a new boiler. b. During final filling of the system a chemical water treatment formulation should be added to the primary circuit to control corrosion and the formation of scale and sludge. Reasonable provision would be to follow the guidance on how to prepare and commission systems given in BS 7593:2006. c. Installers should also refer to the boiler manufacturer's installation instructions for appropriate treatment products and special requirements for individual boiler models. d. Where the mains total water hardness exceeds 200 parts per million, provisions should be made to treat the feed water to water heaters and the hot water circuit to reduce the rate of accumulation of lime scale and the consequent reduction in energy efficiency 	<p><i>Note should also be made of advice in the manufacturer's instructions.</i></p> <p><i>It is advisable to install valves which will isolate both the radiators and the heating circuit when removing radiators for service or maintenance. Avoiding the need to drain down the system will help to retain the circulating fluid and prevent loss of water treatment.</i></p>
5.0 Commissioning	<ul style="list-style-type: none"> a. On completion of the installation of a boiler or hot water storage system, together with associated equipment such as pipework, pumps and controls, the equipment should be commissioned in accordance with the manufacturer's instructions. These instructions will be specific to the particular boiler or hot water storage system used. b. The installer should give a full explanation of the system and its operation to the user, including the manufacturer's user manual where provided. 	<p><i>Only persons who are competent should carry out the installation, eg installers who are registered with HETAS. Such persons will certify that they have carried out installation and commissioning in accordance with requirements in building regulations and in the manufacturer's instructions (which may be more stringent).</i></p> <p><i>Note that the delivery of wood or coal without appropriate documentation into a smoke-control area is an offence under the Clean Air Act.</i></p>

Table 21: Minimum provisions for control of solid fuel central heating systems			
Solid fuel heating	Standards for new systems	Standards for replacement systems	Supplementary information
All appliances, except open fires			
1.0 Burning rate	a. Thermostatic control of the burning rate.	a. Thermostatic control of the burning rate.	
Automatic-feed appliances			
2.0 Zoning	<p>a. Dwellings with a total usable floor area up to 150 m² should be divided into at least two space heating zones with independent temperature control, one of which is assigned to the living area.</p> <p>b. Dwellings with a total usable floor area greater than 150 m² should be provided with at least two space heating zones, each having separate timing and temperature controls.</p> <p>c. For single-storey, open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.</p>	a. No minimum requirement but, as far as it is practicable and economic to do so, controls should be upgraded to the levels defined for new systems .	
3.0 Time control of space and water heating	<p>a. Time control of space and water heating should be provided by:</p> <ul style="list-style-type: none"> i. a full programmer with separate timing to each circuit; or ii. two or more separate timers providing timing control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of the hot water circuit. 	a. No minimum requirement but, as far as it is practicable and economic to do so, controls should be upgraded to the levels defined for new systems .	<i>The level of sophistication should generally be appropriate to and compatible with that of the appliance. The highest levels are only appropriate to appliances with automatic ignition.</i>

Table 21: Minimum provisions for control of solid fuel central heating systems (*continued*)

Solid fuel heating	Standards for new systems	Standards for replacement systems	Supplementary information
4.0 Temperature control of space heating	a. Separate temperature control of zones within the dwelling should be provided using: <ol style="list-style-type: none"> i. room thermostats or programmable room thermostats in all zones; and ii. individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators other than in reference rooms and bathrooms. 	a. No minimum requirement but, as far as it is practicable and economic to do so, controls should be upgraded to the levels defined for new systems .	
5.0 Temperature control of domestic hot water	a. A cylinder thermostat and a zone valve or three-port valve should be fitted to control the temperature of stored hot water. b. Non-electric hot water controllers should not be used. c. Where permitted by the manufacturer, the cylinder thermostat should be wired to provide a boiler interlock	a. A method of temperature control should be provided to prevent excessive tap water temperatures. b. As far as it is practicable and economic to do so, controls should be upgraded to the levels defined for new systems .	<i>In some circumstances, such as with thermal stores, a zone valve is not appropriate; a second pump could be substituted for the zone valve.</i>

Supplementary information on controls for solid fuel central heating

Boiler interlock, provided by a wiring arrangement, to prevent the system from operating when there is no demand for heat, should only be fitted if recommended by the manufacturer.

In some simple batch-fed or automatic appliances (without heat stores or without automatic ignition), it is not possible to switch off the heat output completely, but the appliance output can be lowered to a minimum to reduce fuel consumption.

In most solid fuel systems the room thermostat will switch off the pump, which in turn will cause the boiler to operate at minimum output.

Some automatic solid fuel systems can be fitted with weather compensation, and incorporate multi-zone control. It is important to seek guidance from the manufacturer, especially if the heating package is to include other fuels.

Controls may be provided by any boiler management control system that meets the specified zoning, timing and temperature, and boiler interlock control requirements.

Table 22: Minimum provisions for insulation of pipework in solid fuel central heating systems

Standards for new systems	Supplementary information	
<p>a. Pipes should be insulated to comply with the maximum permissible heat loss indicated in the Supplementary Information column, and labelled accordingly, as follows:</p> <ol style="list-style-type: none"> i. Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces. ii. Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements. iii. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed). iv. If secondary circulation is used, all pipes kept hot by that circulation should be insulated. 	<p>Insulation of pipework in unheated areas</p> <p>Extra provision may need to be made to protect central heating and hot water pipework in unheated areas against freezing. Guidance is available in:</p> <ul style="list-style-type: none"> • BS 5422:2001 "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C". • BRE Report No 262 "Thermal insulation: avoiding risks", 2002 Edition. 	
	<p>Where insulation is labelled as complying with this guide, it must not exceed the following heat loss levels:</p>	
<p>Standards for replacement systems</p>	<p>Pipe outside diameter</p>	<p>Maximum heat loss*</p>
<p>b. Whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes that are exposed as part of the work or are otherwise accessible should be insulated as recommended above – or to some lesser standard where practical constraints dictate.</p>	8 mm	7.06 W/m
	10 mm	7.23 W/m
	12 mm	7.35 W/m
	15 mm	7.89 W/m
	22 mm	9.12 W/m
	28 mm	10.07 W/m
	35 mm	11.08 W/m
	42 mm	12.19 W/m
	54 mm	14.12 W/m
	<p>*In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 60°C in still air at 15°C. Further guidance on converting heat loss limits to insulation thickness for specific thermal conductivities is available in TIMSA "HVAC guidance for achieving compliance with Part L of the Building Regulations".</p>	

5.4 Solid fuel appliances for secondary heating

Solid fuel appliances in new and existing dwellings that are provided for secondary heating and are not part of a central heating system should have a minimum efficiency (gross calorific value) not less than specified in Table 18 for that category of appliance.

Supplementary information on solid fuel appliances providing secondary heating
Minimum efficiencies
 Minimum efficiencies for solid fuel appliances are published in the HETAS “Official guide to approved solid fuel products and services”, and on the website www.hetas.co.uk. Manufacturers’ efficiency figures may be higher than those indicated and should be used where independently certified against the harmonised European Standards now in place.
Appliance types
 Appliances which are most suitable for secondary space heating are summarised in Table 23.

Table 23: Appliance types	
Appliance type	Notes
Open-fire with high output boiler, when used with “link-up”.	
Small solid fuel room heaters (stoves), especially wood-fired.	These can be a dedicated wood burner or burn logs in a multi-fuel appliance or use pellets. They can be matched with a main heating system fired by the same or a different primary fuel or off-peak electricity to reduce carbon emissions, especially wood-fired, with or without thermostatic control. Many designs can provide heating during power cuts. Mineral fuel appliances can be chosen but the attention of designers is drawn to the probable need to supply additional measures, as the carbon emission values of these tend to be high. Mineral fuel appliances may often have slightly higher efficiencies than their wood burning counterparts. Multi-fuel room heaters can enable the user to burn renewable wood as well as an alternative to mineral fuels outside smoke control areas.
Small solid fuel stoves with boilers.	The efficiency of these can be higher than that of dry appliances. They can be integrated with the primary wet heating system. Multi-fuel appliances enable the householder to burn renewable wood outside smoke control areas.
Range cookers.	Typically appliances which are installed in a “living area” and are designed to provide some useful heat from their case into the space in which they are located. They are available in a variety of shapes and sizes and can incorporate a boiler which can be connected to dual-fuel integrated systems (eg link-up). Multi-fuel versions are also available.
Where requested, open fires (HETAS categories B1, B2 and B3) can be fitted.	These do not have thermostatic control of the burning rate and have lower efficiencies. However, they are able to burn wood logs with correspondingly low net carbon emissions. It must be stressed that large open fires with large free face areas (see Note 1) usually have a need for ventilation well in excess of that available in a property built to modern standards of air tightness. This is likely to lead to severe operational problems unless special steps are taken to provide the required air supply. The use of such large (simple) open fires is penalised in the SAP calculations. Note 1: The free face area of an open fire is its opening width times its opening height.

Controls for solid fuel appliances providing secondary heating

Wherever possible, solid fuel appliances should have thermostatic control (these are usually integral to appliances in categories E, F and G). Controls should be appropriate to the level of sophistication of the appliance; automatic appliances can benefit from advanced controls.

Provision of fuel storage for solid fuel appliances providing secondary heating

The quantity of fuel consumed by secondary heating appliances is likely to be less than 1 tonne per year. However it should be stored in a dry and convenient location.

Smoke control areas

The location of the appliance within or without a smoke control area is critical to the process of optimising the choice of appliance and fuel.

For further information on solid fuel appliances see CE47 “Energy Efficiency Best Practice in Housing – Domestic heating by solid fuel: Boiler systems”.

Guidance and standards

EN 12809:2001/ A1:2004/ AC:2006/2007 “Residential Independent boilers fired by solid fuel – Nominal output up to 50kW – Requirements and test methods”.

EN 12815:2001/ A1:2004/2006/2007 “Residential cookers fired by solid fuel – Requirements and test methods”.

EN 13229:2001/ A1:2003/ A2:2004/ AC:2006/2007 “Inset appliances including open fires fired by solid fuel – Requirements and test methods”.

EN 13240:2001/ A2:2004 /AC2006/2007 “Room heaters fired by solid fuel – Requirements and test methods”.

EN 15250:2007 “Slow heat release appliances fired by solid fuel – Requirements and test methods”.

EN 15544 “One-off tiled/ mortared stoves – Calculation method”.

EN 14785:2006 “Residential space heating appliances fired by wood pellets”.

Solid biofuels quality standards: CEN/TS 14588:2004; CEN/TS 14774-1:2004; CEN/TS 14774-2:2004; CEN/TS 14774-3:2004; CEN/TS 14775:2004; CEN/TS 14778-1:2005; CEN/TS 14778-2:2005; CEN/TS 14779:2005; CEN/TS 14780:2005; CEN/TS 14918:2005; CEN/TS 14961:2005; CEN/TS 15103:2005; CEN/TS 15148:2005; CEN/TS 15149-1:2006; CEN/TS 15149-2:2006; CEN/TS 15150:2005; CEN/TS 15210-1:2005; CEN/TS 15234:2006; CEN/TS 15289:2006; CEN/TS 15290:2006; CEN/TS 15296:2006.

Section 6: Community heating systems

6.1 Scope of guidance

This section provides guidance on the specification of community heating systems for dwellings to meet the minimum energy efficiency standards in building regulations.

A community heating system is one that supplies heat to a number of dwellings from a common heat source. A system may heat a small block of flats or a large number of buildings.

The guidance in this section applies to systems that:

- supply 15 or more dwellings from a central boiler, or from a low carbon source such as combined heat and power (CHP), biofuels, heat pumps and solar panels;
- distribute heat from the central source using a wet radiator system (although warm air heating and underfloor heating systems may also be used).

6.2 New and existing community heating schemes

The central heat source should comply with the requirements in the *Non-domestic building services compliance guide* except where specified in this section.

Guidance is provided for two scenarios:

- connecting dwellings to a new community heating scheme; and
- connecting dwellings to an existing community heating scheme.

Connecting dwellings to a new community heating scheme

New community heating systems for both new and existing dwellings should meet the minimum standards for:

- a. energy efficiency in Table 24;
- b. low-carbon heat sources in Table 25;
- c. system control in Table 26;
- d. hot water production, storage and treatment, heat metering and commissioning in Table 27;
- e. insulation of pipework in Table 28.

Connecting dwellings to an existing community heating scheme

When existing community heating systems are connected to new or existing dwellings, the minimum requirements are:

- a. if the existing community heating system is in need of replacement or improvement, a study should be carried out to assess the economic and environmental benefits of a range of options, including the use of CHP and other low carbon heat sources, especially where individual heating systems are being considered as an alternative to continuing with the community heating system;
- b. replacement boilers should meet the minimum standards for boiler efficiency in the *Non-domestic building services compliance guide*;
- c. if thermal energy is purchased from an existing district or community heating system, an assessment of the carbon intensity of the scheme should be carried out. Emission factors should be determined based on the particular details of the scheme, but should take account of the annual average performance of the whole system – that is, of the distribution circuits and all the heat generating plant, including any CHP, and any waste heat recovery or heat dumping. The calculation of the Dwelling CO₂ Emission Rate should be carried out by a suitably qualified person, who should explain how the emission factors were derived;
- d. controls should meet the minimum standards in Table 26;
- e. pipework insulation should meet the minimum standards in Table 28.

Table 24: Minimum provisions for the design of new community heating systems to maximise efficiency of heat generation and minimise energy use by pumps

Community heating	Standards for new systems	Supplementary information
1.0 Boilers	<p>a. Boiler-only community heating systems for new dwellings may be used provided that the Target carbon dioxide Emission Rate (TER) for the dwelling is not exceeded.</p> <p>b. Boilers should be selected to comply with the boiler efficiency requirements of the <i>Non-domestic building services compliance guide</i>.</p>	<p><i>When calculating the carbon emission rate, the type and quantity of fuel used and also the electricity needed to operate the central plant and pumps should be taken into account.</i></p> <p><i>For systems using condensing boilers:</i></p> <ul style="list-style-type: none"> • <i>To achieve high boiler efficiency, return temperatures from radiator circuits should be selected lower than 50°C.</i> • <i>Where instantaneous plate heat exchangers are used to produce hot water in individual dwellings the return temperature selected should be less than 40°C.</i> • <i>Where hot water cylinders are used the coil size should be such as to require a flow rate that results in a nominal return temperature of less than 40°C whilst meeting the required heat-up time.</i> • <i>Where hot water is produced centrally (eg in each block of dwellings) return temperatures lower than 40°C should be achieved.</i>
2.0 Controlling the sequencing and firing of boilers	<p>a. Controls for boilers should meet the requirements of the <i>Non-domestic building services compliance guide</i>, except optimum start is not required.</p>	<p><i>Setting occupation times is not generally possible for a group of dwellings and so optimum start controls are not a requirement.</i></p>
3.0 Minimising energy use by pumps	<p>a. For new community heating systems, the design temperature difference for the community heating primary circuit should be greater than 20°C.</p> <p>b. Variable volume control systems should be used to reduce the volume of water and the pressure difference required from the pumps under part load.</p>	<p><i>Pumping energy can be minimised by optimising operating temperatures and pipe sizes to reduce installed pump power. To take full advantage of variable volume systems, variable speed pumps should be installed and controlled to deliver the required pressure difference to suit the load.</i></p> <p><i>Further guidance is provided in BSRIA Application Guide AG 16/2002 – “Variable-flow water systems: design, installation and commissioning guidance”.</i></p>

Table 25: Minimum provisions for design of low-carbon heat sources where these are included in community heating systems

Community heating	Standards for new systems	Supplementary information
1.0 Low carbon heat sources	a. No minimum standard, but see Supplementary Information.	<i>Community heating systems can be designed to use low-carbon heat sources to meet all or part of the heat demand, which may enable some relaxation of the U-values that would otherwise be required.</i>
2.0 Biofuels	a. No minimum standard, but see supplementary information.	<i>Biofuels can be used to provide heat from boiler systems or as a fuel for CHP systems. Consideration should be given to operation and maintenance of the plant to ensure a long life and to prevent a later replacement by a conventional fuel system. Where a biofuel boiler is to be used in conjunction with conventional heating boilers or electric heating, a reasonable minimum proportion of the annual heat supply from biofuels would be 45% of the annual heat demand (space, domestic hot water and process heating). Further guidance is provided in “Low or zero carbon energy sources: strategic guide”, ODPM 2006.</i>
3.0 Combined heat and power (CHP)	a. Where CHP is used in conjunction with boiler plant, the control system should ensure that, as far as is practicable, the CHP plant operates as the lead heat source.	<i>CHP capacity should be optimised to meet the required economic and environmental objectives. A reasonable minimum proportion of the annual heat supply from CHP would be 45% of the annual heat demand (space, domestic and hot water heating). To maximise the use of CHP heat over the year, consideration should be given to the use of thermal storage to meet peaks, especially in the early morning period. The procedure given in SAP 2009 should be used to calculate the carbon emissions from CHP systems.</i>

Table 25: Minimum provisions for design of low-carbon heat sources where these are included in community heating systems (*continued*)

Community heating	Standards for new systems	Supplementary information
4.0 Heat Pumps	a. No minimum standard, but see Supplementary Information.	<i>Heat pumps can be used as a heat source for community heating systems. Selection of operating temperatures to optimise the efficiency of the community heating system and achieve high COPs is important if carbon emissions are to be reduced. This may involve the use of underfloor heating and the provision of domestic hot water by other means. Where heat pumps are installed in conjunction with conventional heating boilers, a reasonable minimum proportion of the annual heat supply from the heat pump would be 45% of the annual space heating demand.</i>
5.0 Solar	a. No minimum standard, but see Supplementary Information.	<i>Solar thermal panels can be used as the heat source for a centralised domestic hot water system.</i>

Table 26: Minimum provisions for control of systems within dwellings for community heating

Community heating	Standards for new systems	Supplementary information
1.0 Zoning	a. Dwellings with a total usable floor area up to 150 m ² should be divided into at least two zones with independent temperature control, one of which is assigned to the living area. b. Dwellings with a total usable floor area greater than 150 m ² should be provided with at least two space heating zones, each having separate timing and temperature controls.	<i>In single-storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.</i>
2.0 Time control of space heating	a. Time control of space heating should be provided by: <ol style="list-style-type: none"> i. a full programmer; ii. two or more separate timers providing timing control to each zone; or iii. programmable room thermostat(s) to the heating circuit(s). b. For dwellings with a total usable floor area greater than 150 m ² , time control for the separate space heating zones can be achieved by: <ol style="list-style-type: none"> i. multiple heating zone programmers; or ii. a single multi-channel programmer. 	<i>Where the hot water is produced instantaneously, such as with a plate heat exchanger, time control is only required for space heating zones.</i> <i>Time control of domestic hot water heating using a cylinder is not considered essential for community heating and could be a disadvantage with CHP-based systems, increasing the morning peak demand and hence causing more use of the boiler than necessary.</i>
3.0 Temperature control of space heating	a. Separate temperature control of zones within the dwelling should be provided using: <ol style="list-style-type: none"> i. room thermostats or programmable room thermostats in all zones; ii. a room thermostat or programmable room thermostat in the main zone, and individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators in the other zones; or iii. a combination of (i) and (ii) above. 	<i>Control valves and TRVs should be two-port type to reduce flow rates under part load.</i> <i>Differential pressures across control valves and TRVs should be limited to ensure that the control valves work effectively and maintain shut-off.</i>

Table 26: Minimum provisions for control of systems within dwellings for community heating *(continued)*

Community heating	Standards for new systems	Supplementary information
<p>4.0 Temperature control of domestic hot water</p>	<p>a. Temperature control of the domestic hot water service should be provided by means of two-port control valves either electrically operated or direct acting.</p>	<p><i>Where instantaneous heat exchangers are used the control valve should be selected to maintain steady temperatures (<+/- 5°C) for a range of draw-off rates and primary differential pressures. To reduce the incidence of scaling, the control valve should shut off the primary flow when there is no domestic hot water draw off. A small intermittent flow is an advantage to maintain the temperature within the heat exchanger so as to provide more rapid heat up.</i></p>
<p>5.0 Limitation of maximum flow rate into building or dwelling</p>	<p>a. The maximum design flow rate into the dwelling heating system should be limited by suitable control and balancing valves to maintain the overall balance in the network and to avoid excessive pumping energy.</p>	

Table 27: Minimum provisions for domestic hot water production, storage and water treatment, heat meters and commissioning for community heating

Community heating	Standards for new systems	Supplementary information
1.0 DHW production and storage	a. The hot water system should be controlled using variable volume control principles and be designed to maintain low return temperatures in the primary community heating circuit.	<p><i>Hot water can be produced in four ways in community heating systems:</i></p> <ul style="list-style-type: none"> • <i>in individual dwellings using indirect storage cylinders;</i> • <i>in individual dwellings using instantaneous plate heat exchangers;</i> • <i>centrally using storage calorifiers with either an indirect coil or an external plate heat exchanger;</i> • <i>centrally using an instantaneous plate heat exchanger.</i> <p><i>In selecting the system, consideration should be given to:</i></p> <ul style="list-style-type: none"> • <i>the impact on return temperatures in the community heating system;</i> • <i>the impact on flow rates in the community heating system;</i> • <i>the impact on heat demand profiles and compatibility with the heat source;</i> • <i>standing losses from storage cylinders/ calorifiers and the impact on energy use;</i> • <i>the quality of service provided in terms of flow rate and temperature control;</i> • <i>the advantages of having local storage in terms of security of supply.</i> <p><i>Where the network is extensive and hot water production is centralised, a two stage water heating system can be used to deliver low return temperatures. In this design the return water from the space heating circuit is used to pre-heat the cold feed to the domestic hot water.</i></p>
2.0 Water treatment	a. A suitable system for introduction of water treatment chemicals into the community heating system in a controlled manner with facility for monitoring of water quality should be provided.	<p><i>A suitable long-term programme of water treatment is essential to preserve the life of the community heating system by limiting internal corrosion.</i></p> <p><i>Additional chemical and physical treatment should be evaluated especially for larger systems, including:</i></p> <ul style="list-style-type: none"> • <i>removal of oxygen by physical means;</i> • <i>softened water supply;</i> • <i>side-stream filtration;</i> • <i>biocide.</i>
3.0 Heat meters	a. Provision should be made in the design for including heat meters either at the time of installation or at a later date without major pipework changes.	

Table 27: Minimum provisions for domestic hot water production, storage and water treatment, heat meters and commissioning for community heating (*continued*)

Community heating	Standards for new systems	Supplementary information
4.0 Commissioning	<ul style="list-style-type: none"> a. The community heating system should be commissioned so that the design volume flow rates are supplied to each dwelling and there is no excessive bypassing of water that would lead to higher pumping energy use. b. The flow rates in individual heat emitters should be balanced using appropriate return temperatures or by using calibrated control valves. c. The systems within the dwellings should be demonstrated to the resident and suitable information provided on the operation of the controls 	<p><i>Where the central heat source includes a low-carbon heat source, the control system should be proven by demonstrating that the low-carbon heat source will normally act as the lead heat source.</i></p>

Table 28: Minimum provisions for insulation of internal and external pipework for community heating systems

Standards for internal pipework in new systems	Supplementary information	
<p>a. Pipes should be insulated to comply with the maximum permissible heat loss indicated in the Supplementary Information column, and labelled accordingly, as follows:</p> <ol style="list-style-type: none"> i. Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces. ii. Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements. iii. All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed). iv. If secondary circulation is used, all pipes kept hot by that circulation should be insulated. 	<p>Insulation of pipework in unheated areas</p> <p>Extra provision may need to be made to protect central-heating and hot water pipework in unheated areas against freezing. Guidance is available in:</p> <ul style="list-style-type: none"> • BS 5422:2001 “Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C”. • BRE Report No 262 “Thermal insulation: avoiding risks”, 2002 Edition. 	
<p>Standards for internal pipework in replacement systems</p>	<p>Where insulation is labelled as complying with this guide, it must not exceed the following heat loss levels:</p>	
<p>b. Whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes that are exposed as part of the work or are otherwise accessible should be insulated as recommended above – or to some lesser standard where practical constraints dictate.</p>	<p>Pipe outside diameter</p>	<p>Maximum heat loss*</p>
	8 mm	7.06 W/m
	10 mm	7.23 W/m
	12 mm	7.35 W/m
	15 mm	7.89 W/m
	22 mm	9.12 W/m
	28 mm	10.07 W/m
	35 mm	11.08 W/m
	42 mm	12.19 W/m
	54 mm	14.12 W/m
<p>*In assessing the thickness of insulation required, standardised conditions should be assumed in all compliance calculations, based on a horizontal pipe at 60°C in still air at 15°C. Further guidance on converting heat loss limits to insulation thickness for specific thermal conductivities is available in TIMSA “HVAC Guidance for achieving compliance with Part L of the Building Regulations”.</p>		

Table 28: Minimum provisions for insulation of internal and external pipework for community heating systems (*continued*)

Standards for insulation of external distribution pipework	Supplementary information
<p>c. Community heating pipework should be insulated to the standards defined in EN 253 for pre-insulated pipes or to an equivalent performance for conventionally insulated pipes.</p>	<p><i>Community heating pipework typically uses pre-insulated buried pipe systems. Minimum insulation thicknesses are defined in EN standards. Where pipework is run above ground the pipe insulation performance should be at least as high as that used in the buried part of the system. Enhanced insulation standards should be evaluated where community heating is supplied only from fossil-fuelled boilers or where flow temperatures over 100°C are being used.</i></p> <p>Designing for minimum heat losses</p> <p><i>Heat losses can be reduced by optimising operating temperatures in conjunction with the need to minimise pumping energy. Variable volume control systems will assist in maintaining low return temperatures. Whilst some bypasses may be needed to maintain the system in a hot condition ready to meet the demand these should be controlled to the minimum flow needed. The use of temperature controlled bypass valves where the bypass only operates when flow temperature has dropped below a set level is recommended.</i></p>
<p>Further guidance and standards</p> <p><i>Good Practice Guide GPG234 "Guide to community heating and CHP – Commercial, public and domestic applications". Available from the Carbon Trust.</i></p> <p><i>BS EN 13941:2003 "Design and installation of pre-insulated bonded pipe systems for direct heating".</i></p> <p><i>BS EN 14419:2003 "District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Surveillance systems".</i></p> <p><i>BS EN 253:2003 "District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene".</i></p> <p><i>BS EN 448:2003 "District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Fitting assemblies of steel service pipes, polyurethane thermal insulation and outer casing of polyethylene".</i></p> <p><i>BS EN 488:2003 "District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Steel valve assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene".</i></p> <p><i>BS EN 489:2003 "District heating pipes. Pre-insulated bonded pipe systems for directly buried hot water networks. Joint assembly for steel service pipes, polyurethane thermal insulation and outer casing of polyethylene".</i></p>	

Section 7: Underfloor heating systems

7.1 Scope of guidance

This section provides guidance on the specification of underfloor heating systems in new dwellings to meet minimum energy efficiency standards in building regulations.

The guidance in this section covers systems that use both hot water pipes and electric heating elements as the underfloor heat source.

7.2 Underfloor heating in new dwellings

Underfloor heating in new dwellings should meet the minimum standards for:

- a. system control and safe operating temperatures in Table 29;
- b. floor insulation and system design to minimise distribution losses in Table 30; and
- c. in the case of electric underfloor heating systems in new dwellings, construction and controls in Table 31.

Table 29: Minimum provisions for control of wet and electric underfloor heating systems		
Underfloor heating	Standards for new systems	Supplementary information
<p>1.0 System temperature controls: Wet and electric underfloor heating systems</p>	<p>a. All underfloor heating systems, whether warm water or electrical types, should be fitted with the controls to ensure safe system operating temperatures:</p> <ul style="list-style-type: none"> i. A separate flow temperature high-limit thermostat is required for warm water systems connected to any high water temperature heat supply (ie operating at more than 60°C). ii. Mixed systems containing both radiators and floor heating, connected to a common high water temperature supply (ie operating at more than 60°C), should be provided with a separate means of reducing the water temperature to the floor heating system. 	
<p>2.0 Room temperature control: Wet and electric underfloor heating systems</p>	<p>a. Each room should have its own temperature control device; however, it may be acceptable for adjacent rooms with similar function – eg kitchens and utility rooms – to share a thermostat or sensor.</p> <p>b. Bathrooms or en-suites which share a heating circuit with an adjacent bedroom will provide heat only when the bedroom thermostat is activated. In such cases, the bathroom or en-suite areas should be fitted with an independent towel rail or radiator.</p> <p>c. Weather compensating controllers should be installed.</p>	
<p>3.0 Time control: Wet and electric underfloor heating systems</p>	<p>a. Dwellings with a total usable floor area up to 150 m² should be divided into at least two zones with independent temperature control, one of which is assigned to the living area.</p> <p>b. Dwellings with a total usable floor area greater than 150 m² should be provided with at least two space heating zones each having separate on/off timing controls and temperature controls.</p> <p>c. For single storey open-plan dwellings in which the living area is greater than 70% of the total floor area, sub-zoning of temperature control is not appropriate.</p> <p>d. Thick screed floor heating systems (>65 mm) should have facilities for automatic setback of room temperature to a lower level at night or during unoccupied periods.</p>	<p><i>Facilities for automatic setback of room temperature to a lower level at night or during unoccupied periods are recommended for both electric and warm water systems.</i></p>
<p>4.0 Boiler control: Wet underfloor heating systems only</p>	<p>a. Warm-water floor heating system controls should be interlocked with the boiler and stored hot water temperature control to ensure that the boiler does not fire when there is no demand for heat for either space or water heating.</p>	

Table 30: Minimum provisions for floor insulation and minimising distribution losses in wet and electric underfloor heating systems

Underfloor heating	Standards for new systems	Supplementary information
1.0 Exposed ground floors	a. Ground floors on earth, or suspended floors in contact with outside air, should be insulated to limit downward heat loss to not more than 10 W/m ² resulting from thermal resistance of the applied floor finish. b. When heat output is not known, but the floor finish is specified, the extra amount of system thermal insulation may be calculated using the sum of the thermal resistance of the floor finish and the thermal resistance of the underlying heated layer, all multiplied by a factor of 10. c. Supplementary floor heating system thermal insulation may be supplied independently, or added to the statutory insulation requirement. d. Floor heating systems intended for cyclical operation or installed over unheated rooms should be separated from the structural floor by a layer of thermal insulation of at least 1.25 m ² K/W thermal resistance, and installed below the heated plane.	
2.0 Intermediate floors with heated rooms below: wet systems	a. Intermediate floors with heated rooms below should have a separating layer of system thermal insulation to comply with either 1b above or BS EN1264 Part 4, where the minimum thermal resistance is given as not less than $R = 0.75 \text{ m}^2\text{K/W}$.	<i>Thermal insulation of party floors is essential because the floor or ceiling is directly coupled to the heating elements.</i>
3.0 Intermediate floors with heated rooms below: electric systems	a. Intermediate floors with heated rooms below should either comply with 1b above or have a separating layer of system thermal insulation where the minimum thermal resistance is not less than $R = 0.5 \text{ m}^2\text{k/W}$.	
4.0 System design to minimise distribution losses	a. Underfloor heating distribution boards or warm water distribution manifolds should be located centrally between the rooms being heated, thus minimising the length of interconnecting services. b. Service pipes carrying hot water to more distant rooms should be insulated or routed through conduits to reduce distribution losses and the risk of overheating the room or floor finish.	

Table 30: Minimum provisions for floor insulation and minimising distribution losses in wet and electric underfloor heating systems (*continued*)

Underfloor heating	Standards for new systems	Supplementary information
<p>5.0 System commissioning and corrosion protection</p> <p>Control of oxidation, biofilm, scale and sludge in warm water heating systems</p>	<p>a. Commissioning warm water floor heating systems should be carried out in accordance with BS EN 1264 Part 4. Even where plastic tubes contain oxygen gas barriers, the control of corrosion in mixed product heating systems must be addressed carefully.</p> <p>b. After testing and flushing with clean water, the system circulating fluid should be treated with a suitable corrosion inhibitor approved by the tube manufacturer and complying with BS 7593:2006 or DIN 4725/6, and applied strictly in accordance with the additive manufacturer's instructions.</p>	<p>British Standards</p> <p><i>BS 7593:2006 "Code of practice for treatment of water in domestic hot water central heating systems".</i></p> <p><i>Inhibitors should as a minimum be BuildCert approved.</i></p> <p><i>Note should also be made of advice in the manufacturer's instructions.</i></p>

Table 31: Minimum provisions for construction and control of electric underfloor heating systems

Underfloor heating		Standards for new systems	Supplementary information
Electric storage systems with individual room or programmable thermostats and low tariff anticipatory controls	1.0 Construction	<ul style="list-style-type: none"> a. Electric cable underfloor heating low tariff night energy storage systems should have a 65 mm minimum thickness screed for correct operation. b. Principal rooms containing 80% floor area should be assigned to low tariff heating cables and 20% of the floor area should be assigned to either direct-acting perimeter heating cables or systems such as ceiling or panel heaters in order to maximise energy efficiency. 	<p><i>Other areas should be assigned as low tariff heating cables only (subject to heat requirements).</i></p> <p><i>Bathrooms and separate kitchens may have direct acting heating cables (subject to heat requirements).</i></p>
	2.0 Controls	<ul style="list-style-type: none"> a. Anticipatory controllers should be installed controlling low tariff input charge with external temperature sensing and floor temperature sensing. b. Programmable room thermostats with an override feature should be provided for all direct acting zones of the system with air and floor temperature sensing capabilities to be used individually or combined. 	<p><i>Anticipatory controllers (ie weather compensators) reduce night energy storage as a function of external temperature.</i></p>
Electric cable, direct acting (non-storage) systems with individual room timer or thermostat control in screeded floors	3.0 Construction	<ul style="list-style-type: none"> a. Direct acting electric underfloor heating cables should be installed within screeds of thickness not exceeding 60 mm. b. All heated floors should be insulated in accordance with Table 30. 	
	4.0 Controls	<ul style="list-style-type: none"> a. Programmable room thermostats with a manual override feature for all heating zones with air or floor temperature sensing capabilities should be used individually or combined. 	
Electric cable, direct acting systems with individual room timer or thermostat control in timber floors	5.0 Construction	<ul style="list-style-type: none"> a. Direct acting electric underfloor heating cables installed below floor boards in voids between floor joists should be insulated in accordance with Table 30. 	
	6.0 Controls	<ul style="list-style-type: none"> a. Programmable room thermostats with a manual override feature should be provided to control space temperature and limit floor void temperature for safety and comfort in each area. 	

Table 31: Minimum provisions for construction and control of electric underfloor heating systems (continued)

Underfloor heating		Standards for new systems	Supplementary information
Under-tile electric floor heating systems	7.0 Construction	a. Direct acting electric underfloor heating cables should be provided with a pre-fabricated mattress, or equivalent product, of thickness less than 4 mm encapsulated in tile bedding adhesive or mortar, below a ceramic or other equivalent floor finish on a thermally resistive insulation layer as defined in Table 30(1b).	
	8.0 Controls	a. Programmable room thermostats with a manual override feature should be provided to control space temperature and limit floor temperature for safety and comfort in each area.	

Section 8: Mechanical ventilation systems

8.1 Scope of guidance

This section provides guidance on the specification of mechanical ventilation systems in dwellings to meet minimum energy efficiency standards in building regulations.

The guidance covers the following types of mechanical ventilation:

- intermittent mechanical extract ventilation;
- continuous mechanical extract ventilation;
- continuous mechanical supply ventilation;
- continuous mechanical supply and extract with heat recovery.

8.2 Energy efficiency of mechanical ventilation systems

Mechanical ventilation systems should:

- a. follow the guidance in:
 - i. GPG 268 *Energy efficient ventilation in dwellings – a guide for specifiers*; and
 - ii. the CLG publication *Domestic ventilation: installation and commissioning guide*; and
- b. meet the minimum standards for specific fan power, heat recovery efficiency and controls in Table 32.

Table 32: Minimum provisions for mechanical ventilation systems

	Standards for new and replacement systems	Supplementary information
1.0 Fan power	<p>a. Mechanical ventilation systems should be designed to minimise electric fan power. Specific fan power (SFP) should not be worse than:</p> <ul style="list-style-type: none"> i. 0.5 W/l/s for intermittent extract ventilation systems; ii. 0.7 W/l/s for continuous extract ventilation systems; iii. 0.5 W/l/s for continuous supply ventilation systems; iv. 1.5 W/l/s for continuous supply and extract with heat recovery ventilation systems. 	
2.0 Heat recovery efficiency	<p>a. The heat recovery efficiency of balanced mechanical ventilation systems incorporating heat recovery should not be worse than 70%.</p>	
3.0 Controls	<ul style="list-style-type: none"> a. Intermittent mechanical extract ventilation systems should be operated by local manual switches or automatically by a presence sensor. b. All other mechanical ventilation systems should have manual or automatic control of the boost facility. 	<p>British Standards <i>BS EN 15232:2007</i> <i>“Energy performance of buildings – Impact of building automation, controls and building management”.</i></p>

Section 9: Heat pump systems

9.1 Scope of guidance

This section provides guidance on the specification of heat pump systems in dwellings for the provision of space heating and domestic hot water to meet minimum energy efficiency standards in building regulations.

A heat pump is a device which takes heat energy from a low temperature source and upgrades it to a higher temperature at which it can be usefully employed for heating or hot water. Heat pumps may supply all or part of the heating load.

The guidance in this section applies to the types of electrically-driven heat pump in Table 33.

Table 33: Heat pump technologies		
Heat pump type	Warm water and hot water systems	Warm air systems
<p>Ground source systems (GSHP)</p> <p>Heat energy is extracted from the ground using closed pipe loops buried horizontally in trenches or in vertical boreholes that are connected back to the GSHP. The fluid circulating in the closed loop is normally a water/propylene glycol antifreeze mixture or accepted equivalent but some direct expansion GSHPs use refrigerant. Open loops may also be used to collect water from an aquifer and discharge via a separate aquifer downstream of the water table flow; systems of this type normally require permits from the Environment Agency. Heat extracted from the ground may be supplied to a dwelling either by a water-based heating system (ground-to-water heat pump) or by an air distribution system (ground-to-air heat pump).</p>	Ground-to-water	Ground-to-air
<p>Water source systems (WSHP)</p> <p>Heat energy is extracted indirectly from a water source using closed pipe loops as a heat exchanger. The closed loop is connected back to the water to water heat pump. The water source may be a lake, pond or river or other stable water source. The fluid circulating in the closed loop will normally be water but a water/propylene glycol or accepted equivalent antifreeze mixture may be used, depending on operating temperatures. Open loops may also be used subject to the permits being obtained from the Environment Agency. Heat may be supplied to the dwelling either by a water-based heating system (water-to-water heat pump) or by an air distribution system (water-to-air heat pump).</p>	Water-to-water	Water-to-air
<p>Air source systems (ASHP)</p> <p>Air source heat pumps extract heat directly from the ambient air. Heat is supplied to the dwelling either by a water-based heating system (air-to-water heat pump) or by an air distribution system (air-to-air heat pump). Air-to-air heat pumps may be single package or split systems.</p>	Air-to-water	Air-to-air

All heat pump systems are at their most efficient when the source temperature is as high as possible, the heat distribution temperature is as low as possible and pressure losses in air and water systems are kept to a minimum. If installed in a new dwelling, heat pumps should use refrigerants complying with the provisions of EU Directive 2037:2000. Heat pumps should be CE marked in accordance with applicable EU Directives: eg the machinery safety, low voltage, pressure equipment and electromagnetic compatibility directives. If summer cooling is provided by the heat pump, it is recommended that condensate drainage from the indoor units is provided.

9.2 Warm water and hot water heat pumps

Electrically-driven heat pumps used as the heat generator in, eg, underfloor, warm air and medium temperature radiator heating systems should:

- a. have a coefficient of performance not less than 2.2⁴ when used for space heating;
- b. have a specific fan power not worse than the minimum required by BS EN 15450 Table C1 for new build and Table C2 for existing build;
- c. have a coefficient of performance not less than 2.0 when used for heating domestic hot water;
- d. meet the minimum standards for supply temperature, wet system radiator efficiency, installation and commissioning, hot water and controls in Table 34 for warm water and hot water heat pumps;
- e. meet the minimum standards for installation and controls in Table 35 for warm air heat pumps.

⁴ CoP to be measured according to procedures in BS EN 14511-4:2007.

Table 34: Minimum provisions for warm water and hot water heat pumps (ground-to-water, water-to-water and air-to-water systems)

Warm and hot water heat pumps	Standards for new and replacement systems	Supplementary information
1.0 Supply water temperatures and efficiency	Underfloor heating a. Supply water temperatures to the underfloor heating system should be in the range 30°C to 40°C for new buildings and 30°C to 55°C for existing systems.	<i>Section 7 of this guide on underfloor heating.</i>
	Radiators b. High-efficiency radiators with high water volume should be utilised. c. Supply water temperature to the radiators should be in the range 40°C to 55°C.	<i>Space heating may be sized to meet all or part of the space heating load. Secondary heating will be required if the heat pump is sized to meet part of the space heating load.</i>
	Fan coil units d. Supply water temperature to the fan coil units should be in the range 35°C to 45°C.	<i>Fan coil units may be utilised for heating only or for winter heating and summer cooling.</i>
2.0 Installation and commissioning	a. The water distribution system should be arranged for reverse return operation or arranged with a low loss manifold system to maximise efficiency and ease commissioning and future maintenance. b. Pipework not contributing to the space heating should be insulated to prevent heat loss following the guidance in the TIMSA guide. c. If summer cooling is provided by the heat pump, all water distribution pipework should be insulated to prevent condensation following the guidance in the TIMSA guide. d. External pipework between the dwelling and the ground heat exchanger should be insulated following the TIMSA guidance. e. The ground loop water circuit should be protected with an anti freeze solution and inhibitor as recommended by the heat pump manufacturer. f. Ground loops should be cleaned with a cleaning fluid and biocide as part of the commissioning process.	Design <i>A pressurised water distribution system with expansion vessel is recommended. Constant water flow should be maintained through the heat pump. Pipe sizes should be in accordance with the manufacturer's recommendations.</i> Installation <i>Installation should be carried out by an installer approved by the manufacturer. If during installation access to the refrigeration circuit is needed, a competent refrigeration and air conditioning engineer (with a valid refrigerant handling certificate or an Engineering Services Skillcard) should carry out the work. Exposed refrigeration pipework should be insulated and enclosed in protective trunking to limit accidental damage. Installation of the dwelling's water distribution system should be undertaken by a competent central heating specialist.</i>

Table 34: Minimum provisions for warm water and hot water heat pumps (ground-to-water, water-to-water and air-to-water systems) (*continued*)

Warm and hot water heat pumps	Standards for new and replacement systems	Supplementary information
<p>2.0 Installation and commissioning (<i>continued</i>)</p>	<p>g. The internal water distribution circuit should contain an inhibitor and may be protected by an anti freeze solution as recommended by the heat pump manufacturer.</p> <p>h. Ground loops should be filled with a heat transfer fluid. Installers should also refer to the equipment manufacturer's installation instructions for appropriate treatment products and special requirements for individual appliance models.</p>	<p>Guidance and standards</p> <p><i>TIMSA "HVAC guidance for achieving compliance with Part L of the Building Regulations".</i></p> <p><i>BS EN 378 "Specification for refrigerating systems and heat pumps".</i></p> <p><i>TR30 "Guide to good practice – heat pumps", HVCA July 2007.</i></p> <p><i>MIS 3005 "Requirements for contractors undertaking the supply, design, installation, set to work, commissioning and handover of microgeneration heat pump systems", BERR 2008.</i></p>
<p>3.0 Domestic hot water</p>	<p>a. For full heating, the heat pump and any supplementary domestic hot water heating should be capable of supplying water in the range 60°C to 65°C. This is applicable to ground-to-water, water-to-water and air-to-water type heat pumps.</p> <p>b. If the heat pump is not capable of supplying water at these temperatures, supplementary heating should be provided and controlled as described in other sections of this guide. Controls should include an auxiliary heating regime to 60°C or more for disinfection purposes.</p> <p>c. The domestic hot water (DHW) system should include a tank thermostat and a time clock to optimise the time taken to heat the water.</p>	<p><i>The heat pump may be utilised for all or part of the DHW load. During the DHW heating period the heat pump may not necessarily be providing heated water to the space heating system.</i></p>

Table 34: Minimum provisions for warm water and hot water heat pumps (ground-to-water, water-to-water and air-to-water systems) *(continued)*

Warm and hot water heat pumps	Standards for new and replacement systems	Supplementary information
<p>4.0 Controls</p>	<p>a. Heat pump unit controls should include:</p> <ul style="list-style-type: none"> i. control of water pump operation (internal and external as appropriate); ii. control of water temperature for the distribution system; iii. control of outdoor fan operation for air-to-water units; iv. defrost control of external airside heat exchanger for air-to-water systems; v. protection for water flow failure; vi. protection for high water temperature; vii. protection for high refrigerant pressure; viii. protection for air flow failure on air-to-water units. <p>b. External controls should include:</p> <ul style="list-style-type: none"> i. room thermostat to regulate the space temperature and interlocked with the heat pump unit operation; ii. timer to optimise operation of the heat pump. 	

Table 35: Minimum provisions for warm air heat pumps (ground-to-air, water-to-air and air-to-air systems)

Warm air heat pumps	Standards for new and replacement systems	Supplementary information
<p>1.0 Installation</p>	<ul style="list-style-type: none"> a. Minimum clearances adjacent to all airflow paths, as recommended by the manufacturer, should be maintained. b. Pipe sizes should be in accordance with the manufacturer’s recommendations. c. The refrigerant pipework on split systems should be insulated in line with the manufacturer’s recommendations. d. If summer cooling is provided by the heat pump, provision should be made for condensate drainage from the indoor terminal units. e. For ground-to-air and water-to-air systems all external pipework between the dwelling and the external heat exchanger should be insulated by following TIMSA guidance. f. For ground-to-air and water-to-air systems constant water flow should be maintained through the heat pump. 	<p><i>Installation should be carried out by an installer approved by the manufacturer. Installation that requires access to the refrigeration circuit, or the connection of split systems, should be carried out by a competent refrigeration and air conditioning engineer holding a refrigerant handling certificate and, preferably, an Engineering Services Skillcard.</i></p> <p><i>TIMSA “HVAC guidance for achieving compliance with Part L of the Building Regulations”.</i></p>
<p>2.0 Controls</p>	<ul style="list-style-type: none"> a. Heat pump unit controls should include: <ul style="list-style-type: none"> i. control of room air temperature (if not provided externally); ii. control of outdoor fan operation for air-to-air units; iii. defrost control of external airside heat exchanger for air-to-air systems; iv. control for secondary heating (if fitted) on air-to-air systems; v. control of external water pump operation for ground-to-air and water-to-air systems; vi. protection for high water temperature; vii. protection for high refrigerant pressure; viii. protection for indoor air flow failure; ix. protection for external air flow failure on air-to-air units; x. protection for water flow failure on ground-to-air and water-to-air systems. 	

Table 35: Minimum provisions for warm air heat pumps (ground-to-air, water-to-air and air-to-air systems)

Warm air heat pumps	Standards for new and replacement systems	Supplementary information
2.0 Controls (continued)	b. External controls should include: <ul style="list-style-type: none"> i. room thermostat (if not provided internal to the heat pump) to regulate the space temperature, and interlocked with the heat pump unit operation; ii. timer to optimise operation of the heat pump. 	
<p>Supplementary information – further guidance on heat pumps</p> <p><i>EU Directives for machinery safety, low voltage, pressure equipment, electromagnetic compatibility. SAP 2009.</i></p> <p><i>Defra/ Carbon Trust Energy Technology List – Heat Pumps.</i></p> <p><i>BS EN 14511 “Air conditioning, liquid chilling packages and heat pumps with electrical driven compressors for space heating and cooling”. Parts 1-4.</i></p> <p><i>BS EN 15450 “Heating systems in buildings. Design of heat pump heating systems”.</i></p> <p><i>BS EN 15316 “Heating systems in buildings. Method for calculation of system energy requirements and system efficiencies”. Part 4.2: “Space heating generation systems, heat pump systems”.</i></p> <p><i>ISO 13256 “Water-source heat pumps – testing and rating for performance”: Part 1 – “Water-to-air and brine-to-air heat pumps” and Part 2 – “Water-to-water and brine-to-water heat pumps”.</i></p> <p><i>CE 82 Energy Efficiency Best Practice in Housing: “Domestic ground source heat pumps: design and installation of closed-loop systems”.</i></p> <p><i>BS EN 378 “Specification for refrigerating systems and heat pumps. Safety and environmental requirements and system efficiencies”. Part 4-2: “Space heating generation systems, heat pump systems”.</i></p> <p><i>Microgeneration Certification Scheme MIS 3007 “Product certification scheme requirements – heat pumps”.</i></p> <p><i>Microgeneration Certification Scheme MIS 3005 “Requirements for contractors undertaking the supply, design, installation, set to work, commissioning and handover of microgeneration heat pump systems”, BERR 2008.</i></p> <p><i>EU Ecolabel “Establishing the ecological criteria for the award of the Community eco-label to electrically-driven, gas-driven or gas absorption heat pumps”.</i></p> <p><i>Heat Pump Association data sheet “Air-to-water heat pumps”.</i></p> <p><i>HVCA TR30 “Guide to good practice: Heat pumps”.</i></p>		

Section 10: Comfort cooling systems

10.1 Scope of guidance

This section provides guidance on the specification of fixed mechanical comfort cooling systems in dwellings to meet minimum energy efficiency standards in building regulations.

(Dwellings should always be designed to avoid or minimise the need for cooling through the appropriate use of solar control, secure ventilation and thermal mass.)

10.2 Air-cooled and water-cooled air conditioners

Cooling systems in new and existing dwellings should:

- a. meet the minimum standards for efficiency in Table 36; and
- b. be controlled to prevent simultaneous heating and cooling of the same space within the dwelling.

Table 36: Minimum provisions for comfort cooling

Comfort cooling	Standards for new and replacement systems	Supplementary information
1.0 Efficiency	<ol style="list-style-type: none"> a. Air-cooled air conditioners working in cooling mode should have an EER greater than 2.4. b. Water-cooled air conditioners working in cooling mode should have an EER greater than 2.5. c. Fixed air conditioners should have an energy efficiency classification equal to or better than Class C in Schedule 3 of the labelling scheme adopted under The Energy Information (Household Air Conditioners) (No. 2) Regulations, SI 2005/1726. 	<p><i>Installation should be carried out by an installer approved by the manufacturer or supplier. The installer should be a competent refrigeration and air conditioning engineer with a valid refrigerant handling certificate.</i></p> <p><i>Exposed refrigeration pipework should be insulated and enclosed in protective trunking to limit accidental damage.</i></p> <p><i>www.eurovent-certification.com</i></p>
<p>Supplementary information</p> <p>British Standards</p> <p><i>BS EN 14511-2 "Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Test conditions".</i></p> <p><i>BS EN 14511-4 "Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Requirements".</i></p>		

Section 11: Solar water heating

11.1 Scope of guidance

This section provides guidance on the specification of solar water heating for dwellings to meet minimum energy efficiency standards in building regulations.

The guidance in this section covers indirect solar systems with a collector area of less than 20 m² and solar heated water storage of less than 440 litres. It does not cover direct solar systems⁵ or systems intended to contribute exclusively to space heating or systems providing heat exclusively to heat swimming pools. It should be used in conjunction with the guidance on water heating contained in the fuel-based sections of this guide.

11.2 Indirect systems

Indirect solar heating systems installed as ***new systems and replacement systems*** should meet the minimum standards for:

- a. collector certification, identification and testing, collector primary loop transfer fluid, circulation pump power, heat-exchanger sizing, system control, solar pre-heated water storage, and system preparation in Table 37;
- b. system labelling and commissioning in Table 38;
- c. insulating pipes in a solar primary system in Table 39.

Supplementary guidance

When work is carried out on an existing indirect solar hot water system, it is recommended that the system controls and insulation should be upgraded in line with the standards for new and replacement systems.

⁵ See SAP 2009 Appendix H

Table 37: Minimum provisions for indirect solar water heating		
Solar water heating	Standards for new and replacement systems	Supplementary information
1.0 Allowance for collector shading	a. No minimum provision.	<i>Solar collectors should be sited in unshaded locations wherever possible. Where this is unavoidable or in cases of significant or heavy shading or significant variance to the optimum orientation and tilt (ie normal pitch roofs facing between SE and SW), then an allowance for the loss of performance should be made when sizing the collector area according to the factors indicated in SAP 2009 Appendix H.</i>
2.0 Solar collector certification	a. Collectors should be independently certified to comply with all required tests for safety and thermal performance, and for reporting and identification according to BS EN 12975.	<i>Copies of the full test report should be made available upon request.</i>
3.0 Primary circuit fluid	a. The transfer fluid in the collector primary loop should be chosen so as not to deposit limescale, sludge, ice or other solids that could either restrict circulation or impair the rate of heat transfer within the absorber.	<i>In secondary systems, measures to reduce the formation of limescale should be considered so that performance is not significantly affected.</i>
4.0 Circulation pump power	a. The electrical input power of the primary pump in the solar system should be less than 50 W or 2% of peak thermal power of collector, whichever is the higher.	
5.0 Heat-exchanger sizing	a. The heat exchanger between a solar primary and secondary system should be sized so that not less than 0.1 m ² or equivalent of heat exchanger area is provided per 1 m ² of solar collector net absorber area.	<i>A heat exchanger reduces the possibility of clogging and deposition due to dirt, scale or similar impurities that could reduce the system performance. Heat exchangers and store connections should be sized and located to promote a low return temperature to the solar collector. Solar heat exchangers are often sized larger than those usually used on gas- or oil-based primary systems owing to the lower temperature of transfer.</i>

Table 37: Minimum provisions for indirect solar water heating (continued)		
Solar water heating	Standards for new and replacement systems	Supplementary information
6.0 System control	<ul style="list-style-type: none"> a. Solar domestic hot water (DHW) system controls should be fitted to: <ul style="list-style-type: none"> i. maximise the useful energy gain from the solar collectors into the system’s dedicated storage; ii. minimise the accidental loss of stored energy by the solar DHW system, whether originating from solar collectors, cold intake or auxiliary heat sources; iii. ensure that hot water produced by back-up (auxiliary) heat sources is not used when adequate grade solar pre-heated water is available; iv. provide a means of control consistent with the solar system being hydraulically (inherently) secure against the adverse affects of excessive primary temperatures and pressures; v. where a separate DHW heating appliance is pre-heated by a solar system, control the appliance where possible such that no extra heat is added if the target temperature is already satisfied from the pre-heat vessel; vi. inform the end user of the system’s correct function and performance at all times. 	
7.0 Solar pre-heated water storage	<ul style="list-style-type: none"> a. Vented copper hot water storage vessels should comply with the heat loss and back-up heating heat exchanger requirements of BS 1566-1:2002. b. Unvented hot water storage system products should: <ul style="list-style-type: none"> i. comply with BS EN 12897; or ii. be certified by the British Board of Agrément, the Water Research Council or other accredited body as complying with building regulations. c. Primary storage systems should meet the insulation requirements of sections 4.3.1 or 4.3.2 of the Hot Water Association <i>Performance specification for thermal stores</i>. 	<p><i>Vented copper hot water cylinders should carry clear labelling on the product such as a BSI Kitemark, registered firm status or reference to an equivalent quality control scheme.</i></p> <p><i>Vented cylinders which are not of copper construction should be labelled as complying with the heat loss and heat exchanger requirements of BS 1566.</i></p> <p><i>Due to the higher than normal storage temperatures in primary stores it is very important that these are well insulated.</i></p>

Table 37: Minimum provisions for indirect solar water heating (*continued*)

Solar water heating	Standards for new and replacement systems	Supplementary information
8.0 Volume of solar pre-heated water	a. The ratio of solar heated water storage volume to collector area should be as follows: <ol style="list-style-type: none"> i. The dedicated solar storage volume, V_s, should be at least 25 litres (or equivalent heat capacity) per net square metre of the solar collector absorber area. ii. Alternatively, V_s should be a volume (or equivalent heat capacity) which is equivalent to at least 80% of the daily hot water demand, V_d (as defined by SAP 2009). 	<i>Collector area is measured as effective aperture or net absorber area, whichever is smaller. A separate pre-heat storage vessel should be considered wherever possible.</i>
9.0 System preparation and water treatment	<p>New build</p> <ol style="list-style-type: none"> a. Solar primary circuits should be thoroughly cleaned with an appropriate cleaner and flushed through with solar heat transfer fluid before filling with the solar heat transfer fluid. b. Systems should be filled with a heat transfer fluid containing a volatile inhibitor package, capable of protecting the system from frost and corrosion at all operating temperatures. c. Installers should refer to the equipment manufacturer's installation instructions for appropriate treatment products and special requirements for individual appliance models. d. Where mains water is used to fill the solar primary circuit and the total water hardness exceeds 200 parts per million, provisions should be made to reduce the limescale. <p>Existing installations</p> <ol style="list-style-type: none"> a. Solar thermal systems should be cleaned with an appropriate cleaner formulated to remove build-up of degradation films from exhausted heat transfer fluids, then flushed through with fresh solar heat transfer fluid. b. Systems should be filled with a heat transfer fluid containing a volatile inhibitor package, capable of protecting the system from frost and corrosion at all operating temperatures. c. Installers should refer to the equipment manufacturer's installation instructions for appropriate treatment products and special requirements for individual appliance models. 	<i>Parts of BS 7593:2006 "Code of practice for treatment of water in domestic hot water central heating systems" may assist in flushing and cleaning procedures. "Legionnaire's disease: The control of legionella bacteria in water systems". Approved code of practice and guidance, HSE Books.</i>

Table 38: Minimum provisions for labelling, commissioning and documentation for solar hot water systems

Solar water heating	Standards for new and replacement systems	Supplementary information
<p>1.0 Labelling of solar collectors and hot water stores</p>	<p>a. All solar collectors should have a visible and durable label displaying all information required according to BS EN 12975, and including at least the following:</p> <ol style="list-style-type: none"> i. name of manufacturer; ii. collector type; iii. serial number; iv. year of production; v. gross area of collector; vi. aperture area of collector; vii. net absorber area of collector; viii. maximum operation pressure; ix. stagnation temperature at 1000 W/m² and 30°C ambient; x. volume of heat transfer fluid; xi. weight of empty solar collector. <p>b. All hot water storage vessels should carry a label with the following information:</p> <ol style="list-style-type: none"> i. manufacturer's name; ii. nominal overall capacity in litres; iii. dedicated solar capacity in litres; iv. standing heat loss in kWh/day; v. type of vessel; vi. back-up heating heat exchanger performance in kW (where present); vii. solar heating heat exchanger performance in kW. 	<p><i>In addition to the minimum provision for labelling of hot water storage vessels, labelling with the following information is also recommended:</i></p> <ul style="list-style-type: none"> • <i>Total net fluid content of secondary volume normally heated by each heat exchanger, where present (+/- 1.0 litre).</i> • <i>The type, fluid content, maximum pressure and surface area of all heat exchangers.</i>

Table 38: Minimum provisions for labelling, commissioning and documentation for solar hot water systems (*continued*)

Solar water heating	Standards for new and replacement systems	Supplementary information
<p>2.0 Commissioning</p>	<p>a. A signed and dated commissioning certificate should be completed to confirm the equipment has been correctly installed and to record key safety and operational features.</p> <p>b. As a minimum, the commissioning certificate should record the following details of the solar system:</p> <ul style="list-style-type: none"> i. net or aperture area of solar collector; ii. minimum ambient temperature without freeze damage to components; iii. location of device and method for controlling over-pressure; iv. location of the electrical isolating switch; v. type of circulation fluid; vi. circulation rate of collector circuit; vii. location of device for protecting against overheating of solar heated water. 	<p><i>A signed commissioning certificate, certifying that the equipment is safe, legal and fit for its intended purpose, should be handed over to the dwelling owner or user as applicable.</i></p> <p><i>A separate certificate is required to cover the installation and commissioning of the hot water storage vessels and appliances within a solar DHW system.</i></p> <p><i>A commissioning engineer should be a competent person who can personally testify by signature and date that the equipment has been commissioned.</i></p>
<p>3.0 Documentation</p>	<p>a. No minimum standard.</p>	<p><i>Information concerning the solar DHW system should be provided to the dwelling owner or user as applicable. The documentation should include:</i></p> <ul style="list-style-type: none"> • <i>user’s manual;</i> • <i>warranty information;</i> • <i>a recommended maintenance schedule;</i> • <i>commissioning certificate;</i> • <i>full contact details of the installer.</i>

Table 39: Minimum provisions for insulation of pipework in solar hot water systems

Standards for new and replacement systems	Supplementary information																				
<p>a. All pipes of a solar primary system should be insulated throughout the length of the circuit.</p> <p>b. All other pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder, or insulated up to the point where they become concealed.</p> <p>c. Pipes should be insulated with materials labelled as complying with the <i>Domestic building services compliance guide</i> and in line with the guidance in the TIMSA guide.</p>	<p><i>The insulation should be suitably rated for the maximum foreseeable pipe temperature applicable, and where external also be resistant to vermin attack and climatic degradation.</i></p> <p><i>In a dwelling that already has a solar hot water system, it is recommended that the insulation should be upgraded in line with these minimum provisions where significant work, such as change of solar storage, is carried out.</i></p> <p><i>A fully-filled or drainback solar hot water system can have a pipe service temperature of 150°C. Therefore an insulation material should be specified to accommodate this temperature. An EPDM based rubber would normally be a minimum requirement for such an application. Any insulation specified must be better than 0.044 W/m.K at 40°C mean and the insulation diameter must be 87% of the pipe diameter.</i></p> <p><i>Where insulation is labelled as complying with this guide, it must not exceed the following heat loss values:</i></p> <table border="1"> <thead> <tr> <th>Pipe outside diameter</th> <th>Maximum heat loss</th> </tr> </thead> <tbody> <tr><td>8 mm</td><td>7.06 W/m</td></tr> <tr><td>10 mm</td><td>7.23 W/m</td></tr> <tr><td>12 mm</td><td>7.35 W/m</td></tr> <tr><td>15 mm</td><td>7.89 W/m</td></tr> <tr><td>22 mm</td><td>9.12 W/m</td></tr> <tr><td>28 mm</td><td>10.07 W/m</td></tr> <tr><td>35 mm</td><td>11.08 W/m</td></tr> <tr><td>42 mm</td><td>12.19 W/m</td></tr> <tr><td>54 mm</td><td>14.12 W/m</td></tr> </tbody> </table> <p><i>Further guidance on converting heat loss limits to thicknesses of insulation for specific thermal conductivities is available in the TIMSA “HVAC guidance for achieving compliance with Part L of the Building Regulations”.</i></p> <p>Insulation for pipework in unheated areas</p> <p><i>Extra provision may need to be made to protect water-carrying pipework in unheated areas against freezing. Further guidance is available in:</i></p> <ul style="list-style-type: none"> <i>BS 5422:2001 “Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range of -40°C to +700°C”.</i> <i>BRE Report No 262 “Thermal insulation: avoiding risks”, 2002 Edition.</i> 	Pipe outside diameter	Maximum heat loss	8 mm	7.06 W/m	10 mm	7.23 W/m	12 mm	7.35 W/m	15 mm	7.89 W/m	22 mm	9.12 W/m	28 mm	10.07 W/m	35 mm	11.08 W/m	42 mm	12.19 W/m	54 mm	14.12 W/m
Pipe outside diameter	Maximum heat loss																				
8 mm	7.06 W/m																				
10 mm	7.23 W/m																				
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15 mm	7.89 W/m																				
22 mm	9.12 W/m																				
28 mm	10.07 W/m																				
35 mm	11.08 W/m																				
42 mm	12.19 W/m																				
54 mm	14.12 W/m																				

Supplementary information on solar water heating**Guidance and standards**

Microgeneration Certification Scheme MIS3001 "Requirements for contractors undertaking the supply, design, installation, set to work, commissioning and handover of solar heating microgeneration systems", BERR Feb 2008.

Energy Efficiency Best Practice in Housing CE131 "Solar water heating systems. Guidance for professionals".

CIBSE "Solar heating design and installation guide". ISBN 978-1-903287-84-2.

CE 51/GIL59 "Central Heating System Specifications (CHeSS)", 2005.

BS 7431:1991 "Method for assessing solar water heaters. Elastomeric materials for absorbers, connecting pipes and fittings".

BS 6785:1986 "Code of practice for solar heating systems for swimming pools".

prCEN/TS 12977-3:2006 "Performance characterisation of stores for solar heating systems".

prCEN/TS 12977-2:2005 "Thermal solar systems and components. Custom built systems. Test methods".

TS 12977-1:2001 "Thermal solar systems and components. Custom built systems. General requirements".

BS EN ISO 9488:2000. Solar energy. Vocabulary".

BS EN 12976-2:2006 "Thermal solar systems and components. Factory made systems. Test methods".

BS EN 12976-1:2006 "Thermal solar systems and components. Factory made systems. General requirements".

BS EN 12975-2:2006 "Thermal solar systems and components. Solar collectors. Test methods".

BS EN 12975-1:2006 "Thermal solar systems and components. Solar collectors. General requirements".

ISO 9553:1997 "Solar energy-Methods of testing preformed rubber seals and sealing compounds used in collectors",

BS 3734-1: 1997 "Rubber – Tolerances for products – Part 1: Dimensional tolerances".

BS 903-0:2003 "Physical testing of rubber – Part 0: General".

BS 6920:2000 "Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water".

ISO/TR 10217:1989 "Solar energy water heating systems guide".

to material selection with regard to internal corrosion

BS 8000 "Workmanship on building sites".

BS EN 12897 "Water supply. Specification for indirectly heated unvented (closed) storage water heaters".

BS 7671 "Requirements for electrical installations".

BS 1566 "Copper indirect cylinders for domestic purposes".

BS 4814 "Specifications for expansion vessels using an internal diaphragm for sealed hot water heating systems".

BS 7074 "Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems".

BS 5422 "Methods of specifying thermal insulation materials on pipes, ductwork and equipment in the temperature range of –40°C to 700°C".

BS 5449 "Specification of forced circulation hot water central heating systems for domestic premises".

BS 6701 "Telecommunications equipment and telecommunications cabling".

BS 5970 "Code of practice for thermal insulation of pipes and equipment".

BS 6700 "Specification and design, installation, testing and maintenance of services supplying water for domestic uses within buildings and their curtilages".

Section 12 Lighting

12.1 Scope of guidance

This section provides guidance on the specification of fixed internal and external lighting for new and existing dwellings to meet minimum energy efficiency standards in building regulations.

12.2 Key terms

Circuit-watt means the power consumed in lighting circuits by lamps and, where applicable, their associated control gear (including transformers and drivers) and power factor correction equipment.

Light fitting means a fixed light or lighting unit that can comprise one or more lamps and lampholders, control gear and an appropriate housing. The control gear may be integrated in the lamp or located elsewhere in or near to the fixed light.

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

12.3 Internal and external lighting

Fixed internal and external lighting should meet the minimum standards for efficacy and controls in Table 40.

Table 40: Minimum provisions for fixed internal and external lighting		
Lighting	Standards for new and replacement systems	Supplementary information
Fixed internal lighting	<p>a. In the areas affected by the building work, provide low energy light fittings (fixed lights or lighting units) that number not less than three per four of all the light fittings in the main dwelling spaces of those areas (excluding infrequently accessed spaces used for storage, such as cupboards and wardrobes).</p> <p>b. Low energy light fittings should have lamps with a luminous efficacy greater than 45 lamp lumens per circuit-watt and a total output greater than 400 lamp lumens.</p> <p>c. Light fittings whose supplied power is less than 5 circuit-watts are excluded from the overall count of the total number of light fittings.</p>	<p>Light fittings may be either:</p> <ul style="list-style-type: none"> dedicated fittings which will have separate control gear and will take only low energy lamps (eg pin based fluorescent or compact fluorescent lamps); or standard fittings supplied with low energy lamps with integrated control gear (eg bayonet or Edison screw base compact fluorescent lamps). <p>Light fittings with GLS tungsten filament lamps or tungsten halogen lamps would not meet the standard. The Energy Saving Trust publication GIL 20, "Low energy domestic lighting", gives guidance on identifying suitable locations for fixed energy efficient lighting.</p>
Fixed external lighting	<p>Where fixed external lighting is installed, provide light fittings with the following characteristics.</p> <p>a. Either:</p> <ol style="list-style-type: none"> lamp capacity not greater than 100 lamp-watts per light fitting; and all lamps automatically controlled so as to switch off after the area lit by the fitting becomes unoccupied; and all lamps automatically controlled so as to switch off when daylight is sufficient. <p>b. Or</p> <ol style="list-style-type: none"> lamp efficacy greater than 45 lumens per circuit-watt; and all lamps automatically controlled so as to switch off when daylight is sufficient; and light fittings controllable manually by occupants. 	
		<p>British Standards BS EN 15193:2007 "Energy performance of buildings – Energy requirements for lighting".</p> <p>Other related documents CE80 "Domestic lighting innovations", Energy Efficiency Best Practice in Housing. CE61 "Energy efficient lighting – guidance for installers and specifiers", Energy Saving Trust. EP84 "Housing for people with sight loss", Thomas Pocklington Trust Design Guide. IP412 "Making the most of your sight: Improve the lighting in your home", RNIB and Thomas Pocklington Trust.</p>

Section 13: Micro-combined heat and power systems

13.1 Scope of guidance

This section provides guidance on the specification of micro-combined heat and power (micro-CHP) systems for dwellings to meet minimum energy efficiency standards in building regulations.

The guidance covers micro-CHP systems with an electrical output less than 5 kWe.

13.2 Definitions

Heating Plant Emission Rate

The Heating Plant Emission Rate (HPER) is the seasonal performance index that represents the carbon dioxide emissions from fuel and power needed to provide the space heating and hot water service in the building under standardised conditions.

Plant Size Ratio

The Plant Size Ratio (PSR) is defined as the nominal heat output of the heating plant divided by the design heat loss (the average heat loss of the building on a cold day with a temperature differential of 20°C). For a given heat demand, the PSR determines the part-load condition for the heating plant. The design heat loss is calculated in accordance with normal practice, eg as in BS 5449 or its successor.

13.3 Micro-CHP systems

For **new systems** and **replacement systems**:

- a. the Heating Plant Emission Rate (HPER) of a micro-CHP system should be no greater than 0.23 kgCO₂/kWh,
- b. the HPER is to be calculated using the Annual Performance Method for micro-CHP systems that have been tested according to PAS 67. The calculation of the HPER should be performed at a Plant Size Ratio of 1.5.

Supplementary information

It is recommended that the system should be heat-led and capable of exporting electricity to the grid, and controlled in such a way as to avoid heat dumping.

British Standards

BS EN 15316-4-4:2007 "Heating systems in buildings – method for calculation of system energy requirements and system efficiencies – Heat generation systems, building-integrated cogeneration systems".

Other documents

Publicly Available Specification – PAS 67 "Laboratory test to determine heating and electrical performance of heat-led micro-cogeneration packages primarily intended for heating dwellings".

Appendix N of SAP 2009 "Method to evaluate the annual energy performance of micro-cogeneration heating systems in dwellings".

BG 2/2007 "CHP for existing buildings: Guidance on design and installation".

Section 14: Wind-powered electricity generating systems

14.1 Scope of guidance

This section provides guidance on the specification of wind-powered electricity generating systems for new and existing buildings to meet minimum energy efficiency standards in building regulations.

The guidance covers building-integrated wind-powered electricity generating systems for wind turbines that do not require 3-phase grid connection to operate, and fall within the scope of Engineering Recommendation G83 for grid protection⁶.

The scope is limited to turbines with a reference power output of less than 50 kW at 11 m/s wind speed.

Note: For guidance on wind-powered electricity generating systems for wind turbines that require 3-phase grid connection to operate, refer to Engineering Recommendation G59⁷ and the *Non-domestic building services compliance guide*.

14.2 Definitions

Reference power means the wind turbine's power output at 11.0 m/s to the power curve in BS EN 61400-12-1 and as defined by the BWEA *Small wind turbine performance and safety standard*⁸.

Horizontal axis wind turbine means a wind turbine whose rotor axis is substantially horizontal.

Vertical axis wind turbine means a wind turbine whose rotor axis is vertical.

Rated wind speed means the wind turbine's power output at the wind speed specified by the manufacturer.

Integrated generation means generation directly into the electrical distribution network of a building or site, ie into the wiring on the consumer side of the main fuses. Integrated power generation technologies are usually designed to reduce the building or site's grid power demand. Typically the majority of the energy will be used on site rather than exported back to the grid.

⁶ G83/1 *Recommendations for the connection of small-scale embedded generators (up to 16 A per phase) in parallel with public low voltage distribution networks*.

⁷ G59/1 *Recommendations for the connection of embedded generating plant to the public electricity suppliers' distribution systems*.

⁸ www.bwea.com

Annual mean wind speed (AMWS) means the yearly average wind speed for the site calculated either from CIBSE test reference year or from the NOABL database. In either case corrections for height and roughness should be applied to the original figure.

Power curve means a manufacturer’s published data for instantaneous power output against wind speed.

Annual energy performance (AEP) means a curve or table indicating how a turbine’s annual energy yield will vary with the site’s Annual Mean Wind Speed. This is not to be confused with the turbine’s power curve. The Annual Energy Performance should indicate grid delivered power including inverter losses.

Swept area means the area of a wind turbine perpendicular to the direction of the wind in m². It typically equals πr^2 for a horizontal axis wind turbine (where r is the radius of the circle swept by the turbine blades), and height x diameter for a vertical axis wind turbine.

14.3 Building-integrated wind turbines

For building-integrated wind turbines in new and existing buildings:

- a. the annual energy performance in a 5 m/s AMWS should be no worse than 175 kWh/m²/year. This figure is obtained by dividing the published Reference Annual Energy figure (measured in accordance with the BWEA *Small wind turbine safety and performance standard*) by the swept area of the wind turbine.

Supplementary information

The SAP procedure for determining the performance of wind turbines is based on typical conditions using a formula given by GreenSpec⁹ and the wind speed correction factors in the UK Microgeneration Certification Scheme standard MIS 3003, “Requirements for contractors undertaking the supply, design, installation, set to work, commissioning and handover of micro and small wind turbine systems”, BERR, Feb 2008.

British Standards

BS 7671:2008 “Requirements for electrical installations. IEE Wiring Regulations 17th Edition”.

BS EN 61400-2:2006 “Wind turbines – Design requirements for small wind turbines”.

Other documents

Energy Saving Trust CE72 “Installing small wind-powered electricity generating systems”.

⁹ www.greenspec.co.uk/html/energy/windturbines.html

Section 15: Solar photovoltaic microgeneration systems

15.1 Scope of guidance

This section provides guidance on the specification of electricity generation from building-integrated and on-site photovoltaic systems to meet minimum energy efficiency standards in building regulations.

The guidance covers solar photovoltaic (PV) microgeneration systems with electrical output less than 5 kWe for new and existing dwellings.

15.2 Solar photovoltaic systems

Solar photovoltaic (PV) microgeneration systems for new and existing dwellings should meet the minimum standards for:

- a. PV cell efficiency in Table 41;
- b. ventilation of the PV modules in Table 42; and
- c. commissioning in Table 42.

Table 41: Minimum provisions for solar photovoltaic (PV) microgeneration systems

PV module type	Minimum efficiency of conversion, %
Monocrystalline silicon	15
Polycrystalline silicon	12
Thin-film – amorphous silicon	6
Thin-film – cadmium telluride	8
Thin-film – copper indium diselenide	8

Table 42: Minimum provisions for small PV electricity generating systems		
Solar PV	Standards for new and replacement systems	Supplementary information
1.0 Ventilation of PV modules	a. Adequate provision should be made for ventilation behind the PV modules to provide cooling, as required by the manufacturer.	
2.0 Commissioning	a. The solar PV system should be commissioned according to MIS 3002.	<i>Microgeneration Certification Scheme standard MIS 3002 "Requirements for contractors undertaking the supply, design, installation, set to work, commissioning and handover of solar photovoltaic (PV) microgeneration systems", BERR Feb 2008.</i>
<p>Supplementary information</p> <p>British Standards <i>BS EN 15316-4-6:2007 "Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Heat generation systems, photovoltaic systems".</i></p> <p>Other documents <i>"Photovoltaics in buildings – Guide to the installation of PV systems", 2nd Edition 2006, DTI.</i></p>		

Section 16: Heating system circulators

16.1 Scope of guidance

This section provides guidance on the specification of stand-alone, glandless heating system circulators to meet minimum energy efficiency standards in building regulations.

It does not cover circulators supplied as integrated units within the casing of boilers.

16.2 Circulators

Heating system circulators provided as part of **new systems** or **replacement systems** in dwellings should meet the minimum standards for energy efficiency in Table 43.

Table 43: Minimum provisions for stand-alone, glandless heating system circulators

Standards for new and replacement systems	Supplementary information
a. Stand-alone glandless circulators should be labelled for energy efficiency in accordance with the Europump Labelling Scheme. b. The minimum Europump rating is Band C.	<i>Further information and guidance, including a list of approved glandless domestic circulators, is available at www.bpma.org.uk</i>

Appendix A: Assessing the case for a non-condensing boiler

See Appendix A of the December 2008 edition of *Domestic heating compliance guide*.

Volume 2, Chapter 7

**Proposed Non-Domestic Building
Services Compliance Guide**

2010 Edition

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Section 1: Introduction

Note: Any reference to building regulations in this guide is to building regulations in England and Wales, Scotland and Northern Ireland.

1.1 Scope

This guide provides detailed guidance for persons installing fixed building services in new and existing non-domestic buildings to help them comply with building regulations. It covers work on both new systems and replacement systems, identifying the differing requirements where these exist.

This edition of the guide covers conventional means of providing primary space heating, domestic hot water, mechanical ventilation, comfort cooling and interior lighting. In addition, it covers low carbon generation of heat and electricity by heat pumps, combined heat and power systems, wind turbines and solar photovoltaic panels. For guidance on solar hot water systems, see the *Domestic building services compliance guide*.

It is important to note that this guide covers a range of frequently occurring situations but alternative means of achieving compliance with the functional requirements of building regulations may be possible.

The guide also refers to publications which include information on good practice for design and installation over and above the minimum standards in this guide.

1.2 Status of guide

Building regulations contain functional requirements (called standards in Scotland), such as requirements that buildings must be structurally stable, must be constructed and fitted to ensure reasonable levels of fire protection, and must be reasonably energy efficient. These functional requirements are often drafted in broad terms, and so it may not always be immediately clear to a person carrying out work how to comply with the relevant requirements. Consequently, documents are often issued which provide practical guidance on ways of complying with specific aspects of building regulations in some of the more common building situations. Those documents are called Approved Documents in England and Wales, Technical Handbooks in Scotland and Technical Booklets in Northern Ireland.

Approved Documents, Technical Handbooks and Technical Booklets are intended to provide practical guidance but they are not intended to be comprehensive. Consequently, they may contain references to other documents which will provide more detailed information and assistance on parts of the guidance. This guide is one of those documents. It provides more detailed information on the guidance about compliance with the energy efficiency requirements which apply when installing fixed building services in new and existing buildings contained in Approved Documents L2A and L2B, Section 6 of the Non-Domestic Technical Handbook, and Technical Booklet F2.

Note: Following guidance in an Approved Document, Technical Handbook or Technical Booklet does not guarantee compliance with building regulations. If you follow the guidance in an Approved Document, Technical Handbook or Technical Booklet and in any document referred to (such as this guide) which provides additional information to help you follow that guidance, there is a legal presumption that you have complied with building regulations. However, in every case it is for the building control body to decide whether work complies with building regulations. So, you should always check with the building control body before you start work what they consider it is necessary for you to do to comply with building regulations.

1.3 How to use the guide

The guide is divided into the following sections:

- Section 01: Introduction and summary of requirements
- Section 02: Gas, oil and biomass-fired heating
- Section 03: Heat pumps
- Section 04: Gas and oil-fired warm air heating
- Section 05: Gas and oil-fired radiant heating
- Section 06: Combined heat and power and community heating
- Section 07: Direct electric heating
- Section 08: Domestic hot water
- Section 09: Comfort cooling
- Section 10: Air distribution systems
- Section 11: Pipework and duct insulation
- Section 12: Wind turbine-generated electricity
- Section 13: Solar electricity
- Section 14: Interior lighting
- Section 15: Heating system glandless circulators and water pumps
- Section 16: Compliance checklist and data for the National Calculation Methodology

For each building service, the guide sets the minimum recommended energy efficiency standards for compliance with building regulations. Table 1 in Section 1.5 presents a summary of the requirements.

Section 16 identifies building services parameters needed by National Calculation Methodology (NCM)¹ tools such as SBEM² to calculate carbon dioxide emissions from new buildings. Key parameters are summarised in a Compliance Checklist.

In relevant sections, the guide identifies additional non-prescriptive measures that can be used to improve plant efficiency, and thus gain “heating efficiency credits” to help meet minimum recommended efficiency standards or the carbon dioxide emission targets. Note that the NCM itself recognises the benefit of some of these measures for new buildings by reducing the carbon dioxide emission rate by an appropriate amount. To avoid “double counting” of the benefits, heating efficiency credits are not gained when these particular measures are applied in new buildings.

1.4 Definitions for space heating and domestic hot water systems

The following general definitions are applicable to the sections that deal with space heating and hot water. Further definitions are included in later sections as appropriate.

Heat generator means a device for converting fuel or electricity into heat, eg a boiler or radiant heater.

Heat generator efficiency means the ratio of useful heat output to energy input in the fuel (based on gross calorific value) or electricity delivered to the heat generator, as determined by the appropriate test methods for that type of heat generator.

Heat generator seasonal efficiency means the estimated seasonal ratio of heat output from the heat generator to heat input. This will depend on the Heat Generator Efficiency and the operating mode of the heat generator over the heating season. For example, in the case of boilers it is a “weighted” average of the efficiencies of the boiler at 30% and 100% of the boiler output. For other technologies the Heat Generator Seasonal Efficiency may be the same as the Heat Generator Efficiency.

Heating efficiency credits are awarded for the provision of Additional Measures, such as additional controls, that raise the energy efficiency of the system and go beyond minimum requirements. Different credits apply to the different measures that are available for heating and hot water technologies. Heating Efficiency Credits are added to the Heat Generator Seasonal Efficiency to obtain the Effective Heat Generating Seasonal Efficiency.

¹ The National Calculation Methodology modelling guide can be downloaded from www.communities.gov.uk/publications/planningandbuilding/ncmmodellingguide

² The Simplified Building Energy Model (SBEM) tool can be downloaded from www.2010ncm.bre.co.uk

Effective heat generating seasonal efficiency is obtained by adding Heating Efficiency Credits, where applicable, to the Heat Generator Seasonal Efficiency:

Effective Heat Generating Seasonal Efficiency =

$$\text{Heat Generator Seasonal Efficiency} + \text{Heating Efficiency Credits} \quad \text{Equation 1}$$

This guide sets standards for Effective Heat Generating Seasonal Efficiency so that a heat generator with an inherently low efficiency may be used in combination with Additional Measures.

Minimum controls package means a package of controls specific to each technology that represents the recommended minimum provision necessary to meet building regulation energy efficiency requirements.

Additional measures means additional controls or other measures that go beyond the required Minimum Controls Package and for which Heating Efficiency Credits are available.

Additional Measures may also be used to improve the calculated carbon performance of a new building, but only if the benefits of the measures are not already recognised by the NCM.

Space heating system means the complete system that is installed to provide heating to the space. It includes the heating plant and the distribution system by which heating is delivered to zones. Heat losses from the distribution system can be addressed by reference to TIMSA HVAC guidance on insulation³.

Domestic hot water system means a local or central system for providing hot water for use by building occupants.

³ TIMSA HVAC guidance at www.timsa.org.uk

1.5 Energy efficiency standards for compliance with building regulations

To comply with the minimum energy efficiency requirements in building regulations, this guide sets standards for:

- the Heat Generator Seasonal Efficiency of the device that generates heat or hot water;
- for heating and hot water systems where applicable, the Effective Heat Generating Seasonal Efficiency;
- the Energy Efficiency Ratio of cooling systems;
- a minimum controls package to ensure that systems do not provide space heating, hot water or cooling unnecessarily or excessively;
- insulation to avoid excessive heat loss from pipes and ducts serving space heating or hot water systems, and to avoid heat gain by pipes and ducts serving cooling systems;
- specific fan power for fans serving air distribution systems;
- conversion efficiencies for wind turbines and solar photovoltaic cells;
- lighting efficacy and controls.

Table 1 below summarises key recommended minimum energy efficiency standards for space heating, hot water, cooling, ventilation, lighting and microgeneration systems covered by this guide. The sections that follow give guidance on how to meet these standards.

It is important to note that many of these recommended minimum standards will need to be exceeded if the building regulations target carbon dioxide emission rate (TER) for new buildings is to be met.

Table 1: Summary of recommended minimum energy efficiency standards for building services

Technology	System type	Minimum standards
Gas and oil-fired boilers		Boiler seasonal efficiency (based on gross calorific value)
New buildings	Natural gas	Single boiler system – 86% Multiple-boiler system – 82% for any individual boiler and 86% for the overall multi-boiler system
	LPG	Single boiler system – 87% Multiple-boiler system – 82% for any individual boiler and 87% for the overall multi-boiler system
	Oil	Single boiler system – 84% Multiple-boiler system – 82% for any individual boiler and 84% for the overall multi-boiler system
	Biomass	75%
Existing buildings	Natural gas	82%
	LPG	81%
	Oil	84%
	Biomass	75%
Heat pumps		CoP (Heat generator efficiency)
	All types (except absorption heat pumps and gas-engine heat pumps) for space heating	2.2 (220%) when operating at the rating conditions ⁴
	All types (except absorption heat pumps and gas-engine heat pumps) for domestic hot water heating	2.0 (200%) when operating at the rating conditions
	Absorption heat pumps	0.5 (50%) when operating at the rating conditions
	Gas-engine heat pumps	1.0 (100%) when operating at the rating conditions
Gas and oil-fired warm air systems		Thermal efficiency (based on net calorific value)
	Gas-fired forced convection (natural gas)	91%
	Gas-fired forced convection (LPG)	91%
	Direct gas-fired forced convection	100%
	Oil-fired forced convection	91%

⁴ Rating conditions – standardised conditions provided for the determination of data presented in BS EN 14511:2007 *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling*.

Table 1: Summary of recommended minimum energy efficiency standards for building services (*continued*)

Technology	System type	Minimum standards	
Radiant heaters		Efficiency (net calorific value)	
		Thermal	Radiant
	Luminous radiant heater (unflued)	86%	55%
	Non-luminous radiant heater (unflued)	86%	55%
	Non-luminous radiant heater (flued)	86%	55%
	Multi-burner radiant heater	91%	N/A
CHP		Quality index/Power efficiency	
	All types	CHPQA quality index < 105 Power efficiency > 20%	
Electric (primary) heating			
	Boiler	N/A	
	Warm air	N/A	
Domestic hot water systems		Thermal efficiency (based on gross calorific value)	
Direct-fired	Natural gas	73%	
	LPG-fired	74%	
	Oil-fired	75%	
Indirect-fired (dedicated hot water boiler)	Natural gas	80%	
	LPG-fired	81%	
	Oil-fired	82%	
Electric DHW heaters	Electricity	100%	
Comfort cooling systems		Energy efficiency ratio (EER)	
	Packaged air conditioners – single duct types	2.5	
	Packaged air conditioners – other types	2.5	
	Split and multi-split air conditioners	2.5	
	Variable refrigerant flow systems	2.5	
	Vapour compression cycle chillers, water cooled <750 KW	3.85	

Table 1: Summary of recommended minimum energy efficiency standards for building services (*continued*)

Technology	System type	Minimum standards	
	Vapour compression cycle chillers, water cooled >750 kW	4.65	
	Vapour compression cycle chillers, air cooled <750 kW	2.5	
	Vapour compression cycle chillers, air cooled >750 kW	2.6	
	Water loop heat pump	3.2	
	Absorption cycle chillers	0.7	
	Gas engine driven variable refrigerant flow	1.0	
Air distribution systems		Specific fan power/Pressure drop	
New buildings		Maximum specific fan power	Maximum external system pressure drop
	Central mechanical ventilation system including heating and cooling	1.8 W/l/s	400 Pa supply 250 Pa extract
	Central mechanical ventilation system including heating only	1.6 W/l/s	400 Pa supply 250 Pa extract
	All other central mechanical ventilation systems	1.4 W/l/s	400 Pa supply 250 Pa extract
	Zonal supply system where the fan is remote from the zone, such as ceiling void or roof mounted units	1.2 W/l/s	200 Pa
	Zonal extract system where the fan is remote from the zone	0.6 W/l/s	200 Pa
	Zonal supply and extract ventilation units such as ceiling void or roof units serving a single room or zone with heating and heat recovery	2.0 W/l/s	150 Pa
	Local supply and extract ventilation system such as wall/roof units serving a single area with heating and heat recovery	1.8 W/l/s	150 Pa
	Local supply or extract ventilation units such as window/wall/roof units serving a single area (eg toilet extract)	0.4 W/l/s	30 Pa
	Other local ventilation units	0.6 W/l/s	30 Pa
	Fan-assisted terminal VAV unit	1.2 W/l/s	30 Pa

Table 1: Summary of recommended minimum energy efficiency standards for building services (*continued*)

Technology	System type	Minimum standards	
	Fan coil units (rating weighted average)	0.6 W/l/s	30 Pa
Existing buildings		Maximum specific fan power	
	Central balanced mechanical ventilation system including heating and cooling	2.2 W/l/s	
	Central balanced mechanical ventilation system including heating only	1.6 W/l/s	
	All other central balanced mechanical ventilation systems	1.8 W/l/s	
	Zonal supply system where the fan is remote from the zone, such as ceiling void or roof mounted units	1.5 W/l/s	
	Zonal extract system where the fan is remote from the zone	0.6 W/l/s	
	Zonal supply and extract ventilation units such as ceiling void or roof units serving a single room or zone with heating and heat recovery	2.0 W/l/s	
	Local balanced supply and extract ventilation system such as wall/ roof units serving a single area with heating and heat recovery	1.8 W/l/s	
	Local supply or extract ventilation units such as window/wall/roof units serving a single area (eg toilet extract)	0.5 W/l/s	
	Other local ventilation supply and/or extract units	0.6 W/l/s	
	Fan-assisted terminal VAV unit	1.2 W/l/s	
	Fan coil units (rating weighted average)	0.6 W/l/s	
Heat recovery		Minimum dry heat recovery efficiency	
	Plate heat exchanger	50%	
	Heat pipes	60%	
	Thermal wheel	65%	
	Run around coil	45%	

Table 1: Summary of recommended minimum energy efficiency standards for building services (*continued*)

Technology	System type	Minimum standards
Wind-powered electricity generating systems		Wind turbine energy performance
		Annual output >175 kWh/m ² /year at 5 m/s annual mean wind speed
Solar photovoltaic (PV) systems		Solar PV module conversion efficiency
	Monocrystalline silicon	15%
	Polycrystalline	12%
	Thin-film – amorphous silicon	6%
	Thin-film – cadmium telluride	8%
	Thin-film – copper indium diselenide	8%
Internal lighting		Lighting efficacy
	General lighting in office, storage and industrial areas	New buildings – 55 luminaire lumens per circuit-watt Existing buildings – 55 luminaire lumens per circuit-watt
	General lighting in other types of space other than office areas	55 lamp lumens per circuit-watt
	Display lighting	22 lamp lumens per circuit-watt

Section 2: Gas, oil and biomass-fired boilers

2.1 Introduction

This section provides guidance on specifying gas, oil and biomass-fired space heating systems for new and existing buildings to meet minimum energy efficiency standards in building regulations. It covers relevant boiler types, and describes measures – such as the use of better controls – to gain Heating Efficiency Credits to improve the Effective Heat Generating Seasonal Efficiency.

2.2 Scope of guidance

The guidance applies to wet central heating systems using commercial boilers fired by:

- natural gas;
- liquid petroleum gas (LPG);
- oil; and
- biomass.

The guidance in this section does not cover:

- steam boilers (these are used primarily for processes, rather than provision of space heating); or
- electric boilers (for which see Section 7).

2.3 Definitions

The terminology used to describe efficiencies for boiler systems is detailed below. In this section a heat generator refers to a boiler.

Biomass means all material of biological origin, excluding material embedded in geological formations and transformed to fossil fuel.

Boiler efficiency means the energy delivered by the water as it leaves the boiler (or boilers in multi-boiler installations) to supply the heat emitters divided by the energy (based on gross calorific value) in the fuel delivered to the boiler expressed as a percentage. It is an expression of the boiler's performance and excludes energy used by boiler auxiliary controls, pumps, boiler room ventilation fans, mechanical flue extraction fans and fan dilution systems. The boiler efficiency is measured according to the standards that are used to demonstrate compliance with the Boiler Efficiency Directive⁵.

⁵ Council Directive 92/42/EEC (the Boiler Efficiency Directive) relates to the efficiency requirements for new hot water boilers fired with liquid or gaseous fuels. The associated UK legislation is the Boiler (Efficiency) Regulations 1993 (SI 1993/3083), amended by the Boiler (Efficiency) (Amendment) Regulations 1994 (SI 1994/3083).

Effective heat generating seasonal efficiency is the Heat Generator Seasonal Efficiency (the Boiler Seasonal Efficiency as calculated by Equation 2 below for individual boilers, or by Equation 3.1 for multiple boilers) plus any applicable Heating Efficiency Credits for existing buildings.

Economiser means a device including a secondary heat exchanger fitted on, or near to, a boiler providing additional heat transfer capacity. For the purpose of this guide, any boiler which will be supplied with an economiser should have the economiser fitted when the boiler efficiency is tested according to the standards that are used to demonstrate compliance with the Boiler Efficiency Directive. The effect of this on the boiler efficiency at 30% and 100% of the boiler output may be taken into account in the values used for the calculation of the Heat Generator Seasonal Efficiency (Seasonal Boiler Efficiency) using Equations 2 or 3.1 or the three-step method and Equations 3.2 and 3.3, as appropriate.

Condensing boiler means a boiler that offers a higher energy efficiency by recovering heat from the flue gases. This is achieved by increasing the heat exchanger surface area, which recovers extra sensible heat whenever the boiler fires. The becomes even more efficient when system water temperatures are low because the larger heat exchanger area promotes condensation, allowing much of the latent heat to be recaptured. Standing losses (when the boiler is not firing) are low and part load performance is very good. In multiple-boiler systems condensing boilers can be used as the lead boiler.

Standard boiler means, in the context of this document, a non-condensing boiler.

Zone control means independent control of rooms or areas within buildings that need to be heated to different temperatures at different times. Where several rooms or areas of a building behave in a similar manner, they can be grouped together as a “zone” and put on the same circuit and controller.

Sequence control enables two or more heating boilers to be switched on or off in sequence when the heating load changes. This maximises the efficiency of the boilers, so reducing fuel consumption, and reduces wear and tear on the boilers.

Direct acting weather compensation is a type of control that enables a heat generator to work at its optimum efficiency. The control allows the boiler to vary its operating flow temperature to suit weather conditions and the temperatures inside the building. Weather compensation relies on communication between an external sensor and one inside the boiler. The boiler’s water flow temperature is varied accordingly, so that energy is not wasted by the boiler turning on and off.

Weather compensation via a mixing valve is similar to “direct acting weather compensation” except that the temperature of water supplied to the heat emitters is controlled by mixing the boiler flow and return rather than by altering the boiler temperature.

Optimiser is a control system employing an optimum start algorithm.

Optimum start is a control system or algorithm which starts plant operation at the latest time possible to achieve specified conditions at the start of the occupancy period.

Optimum stop is a control system or algorithm which stops plant operation at the earliest possible time such that internal conditions will not deteriorate beyond preset limits by the end of the occupancy period.

Two-stage burner control is a type of control that offers two distinct boiler firing rates.

Multi-stage burner control is a type of control that offers more than two distinct firing rates, but without continuous adjustment between firing rates.

Modulating burner control is a type of control that provides a continuously variable firing rate, which is altered to match the boiler load over the whole turndown ratio.

Decentralisation means the replacement of centralised boiler plant and its associated distribution pipework with several smaller, more accurately sized boiler plants, installed within or adjacent to the buildings or systems they serve. This eliminates long pipe runs between buildings or through unheated areas, so reducing heat losses.

Building management system (BMS) means a building wide network which allows communication with and control of items of HVAC plant (and other building systems) from a single control centre, which may be local or remote. More advanced (“full”) building management systems offer a wide range of functions, including sequential control, zone control, weather compensation, frost protection and night set-back, as well as monitoring and targeting.

2.4 Determining Seasonal Boiler Efficiency

Single-boiler systems and multiple-boiler systems using identical boilers

For boilers the relevant Heat Generator Seasonal Efficiency is the Seasonal Boiler Efficiency. The Seasonal Boiler Efficiency is a “weighted” average of the efficiencies of the boiler at 15%, 30% and 100% of the boiler output (the efficiency at 15% being taken to be the same as that at 30%). This is usually quoted by the boiler

manufacturer. Note that the efficiency based on net calorific value should be converted to that based on gross calorific value using the appropriate conversion factor in Appendix 1.

The boiler efficiencies, measured at 100% load and at 30% load, are used in Equation 2 to calculate the Seasonal Boiler Efficiency. The weighting factors in Equation 2 reflect typical seasonal operating conditions for a boiler.

$$\text{Seasonal Boiler Efficiency} = 0.81\eta_{30\%} + 0.19\eta_{100\%} \quad \text{Equation 2}^6$$

where:

$\eta_{30\%}$ is the gross boiler efficiency measured at 30% load, and

$\eta_{100\%}$ is the gross boiler efficiency measured at 100% load.

Equation 2 applies to:

- single boiler systems where the boiler output is ≤ 400 kW and the boiler will operate on a low temperature system;
- multiple-boiler systems where all individual boilers have identical efficiencies and where the output of each boiler is ≤ 400 kW operating on low temperature systems.

For boilers with an output > 400 kW the manufacturer's declared efficiencies should be used.

Seasonal boiler efficiency for a multiple-boiler system replacing an existing installation where the proposed component boilers have efficiencies that are not identical

Where more than one boiler is installed on the same heating system and the efficiencies of the boilers are not all identical, Equation 3.1 should be used to calculate the overall seasonal boiler efficiency. All boilers should be included in the calculation, even when some are identical.

⁶ This equation assumes that the efficiency at 15% load is the same as that at 30% (and therefore the equation has been simplified accordingly).

The Seasonal Boiler Efficiency for multiple-boiler systems with non-identical boilers is:

$$\eta_{\text{OBSE}} = \frac{\sum \eta_{\text{SBE}} R}{\sum R} \quad \text{Equation 3.1}$$

where

η_{OSBE} is the gross overall seasonal boiler efficiency, being an average weighted by boiler output of the individual seasonal boiler efficiencies;

η_{SBE} is the gross seasonal boiler efficiency of each individual boiler calculated using Equation 2;

R is the rated output in kW of each individual boiler (at 80°C/60°C).

Seasonal boiler efficiency for a multi-boiler system in a new building

In the case of multiple boilers in new buildings, the more accurate 3-step method described below should be used to calculate the overall seasonal boiler efficiency. These steps can readily be programmed into a spreadsheet to automate the calculation.

Step 1

Determine which boilers are operating at what individual part-load level at each of the three system part-load conditions of 15%, 30% and 100%. For example, if the total system output is made up of three equally sized boilers, at 15% of system output the lead boiler will be operating at 45% of its rated output, with the other two boilers switched off.

Step 2

Determine the efficiency at which each individual boiler is operating at each of the above operating conditions. In the above example, the efficiency of the boiler operating at 45% can be determined by linear interpolation between its efficiencies at 30% and 100% of rated output. Where it is necessary to determine the efficiency of an individual boiler at 15% of rated output, this should be taken as the same as the efficiency at 30% of rated output. (Note that the efficiency at 15% of rated output will only be needed if a single boiler meets the full design output.)

Step 3

Calculate the overall operating efficiency at each of the system part load conditions using:

$$\eta_p = \frac{Q_p}{\sum \frac{q_{b,p}}{\eta_{b,p}}} \quad \text{Equation 3.2}$$

where

η_p is the system efficiency at part load condition p, ie 15%, 30% and 100% of system rated output;

Q_p is the system heat output at part load condition p;

$q_{b,p}$ is the individual boiler heat output at system part load condition p;

$\eta_{b,p}$ is the individual boiler efficiency at system part load condition p.

Calculate the overall seasonal boiler efficiency as the weighted average of the efficiencies at the three load conditions using:

$$\eta_{OSBE} = 0.36\eta_{15\%} + 0.45\eta_{30\%} + 0.19\eta_{100\%} \quad \text{Equation 3.3}$$

Table 2 is a worksheet that can be used to follow through these calculations. Table 3 shows a completed example calculation using this worksheet, for the case where a system with a rated output of 625 kW is served by three boilers, each rated at 250 kW. The first two boilers are condensing boilers, with the third being a standard boiler. Because the installation is oversized (750 kW compared to 625 kW), at full system output the final boiler is only operating at 50% output (125/250).

The notes at the foot of the table illustrate how the various values are calculated.

Table 2: Worksheet for calculating the overall seasonal boiler efficiency of a multiple-boiler system using the alternative three-step method

Boiler no	Rating kW	Boiler % efficiency at stated boiler % output (manufacturer data)		Boiler % output at stated system % output			Boiler % efficiency at stated system % output		
		@100%	@30%	15%	30%	100%	15%	30%	100%
1									
2									
3									
4									
5									
6									
7									
8									
System efficiency at part load									
Weighting factor							0.36	0.45	0.19
Overall seasonal boiler efficiency									

Table 3: Example calculation of the overall seasonal boiler efficiency of a multiple boiler system in a new building

Boiler No.	Rating kW	Boiler % efficiency at stated boiler % output (manufacturer data)		Boiler % output at stated system % output			Boiler % efficiency at stated system % output		
		@ 30%	@ 100%	15%	30%	100%	15%	30%	100%
1	250	90%	86%	38.0%	75.0%	100.0%	89.6% ¹	87.4%	86.0%
2	250	90%	86%	not firing	not firing	100.0%	not firing	not firing	86.0%
3	250	85%	82%	not firing	not firing	50.0%	not firing	not firing	84.1%
System efficiency at part load							89.6%	87.4%	85.6% ²
Weighting factor							0.36	0.45	0.19
Overall seasonal boiler efficiency							87.9% ³		
<p>Notes</p> <p>1: Calculated by linear interpolation $\eta_{b,p} = \eta_{30\%} - (\eta_{30\%} - \eta_{100\%}) * \frac{(q_{b,p} - 30\%)}{(100\% - 30\%)}$</p> $\eta_{1,15\%} = \eta_{30\%} - (\eta_{30\%} - \eta_{100\%}) * \frac{(38\% - 30\%)}{(100\% - 30\%)}$ <p>2: Calculated by dividing the thermal output of the system (625 kW) by the rate of fuel consumption, which is given by the sum of the boiler outputs divided by their individual operating efficiency, ie</p> $\eta_{100\%} = \frac{625}{\frac{250 * 100\%}{86.0\%} + \frac{250 * 100\%}{86.0\%} + \frac{250 * 50\%}{84.1\%}} = 85.6\%$ <p>3: Calculated as the weighted average, ie</p> $89.6\% * 0.36 + 87.4\% * 0.45 + 85.6\% * 0.19 = 87.9\%$									

2.5 Minimum provisions for boilers in new buildings

Background

New buildings should be provided with high efficiency condensing or non-condensing boilers that meet the minimum requirements for Heat Generator Seasonal Efficiency in this guide.

Commercial heating systems are inherently more complicated than domestic systems with a wider range of temperatures and heat emitters. The selection of condensing or non-condensing boilers will be determined by application and physical constraints.

Condensing boilers will meet projected efficiencies only when they operate with a system return temperature between 30°C and 40°C for 80% of the annual operating hours. With a return temperature of 55°C and above, condensing boilers will not produce condensate and will have similar efficiencies to non-condensing high efficiency boilers. Some systems are suitable for outside compensator control that allows return temperatures to fall into the condensing range for some periods of the heating season, and these may be best served by a mixture of condensing and non-condensing boilers.

The efficiency value that should be entered into accredited NCM tools to calculate carbon dioxide emission rates is the Effective Heat Generating Seasonal Efficiency. For boilers in new buildings, no Heating Efficiency Credits can be gained and the Effective Heat Generating Seasonal efficiency is therefore the same as the Heat Generator Seasonal Efficiency.

Minimum provisions

To meet the minimum energy efficiency standards in building regulations when installing boiler plant in new buildings:

- a. where a single boiler is used to meet the heat demand, its Seasonal Boiler Efficiency (gross calorific value) calculated using Equation 2 should be not less than the value in Table 4; or
- b. for multiple-boiler systems, the Seasonal Boiler Efficiency of each boiler should not be less than 82% (gross calorific value), as calculated using Equation 2; and the overall Seasonal Boiler Efficiency of the multi-boiler system, as defined by the 3-step method and calculated using Equations 3.2 and 3.3, should be not less than the value in Table 4; and
- c. the relevant minimum controls package in Table 5 should be adopted.

Table 4: Minimum Effective Heat Generating Seasonal Efficiencies and minimum Boiler Seasonal Efficiencies for boiler systems in new buildings

Fuel type	Minimum effective heat generating seasonal efficiency (% gross calorific value)
Natural gas	86
LPG	87
Oil	84

Table 5: Minimum controls package for new boilers and multiple boiler systems

Boiler plant output	Package	Minimum controls
<100 kW	A	a. Timing and temperature demand control, which should be zone specific where the building floor area is greater than 150 m ² . b. Weather compensation except where a constant temperature supply is required.
100 kW to 500 kW	B	a. Controls package A above; and b. optimal start/stop control with either night set-back or frost protection outside occupied periods; and c. two stage high/low firing facility in boiler, or multiple boilers with sequence control to provide efficient part-load performance. Note: The heat loss from non-firing boiler modules should be limited by design or application. For boilers that do not have low standing losses, it may be necessary to install isolation valves or dampers.
>500 kW individual boilers	C	a. Controls package A and Controls package B; and b. for gas-fired boilers and multi-stage oil-fired boilers, fully modulating burner controls.

2.6 Minimum provisions for boilers in existing buildings

Background

Boiler efficiencies have improved markedly over recent years. A modern boiler meeting the minimum requirements of the Boiler Efficiency Directive has a Boiler Seasonal Efficiency of approximately 78.5% (based on gross calorific value).

This guidance recognises that in many cases using condensing boiler technology in existing buildings would be either technically impractical (due to flueing constraints) or economically unviable. For this reason non-condensing boilers may be used provided that they meet the minimum efficiency standards given in this section.

Replacement boilers

To meet the minimum energy efficiency standards in building regulations when installing boiler plant in existing buildings:

- a. the Seasonal Boiler Efficiency (gross calorific value) of each boiler (whether it is in a single-boiler system or part of a multiple-boiler system) calculated using Equation 2 should be not less than the value in Table 6;
- b. for multiple-boiler systems, the Seasonal Boiler Efficiency calculated using Equation 3.1 should be not less than the value in Table 6;
- c. the controls package in Table 7 should be adopted – ie zone control, demand control and time control;

- d. the Effective Heat Generating Seasonal Efficiency should be not less than the value in Table 6. Additional Measures from Table 8 may need to be adopted to gain Heating Efficiency Credits to meet the standard (see below).

Table 6: Minimum Effective Heat Generating Seasonal Efficiencies and minimum Boiler Seasonal Efficiencies for boiler systems in existing buildings

Fuel type	Minimum effective heat generating seasonal efficiency (% gross calorific value)	Minimum boiler seasonal efficiency (% gross calorific value)
Natural gas	84	82
LPG	85	81
Oil	86	84

Table 7: Minimum controls package for replacement boilers in existing buildings

Minimum controls package	Suitable controls
a. Zone control; and	Zone control is required only for buildings where the floor area is greater than 150 m ² . As a minimum on/off control (eg through an isolation valve for unoccupied zones) should be provided. This is achieved by default for a building of floor area 150 m ² or less.
b. demand control; and	Room thermostat which controls through a diverter valve with constant boiler flow water temperature. This method of control is not suitable for condensing boilers.
c. time control.	Time clock controls

2.7 Heating Efficiency Credits for replacement boilers

Where the Boiler Seasonal Efficiency is less than the minimum Effective Heat Generating Efficiency for that type of boiler, Additional Measures will need to be adopted to achieve the minimum Effective Heat Generating Seasonal Efficiency in Table 6.

Table 8 indicates the measures that may be adopted and the relevant Heating Efficiency Credits that are applicable. It should be noted that the maximum number of Heating Efficiency Credits that can be claimed is 4 percentage points.

Table 8: Heating Efficiency Credits for measures applicable to boiler replacement in existing buildings

Measure		Heating efficiency credits % points ⁷	Comments/definition
A	Boiler oversize ≤20%	2	Boiler oversize is defined as the amount by which the maximum boiler heat output exceeds the system heat output at design conditions, expressed as a percentage of that system heat output. For multiple-boiler systems the maximum boiler heat output is the sum of the maximum outputs of all the boilers in the system.
B	Multiple boilers	1	Where more than one boiler is used to meet the heat load.
C	Sequential control of multiple boiler systems	1	Applies only to multi-boiler/module arrangements. It is recommended that the most efficient boiler(s) should act as the lead in a multi-boiler system.
D	Monitoring & targeting	1	Means of identifying changes in operation or onset of faults. The credit can only be claimed if metering is included and a scheme for data collection is provided and available for inspection.
E	i) Thermostatic radiator valves (TRVs) alone. Would also apply to fanned convector systems	1	TRVs enable the building temperature to be controlled and therefore reduce waste of energy.
	ii) Weather (inside/outside temperature) compensation system using a mixing valve	1.5	Provides more accurate prediction of load and hence control.
	iii) Addition of TRV or temperature zone control to (ii) above to ensure full building temperature control	1	This credit is additional to E (ii) above.
F	i) A “room” thermostat or sensor that controls boiler water temperature in relation to heat load	0.5	
	ii) Weather (inside/outside temperature) compensation system that is direct acting	2	Provides more accurate prediction of load and hence control.
	iii) Addition of TRV or temperature zone control to (i) or (ii) above to ensure full building temperature control	1	This credit is additional to F (i) or F (ii) above. Note F (i) and F (ii) are not used together.

⁷ The maximum that can be claimed is 4 points.

Table 8: Heating Efficiency Credits for measures applicable to boiler replacement in existing buildings (*continued*)

Measure		Heating efficiency credits % points ⁷	Comments/definition
G	i) Optimized start	1.5	A control system which starts plant operation at the latest time possible to achieve specified conditions at the start of the occupancy period.
	ii) Optimised stop	0.5	A control system which stops plant operation at the earliest possible time such that internal conditions will not deteriorate beyond preset limits by the end of the occupancy period.
	iii) Optimised start/stop	2	A control system which starts plant operation at the latest time possible to achieve specified conditions at the start of the occupancy period and stops plant operation at the earliest possible time such that internal conditions will not deteriorate beyond preset limits by the end of the occupancy period. Note that if optimised start/stop systems are installed credits G (i) and G (ii) cannot also be claimed.
H	Full zoned time control	1	Allowing each zone to operate independently in terms of start/stop time. Only applicable where operational conditions change in different zones. Does not include local temperature control.
I	Full building management system (BMS)	4	A full BMS linked to the heating plant will provide: sequential control of multiple boilers, full zoned time control and weather compensation where applicable; frost protection or night set back; optimisation and monitoring and targeting. Note that if a full BMS is installed, no further Heating Efficiency Credits can be claimed.
J	De-centralized heating systems	1	Elimination of long pipe runs between buildings or through unheated areas in buildings in order to reduce excessive heat losses.

Example: Using Heating Efficiency Credits to achieve the minimum Effective Heat Generating Seasonal Efficiency for a boiler system in an existing building

An existing boiler is to be replaced with a gas boiler with a Boiler Seasonal Efficiency of 82%, the minimum allowed by Table 6.

The boiler's Effective Heat Generating Seasonal Efficiency needs to be at least 84% according to Table 6, which means that 2 % points of Heating Efficiency Credits are needed.

The following approach would achieve this:

- a. restrict boiler oversizing to 15% (after a detailed assessment of load);
- b. fit room thermostat to control boiler water temperature in relation to heat load;
- c. use two equally sized boilers to meet the heat load in place of the existing single boiler;
- d. fit TRVs to control the temperature in areas other than where the room thermostat is fitted.

Table 9 below shows how credits would be awarded in this example.

Table 9: Example to illustrate allocation of Heating Efficiency Credits for a replacement boiler in an existing building	
Plant description	Heating efficiency credits (% points)
Boiler efficiency 82%	
Boiler oversizing is less than 20%	2
System controlled by room thermostat which controls boiler water temperature	0.5
System uses TRVs to ensure full building temperature control	1
Multiple boilers	1
Total credits	4.5

Effective Heat Generating Seasonal Efficiency

= Boiler Seasonal Efficiency + maximum of 4 Heating Efficiency Credits

= 82% + 4.0% = 86.0%

In this example the minimum required Effective Heat Generating Seasonal Efficiency of 84% is exceeded by 2.0%.

2.8 Minimum provisions for biomass boilers

Background

The method in Section 2.4 for calculating the seasonal efficiency of single and multiple-boilers fired by gas, LPG and oil is not appropriate for biomass boilers.

For biomass boilers, requirements and test methods are covered by EN 12809:2001 *Residential independent boilers fired by solid fuel – nominal output up to 50 kW – requirements and test methods*.

Minimum provisions

To meet minimum energy efficiency standards in building regulations:

- a. the efficiency of biomass boilers at their nominal load should be at least:
 - i. 65% for independent gravity-fed boilers < 20.5 kW;
 - ii. 75% for independent automatic pellet/woodchip boilers;
- b. controls as for gas, LPG and oil boilers in Table 5 should be provided, where technically feasible.

Section 3: Heat pumps

3.1 Introduction

This section gives guidance on specifying heat pumps to provide space heating and domestic hot water in new and existing buildings to meet minimum energy efficiency standards in building regulations.

The heat pumps covered in this section take heat energy from a low temperature source and upgrade it to a higher temperature at which it can be usefully employed for heating.

The guidance covers measures that can be taken, such as the use of improved controls, to gain Heating Efficiency Credits to improve the Effective Coefficient of Performance of heat pumps.

For guidance on reverse cycle heat pumps that also provide cooling, see Section 9 of this guide.

3.2 Scope of guidance

The guidance in this section applies to the commercial heat pump systems identified in Table 10, which categorises the different types of heat pump according to:

- the source of the heat;
- the medium by which it is delivered; and
- the technology.

Table 10: Heat pump types and associated test standards

Heat pump type	Technology	Sub-technology	Test standard
Electrically driven warm air	Ground-to-air	Single package + variable refrigerant flow warm air systems	ISO 13256-1 ⁸
		Energy transfer systems (matching heating/cooling demands in buildings)	
	Water-to-air	Single package + variable refrigerant flow warm air systems	BS EN 14511 ⁹
		Energy transfer systems (matching heating/cooling demands in buildings)	
	Air-to-air	Single package	BS EN 14511
		Split system	
		Multi-split system	
		Variable refrigerant flow systems	
Electrically driven warm water	Ground-to-water	Single package + variable refrigerant flow warm air systems	ISO 13256-2 ¹⁰
		Split package	
	Water-to-water	Single package + variable refrigerant flow warm air systems	BS EN 14511
		Split package	
	Air-to-water	Single package	BS EN 14511
	Split package + variable refrigerant flow warm air systems		
Gas engine-driven	Available as variable refrigerant flow warm air systems		Generally to BS EN 14511

3.3 Definitions

Coefficient of performance (CoP) is a measure of the efficiency of heat pumps, which may also be expressed as a percentage.

The heating CoP for a heat pump is the heat output of the heat pump divided by its power input:

$$\text{Heating CoP} = \text{Heat output/power input} \quad \text{Equation 4}$$

$$\% \text{ Heating CoP (heat generator efficiency)} = \text{CoP} \times 100$$

⁸ ISO 13256-1 *Water-source heat pumps – Testing and rating for performance – Part 1: Water-to-air and brine-to-air heat pumps.*

⁹ BS EN 14511-3:2007 *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling. Test methods.*

¹⁰ ISO 13256-2 *Water-source heat pumps -Testing and rating for performance – Part 2: Water-to-water and brine-to-water heat pumps.*

In order to calculate the CoP, the heat pump should be tested in accordance with the standard identified in Table 10. The input power items to be included in the calculation are defined in the standard.

3.4 Minimum provisions for heat pumps in new and existing buildings

Heat pump systems in new and existing buildings should:

- a. have a Coefficient of Performance which is no worse than the value in Table 11; and
- b. feature as a minimum the controls package in Table 12 for systems in new buildings and the controls package in Table 13 for systems in existing buildings.

There are currently no European test standards for part load testing of heat pumps, so a single minimum figure should be used, obtained at the heating system rating conditions.

Table 11: Minimum CoP for heat pump systems in new and existing buildings

Heat pump type	Minimum CoP at the rating conditions ¹¹
All types (except absorption heat pumps and gas-engine heat pumps) for space heating	2.2
All types (except absorption heat pumps and gas-engine heat pumps) for domestic hot water heating	2.0
Absorption heat pumps	0.5
Gas engine heat pumps	1.0

For non-residential buildings, the heat pump system can be sized to meet either the full heating and hot water demand or part of it. Economically viable installations provide at least 50% of the heating and hot water demand for the building.

¹¹ Rating conditions – standardised conditions provided for the determination of performance data presented in BS EN 14511:2007 *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling.*

Table 12: Minimum controls package for heat pump systems in new and existing buildings

Heat source/sink	Technology	Minimum controls package	
All types	All technologies	A	<ul style="list-style-type: none"> a. On/off zone control. If the unit serves a single-zone, and for buildings with a floor area of 150 m² or less, the minimum requirement is achieved by default. b. Time control.
Air-to-air	Single package Split system Multi-split system Variable refrigerant flow system	B	<ul style="list-style-type: none"> a. Controls package A above; and b. heat pump unit controls for: <ul style="list-style-type: none"> i. control of room air temperature (if not provided externally); ii. control of outdoor fan operation; iii. defrost control of external airside heat exchanger; iv. control for secondary heating (if fitted); c. external room thermostat (if not provided in the heat pump unit) to regulate the space temperature and interlocked with the heat pump unit operation.
Water-to-air Ground-to-air	Single package Energy transfer systems (matching heating/cooling demand in buildings)	D	<ul style="list-style-type: none"> a. Controls package A above; and b. heat pump unit controls for: <ul style="list-style-type: none"> i. control of room air temperature (if not provided externally); ii. control of outdoor fan operation for cooling tower or dry cooler (energy transfer systems); iii. control for secondary heating (if fitted) on air to air systems; iv. control of external water pump operation; c. external room thermostat (if not provided in the heat pump unit) to regulate the space temperature and interlocked with the heat pump unit operation.
Air-to-water Water-to-water Ground-to-water	Single package Split package	E	<ul style="list-style-type: none"> a. Controls package A above; and b. heat pump unit controls for: <ul style="list-style-type: none"> i. control of water pump operation (internal and external as appropriate); ii. control of water temperature for the distribution system; iii. control of outdoor fan operation for air to water units; iv. defrost control of external airside heat exchanger for air to water systems c. external room thermostat (if not provided in the heat pump unit) to regulate the space temperature and interlocked with the heat pump unit operation.
Gas engine-driven heat pumps are currently available only as variable refrigerant flow warm air systems	Multi-split Variable refrigerant flow	F	<ul style="list-style-type: none"> a. Controls package A above; and b. heat pump unit controls for: <ul style="list-style-type: none"> i. control of room air temperature (if not provided externally); ii. control of outdoor fan operation; iii. defrost control of external airside heat exchanger; iv. control for secondary heating (if fitted); c. external room thermostat (if not provided in the heat pump unit) to regulate the space temperature and interlocked with the heat pump unit operation.

3.5 Heating Efficiency Credits for heat pump systems in existing buildings

Heating Efficiency Credits can be gained for heat pump systems installed in existing buildings by adopting the measures in Table 13, which go beyond the minimum requirements in Tables 11 and 12. These credits are added to the % CoP to produce an Effective % CoP.

$$\text{Effective \% CoP} = \% \text{ CoP} + \text{Heating Efficiency Credits}$$

Table 13: Heating Efficiency Credits for measures applicable to heat pump systems in existing buildings

Measure	Heating efficiency credits (% points)	Comments/definition
< 20% oversizing	2	The amount by which the maximum heat pump output exceeds the system heat output at design conditions, expressed as a percentage of that system heat output.
Optimized stop	2	A control system which stops plant operation at the earliest possible time such that internal conditions will not deteriorate beyond preset limits by the end of the occupancy period.
Full zone control	2	Allows each zone to operate independently in terms of start/stop time. Only appropriate where operational conditions change in different zones.
Monitoring and targeting	2	Means of identifying changes in operation or onset of faults.

Example: Using Heating Efficiency Credits to exceed the minimum Effective CoP for a heat pump installation

The following example illustrates how Heating Efficiency Credits can be added to the efficiency of a heat pump system to achieve the minimum requirement.

The proposed system will have an air-to-water, electrically-driven heat pump to be used with an underfloor heating system. When tested to EN14511, the CoP is found to be 2.16, which is below the minimum allowed by Table 11 for this type of system.

Controls package E will be installed, the minimum required by Table 12:

- a. zone control and time control;
- b. heat pump unit controls for:
 - i. control of outdoor fan operation for cooling tower or dry cooler (energy transfer systems);
 - ii. control for secondary heating (if fitted) on air to air systems;

- iii. control of external water pump operation and water temperature for the distribution system.
- c. room thermostat to regulate the space temperature and interlocked with the heat pump unit operation.

In addition, optimised stop control and full zone control will be installed.

Table 14 shows how credits would be awarded to this example.

Table 14: Example to illustrate the allocation of Heating Efficiency Credits to a new heat pump system in an existing building

Measure	Heating efficiency credits (% points)
% CoP of single duct air-to-water heat pump is 216 in this example (the manufacturer's rating)	
Measures specified in controls package A	0 (as minimum requirement)
Measures specified in controls package B	0 (as minimum requirement)
Optimised stop	2
Full zone control	2
Total credits	4

Effective % CoP = % CoP + Heating Efficiency Credits = 216 + 4 = 220

The Effective CoP would therefore be 2.20, which meets the minimum required by Table 11.

3.6 Supplementary information on heat pumps

Table 15 contains further guidance which is good practice but not required to meet the minimum energy performance standards in building regulations.

Table 15: Supplementary information on heat pumps

Heat source/sink	Technology	Comments
Air-to-air	Single package	Units may be ducted on one or other of the supply and return air sides or ducted on both sides. Ducting needs to be designed to take into account the maximum specific fan power allowable (see Section 10 of this guide) and to maintain the minimum allowable coefficient of performance.
	Split system Multi-split system Variable refrigerant flow system Gas engine-driven	A split system will comprise a single outdoor unit and a single indoor unit as a package. Multi-split and VRF systems will comprise a single outdoor unit and two or more indoor units as a package. Several packages may be used to satisfy the requirements of the building. In order for efficiencies to be maintained, all connecting pipework must be installed in accordance with manufacturers' recommendations (diameter, length, insulation and riser height). Any ducting needs to be designed to take into account the maximum specific fan power allowable and to maintain the minimum allowable coefficient of performance.
Water-to-air Ground-to-air	Single package Energy transfer systems (matching heating/cooling demand in buildings)	Energy transfer systems generally consist of multiple water-source heat pumps connected in parallel to a common closed water loop. They are installed to offset the simultaneous heating and cooling demand in a building due to the different loads present on the aspects of the building. Water circulation pumps for the closed loop need to be taken into consideration along with the fan power required for the cooling tower or dry cooler or energy for water pumps for the ground loop if this method is utilised for heat injection and rejection. Any ducting needs to be designed to take into account the maximum specific fan power allowable and to maintain the minimum allowable coefficient of performance.
Air-to-water Water-to-ground Water-to-water	Single package Split package	Water circulation pumps for the delivery of heated water to the building need to be taken into consideration in the calculation. Additionally the energy of water pumps used for the heat source (water or ground) need to be considered in the calculation. Any ducting needs to be designed to take into account the maximum specific fan power allowable and to maintain the minimum allowable coefficient of performance.
Additional guidance on design criteria for heating systems with integrated heat pumps is given in BS EN 15450:2007 ¹² .		

¹² BS EN 15450:2007 Heating systems in buildings – Design of heat pump heating systems.

Section 4: Gas and oil-fired warm air heaters

4.1 Introduction

This section gives guidance on specifying gas and oil-fired warm air heaters for space heating in new and existing buildings to meet minimum energy efficiency standards in building regulations. It includes guidance on measures, such as the use of better controls, to gain Heating Efficiency Credits to improve the Effective Heat Generating Seasonal Efficiency.

4.2 Scope of guidance

The guidance in this section covers the warm air heaters listed in Table 16. The guidance also covers indirect gas or oil-fired heat exchangers (as used in large ducted systems for office blocks, shopping and leisure complexes, etc) to provide heating and fresh or conditioned air. Warm air central heating systems are not within the scope of this section but are covered in the relevant heat generator section and Section 10 *Air distribution systems*.

Table 16: Warm air heaters and test methods

Type of warm air heater		Product standard
Type 1	Gas-fired forced convection without a fan to assist transportation of combustion air and/or combustion products	BS EN 621:1998 ¹³
Type 2	Gas-fired forced convection incorporating a fan to assist transportation of combustion air or combustion products	BS EN 1020:1998 ¹⁴
Type 3	Direct gas-fired forced convection	BS EN 525:1998 ¹⁵
Type 4	Oil-fired forced convection	BS EN 13842:2004 ¹⁶

4.3 Definitions

Heat generator seasonal efficiency of air heaters, since they operate under the same conditions at all times, is equivalent to their measured steady state thermal efficiency (net calorific value). Net thermal efficiency will be obtained from the heater manufacturer's data. Net efficiency can be converted to gross efficiency using the conversion factors in Appendix 1.

For indirect-fired heaters, data values for net heat input and output are measured using the efficiency test methods described in EN 1020, EN 621 or EN 13824 as appropriate.

¹³ BS EN 621:1998 *Non-domestic gas fired forced convection air heaters for space heating not exceeding a net heat input of 300kW, without a fan to assist transportation of combustion air*. ISBN 0 580 295834.

¹⁴ BS EN 1020:1998 *Non-domestic gas-fired convection air heaters for space heating not exceeding a net heat input of 300 kW, incorporating a fan to assist transportation of combustion air and/or combustion products* (AMD 13525).

¹⁵ BS EN 525:1998 *Non-domestic direct gas-fired forced convection air heaters for space heating not exceeding a net input of 300 kW*.

¹⁶ BS EN 13842:2004 *Oil-fired convection air heaters – stationary and transportable for space heating*.

For direct-fired heaters the efficiency should be calculated using the method described in EN 525.

The calculation of the net thermal efficiency should:

- take account of the heater and the exhaust chimney within the building envelope;
- exclude fans.

Note: For these appliances use net calorific values.

4.4 Minimum provisions for warm air heaters in new and existing buildings

Warm air systems in new and existing buildings should have:

- an Effective Heat Generating Seasonal Efficiency which is no worse than in Table 17; and
- a controls package featuring, as a minimum, time control, space temperature control, and, where appropriate for buildings with a floor area greater than 150 m², zone control.

The Effective Heat Generating Seasonal Efficiency is the Heat Generator Seasonal Efficiency with added Heating Efficiency Credits (see below).

Table 17: Minimum Effective Heat Generating Seasonal Efficiency	
Warm air heater type (as defined in Table 16)	Effective heat generating seasonal efficiency, %
Types 1, 2 natural gas	91
Types 1, 2 LPG	91
Type 3*	100
Type 4	91

*Note: For Type 3 air heaters 100% of the net heat input is delivered to the space. Specific ventilation requirements as defined in EN 525 must be met.

4.5 Heating Efficiency Credits for warm air heaters in new and existing buildings

Heating Efficiency Credits can be gained by adopting the optional measures listed in Table 18. They are added to the Heat Generator Seasonal Efficiency to give the Effective Heat Generating Seasonal Efficiency.

The Effective Heat Generating Seasonal Efficiency is the value entered into NCM tools such as SBEM to calculate a proposed building's carbon dioxide emission rate (BER).

Table 18: Heating Efficiency Credits for measures applicable to warm air heaters

Measure	Heating efficiency credits (% points)	Comments/definition
Optimised shut down	1	A control system which stops plant operation at the earliest possible time such that internal conditions will not deteriorate beyond preset limits by the end of the occupancy period.
Hi/Lo Burners	2	Two stage burners which enable two distinct firing rates.
Modulating burners	3	Burner controls which allow continuous adjustment of the firing rate.

Destratification fans and air-induction schemes

It is recognised that destratification fans and air-induction schemes may improve the efficiency of a warm air system and significantly reduce the carbon emissions associated with the heating system. The benefits of these measures are already taken into account by the NCM so no Heating efficiency Credits can be gained by using them. Note that warm air systems with air induction schemes or destratification fans should not be confused with central heating systems that have air distribution.

Example: Using Heating Efficiency Credits to exceed the minimum Effective Heat Generating Seasonal Efficiency for a warm air heater

The following example illustrates how Heating Efficiency Credits can be used to exceed the minimum Effective Heat Generating Seasonal Efficiency for a warm air heater system.

The proposed building will have a gas-fired forced-convection warm air heater without a fan to assist transportation of combustion air or combustion products. When tested to BS EN 621:1998 the net thermal efficiency is found to be 91%, which meets the minimum Effective Heat Generating Efficiency requirement for this type of system in Table 17.

The minimum controls package will be installed, ie zone, space temperature and time controls, along with optimum start/stop control, modulating burners and destratification fans providing seven volume changes per hour.

Table 19 shows how credits would be awarded in this example.

Table 19: Example to illustrate the allocation of Heating Efficiency Credits to a warm air heater system

Measure	Heating efficiency credits (% points)
Thermal efficiency of warm air heater 91%	
Zone, space and temperature controls	0 (as minimum requirement)
Modulating burners	3
Optimised shut down	1
De-stratification fans	0 (as benefits already recognised by NCM)
Total credits	4

Effective Heat Generating Seasonal Efficiency = Net Thermal Efficiency + Heating Efficiency Credits

$$= 91\% + 4\% = 95\%$$

The Effective Heat Generating Seasonal Efficiency would therefore be 95%, exceeding the minimum requirement by four percentage points. The value that would be entered into the accredited NCM tool to calculate the carbon dioxide emission rate is 95%.

Section 5: Gas and oil-fired radiant technology

5.1 Introduction

This section gives guidance on specifying radiant heaters for space heating in new and existing buildings to meet minimum energy efficiency standards in building regulations. It includes guidance on measures, such as the use of better controls, to gain Heating Efficiency Credits to improve the Effective Heat Generating Seasonal Efficiency.

5.2 Scope of guidance

The guidance in this section covers the types of radiant heater listed in Table 20.

Table 20 Types of radiant heater and associated product standards

Radiant heater type	Product standard
Luminous radiant heater	BS EN 419:2000 ¹⁷
Non-luminous radiant heater	BS EN 416-1:1999 ¹⁸
Multi-burner radiant heater	BS EN 777 series ¹⁹
Oil-fired radiant heater	N/A

5.3 Definitions

Radiant heater seasonal efficiency (Heat Generator Seasonal Efficiency) is equivalent to thermal efficiency (net calorific value).

For flued appliances, the manufacturer of the radiant heater should declare a thermal efficiency measured to the test standards EN1020²⁰ or EN13842²¹ as applicable.

The calculation of the thermal efficiency (net calorific value) should:

- a. take account of the radiant heater and associated flue pipe/tailpipe within the building envelope;
- b. exclude fans.

For unflued heaters the minimum thermal efficiency levels given in Table 21 should be used.

¹⁷ BS EN 419-1:2000 *Non-domestic gas-fired overhead luminous radiant heaters. Safety.*

¹⁸ BS EN 416-1:1999 *Single-burner gas-fired overhead radiant tube heaters. Safety.*

¹⁹ BS EN 777-1:1999 *Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use. System D, safety.*

BS EN 777-2:1999 *Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use. System E, safety.*

BS EN 777-3:2000 *Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use. System F, safety.*

BS EN 777-4:1999 *Multi-burner gas-fired overhead radiant tube heater systems for non-domestic use. System H, safety.*

²⁰ BS EN 1020 *Non-domestic gas-fired convection air heaters for space heating not exceeding a net heat input of 300kW, incorporating a fan to assist transportation of combustion air and/or combustion products (AMD 13525).*

²¹ BS EN 13842:2004 *Oil-fired convection air heaters – stationary and transportable for space heating.*

5.4 Minimum provisions for radiant heaters

Radiant heaters in new and existing buildings should have:

- a. an Effective Heat Generating Seasonal Efficiency not worse than in Table 21; and
- b. a controls package consisting of, as a minimum, time control and space temperature control with black bulb sensors.

Table 21: Minimum performance criteria for radiant heater technology

Appliance type	Minimum effective heat generating seasonal efficiency	
	Thermal	Radiant
Luminous radiant heater – unflued)	86	55
Non-luminous radiant heater – unflued)	86	55
Non-luminous radiant heater – flued	86	55
Multi-burner radiant heater	91	N/A

5.5 Heating Efficiency Credits for radiant heaters in existing buildings

Heating Efficiency Credits can be gained by adopting the optional measures listed in Table 22. They are added to the Heat Generator Seasonal Efficiency (the thermal efficiency – net calorific value) to give the Effective Heat Generating Seasonal Efficiency.

Table 22: Heating Efficiency Credits for measures applicable to radiant heaters

Measure		Heating efficiency credits (% points)	Comments/definition
Controls (additional to the minimum package)	Optimum stop	1	A control system which stops plant operation at the earliest possible time such that internal conditions will not deteriorate beyond preset limits by the end of the occupancy period.
	Optimum start	0.5	A control system which starts plant operation at the latest possible time such that internal conditions will be up to required limits at the start of the occupancy period.
	Zone control	1	A control system in which each zone operates independently in terms of start/stop time. It is only appropriate where operational conditions change in different zones.

Example: Using Heating Efficiency Credits to achieve the minimum Effective Heat Generating Seasonal Efficiency for a radiant heater system

The proposed building will have a flued non-luminous radiant heater system with a net thermal efficiency (Heat Generator Seasonal Efficiency) of 84%. A black bulb sensor and an optimiser will be fitted.

The Heating Efficiency Credits associated with these measures are added to the appliance thermal efficiency to obtain the Effective Heat Generating Seasonal Efficiency.

Table 23 shows how credits would be awarded for this example.

Table 23: Example to illustrate the allocation of Heating Efficiency Credits to a radiant heater system	
Measure	Heating efficiency credits (% points)
Net thermal efficiency of radiant heater	84%
Black bulb sensor	0 (as minimum requirement)
Optimised shut down	1
Zone control	1
Total credits	2

Effective Heat Generating Seasonal Efficiency = Net Thermal Efficiency + Heating Efficiency Credits

$$= 84\% + 2\% = 86\%$$

In this example, the application of Additional Measures to gain Heating Efficiency Credits has brought the radiant heater's Effective Heat Generating Seasonal Efficiency up to the minimum required value.

Section 6: Combined heat and power and community heating

6.1 Introduction

This section gives guidance on specifying combined heat and power (CHP) systems for space heating in new and existing buildings to meet minimum energy efficiency standards in building regulations. It includes guidance on measures, such as the use of improved controls, to gain Heating efficiency Credits to improve the Effective Heat Generating Seasonal Efficiency of the heat generator.

CHP units are normally used in conjunction with boilers. The majority of the annual heat demand is usually provided by the CHP plant, while the boilers are used to meet peak demand and in periods when the CHP unit is not operating (for example at night or when undergoing maintenance).

CHP units may on a relatively small scale supply single buildings, or on a larger scale supply a number of buildings through a community heating system. The most common fuel is natural gas, which can be used in spark-ignition gas engines, micro-turbines, or gas turbines in open cycle or combined cycle.

6.2 Scope of guidance

The guidance in this section covers CHP systems with a total power capacity less than 500 kWe used in commercial applications. The CHP units may or may not supply community heating.

Guidance on community heating systems with micro-CHP (having a total power capacity less than 5 kWe) and other heat generators is available in the *Domestic building services compliance guide*.

6.3 Definitions

Combined heat and power (CHP) means the simultaneous generation of heat and power in a single process. The power output is usually electricity, but may include mechanical power. Heat outputs can include steam, hot water or hot air for process heating, space heating or absorption cooling.

Combined heat and power quality assurance (CHPQA) is a scheme²² under which registration and certification of CHP systems is carried out according to defined quality criteria.

²² Further information about the CHPQA programme is available at www.chpqa.com

CHPQA quality index is an indicator of the energy efficiency and environmental performance of a CHP scheme relative to generation of the same amounts of heat and power by alternative means.

Power efficiency is the total annual power output divided by the total annual fuel input of a CHP unit.

6.4 Minimum provisions for CHP in new and existing buildings

CHP plant in new and existing buildings should have:

- a. a minimum CHPQA Quality Index (QI) of 105 and Power Efficiency greater than 20%, both under annual operation;
- b. a control system that, as a minimum, ensures that the CHP unit operates as the lead heat generator;
- c. metering to measure hours run, electricity generated and fuel supplied to the CHP unit; and
- d. peak and standby boilers, if installed, with the minimum boiler efficiencies and minimum controls identified in Section 2.

The CHP should be sized to supply not less than 45% of the annual total heating demand (ie space heating, domestic hot water heating and process heating) unless there are overriding practical or economic constraints.

Calculating the CO₂ emissions from a CHP heating system

CHP may be used as a main or supplementary heat source in community heating or district heating schemes. To calculate the CO₂ emission rate for a new building for the purposes of showing compliance with building regulations, the following data will need to be entered into an accredited NCM tool such as SBEM:

- a. the proportion of the annual heat demand (H MWh) to be supplied by the CHP plant (P MWh), calculated from heating only requirement. This is needed as the CHP unit is normally sized below the peak heat demand of the building and will also be out of service for maintenance purposes;
- b. the overall efficiency ratio of the CHP plant (E) as defined by Equation 5 and taking account of part-load operation and all heat rejection predicted by an operating model:

E = annual useful heat supplied + annual electricity generated (net of parasitic electricity use) divided by the annual energy of the fuel supplied (in gross calorific value terms)

Equation 5

- c. the heat to power ratio of the CHP plant (R) is calculated for the annual operation according to Equation 6:

$$R = \text{annual useful heat supplied} \div \text{annual electricity generated} \\ (\text{net of parasitic electricity use}) \quad \text{Equation 6}$$

- d. from these parameters, the NCM tool will calculate the CO₂ emissions in the heat supplied from the CHP plant using an emissions factor for the electricity generated by the CHP of X g/kWh applied to the annual total of electricity generation.
- e. the figure for annual CO₂ emissions for the heat supplied by the CHP plant (assuming it is gas-fired) is then:

$$= ((H \times P)/E) + (H \times P)/(R \times E)) \times 194 - ((H \times P)/R) \times X \quad \text{kg} \quad \text{Equation 7}$$

The CO₂ emissions for the balance of heat supplied by the boilers is then calculated by the NCM tool as for a boiler only system.

6.5 Supplementary information on community heating

The design of the community heating connection and the building's heating control system should take account of the requirements of the community heating organisation with respect to maintaining low return temperatures at part-load and limiting the maximum flow rate to be supplied by the community heating system to the agreed level. A heat meter should be installed to measure the heat energy supplied and to monitor the maximum heat demand, the maximum community heating flow rate and the return temperatures into the community heating network.

Further guidance can be found in the following documents:

- Carbon Trust GPG 234 "Community heating and CHP";
- CIBSE AM12 "Small-scale CHP for buildings";
- HVCA TR/30 "Guide to good practice – Heat pumps".

Section 7: Direct electric space heating

7.1 Introduction

This section gives guidance on specifying direct electric heaters for space heating in new and existing buildings. It addresses the relevant electric heater types and the minimum provision of controls.

7.2 Scope of guidance

The guidance given in this section covers the following types of electric heating systems which may be used to provide primary or secondary space heating:

- electric boilers;
- electric warm air systems;
- electric panel heaters;
- electric storage systems including integrated storage/direct systems;
- electric fan heaters and fan convector heaters;
- electric radiant heaters including quartz and ceramic types.

The guidance does not cover electric heat pumps or portable electric heating devices.

7.3 Minimum provisions for electric space heating in new and existing buildings

It is assumed that electric heating devices convert electricity to heat within a building with an efficiency of 100%. A Minimum Heat Generating Seasonal Efficiency is therefore not specified.

Electric space heating systems in new and existing buildings should meet the minimum standards for:

- a. controls for electric boilers in Table 24; or
- b. controls for electric heating systems other than boilers in Table 25.

Table 24: Minimum provisions for control of electric boiler systems		
Type of control	Minimum standard	Comments
Boiler temperature control	a. The boiler should be fitted with a flow temperature control and be capable of modulating the power input to the primary water depending on space heating conditions.	
Zoning	<p>a. Buildings with a total usable floor area up to 150 m² should be divided into at least two zones with independent temperature control.</p> <p>b. For buildings with a total usable floor area greater than 150 m², at least two space heating zones should be provided, each having separate timing and temperature controls, either by:</p> <ul style="list-style-type: none"> i. multiple heating zone programmers, or ii. a single multi-channel programmer. 	If the building floor area is less than 150 m ² sub-zoning of temperature control is not appropriate.
Temperature control of space heating	<p>a. Separate temperature control of zones within the building, using either:</p> <ul style="list-style-type: none"> i. room thermostats or programmable room thermostats in all zones; or ii. a room thermostat or programmable room thermostat in the main zone and individual radiator controls such as thermostatic radiator valves (TRVs) on all radiators in the other zones; or iii. a combination of (i) and (ii) above. 	
Time control of space and water heating	<p>b. Time control of space and water heating should be provided by either:</p> <ul style="list-style-type: none"> i. a full programmer with separate timing to each circuit; ii. two or more separate timers providing timing control to each circuit; or iii. programmable room thermostat(s) to the heating circuit(s), with separate timing of each circuit. 	

Note: An acceptable alternative to the above controls is any boiler management control system that meets the specified zoning, timing and temperature requirements.

Table 25: Minimum provisions for control of primary and secondary electric heating systems (other than electric boilers)

Type of electric heating system	Type of control	Minimum standard	Comments
Warm air	Time and temperature control, either integral to the heater or external	a. A time switch/programmer and room thermostat; or b. a programmable room thermostat.	
	Zone control	a. For buildings with a total usable floor area greater than 150 m ² , more than one space heating circuit should be provided, each having separate timing and temperature controls. b. Control should be by: <ul style="list-style-type: none"> i. multiple heating zone programmers; or ii. a single multi-channel programmer. 	
Radiant heaters	Zone or occupancy control	a. Connection to a passive infra-red detector.	Electric radiant heaters can provide zone heating or be used for a full heating scheme. Common electric radiant heaters include the quartz or ceramic type.
Panel/skirting heaters	Local time and temperature control	a. Time control provided by: <ul style="list-style-type: none"> i. a programmable time switch integrated into the appliance; or ii. a separate time switch. b. Individual temperature control provided by: <ul style="list-style-type: none"> i. integral thermostats; or ii. separate room thermostats. 	Panel heater systems provide instantaneous heat.
Storage heaters	Charge control	a. Automatic control of input charge (based on an ability to detect the internal temperature and adjust the charging of the heater accordingly).	
	Temperature control	a. Manual controls for adjusting the rate of heat release from the appliance, such as adjustable damper or some other thermostatically-controlled means.	
Fan/fan convector heaters	Local fan control	a. A switch integrated into the appliance; or b. a separate remote switch.	
	Individual temperature control	a. Integral switches; or b. separate remote switching.	

Section 8: Domestic hot water

8.1 Introduction

This section gives guidance on specifying domestic hot water (DHW) systems for new and existing buildings to meet minimum energy efficiency standards in building regulations. It includes guidance on measures, such as the use of better controls, to gain Heating Efficiency Credits to improve the Effective Heat Generating Seasonal Efficiency.

As well as building regulations, other regulations apply to the provision of domestic hot water. Energy-saving measures should not compromise the safety of people or the ability of the system to achieve approved regimes for the control of legionella.

Domestic hot water systems are referred to as hot water service systems in SBEM.

8.2 Scope of guidance

The guidance in this section covers the conventional gas, electric and oil-fired domestic hot water systems shown in Table 26.

The minimum standards of this section apply only to dedicated water heaters. Central heating boilers which provide space heating and domestic hot water should meet the minimum standards in Section 2.

Section 3 contains guidance on the use of heat pumps to heat domestic hot water.

This section does not cover solar thermal hot water systems – for this see the *Domestic building services compliance guide*. However, the guidance in this section does apply to back-up gas or electric systems used with solar thermal hot water systems.

Table 26: Types of hot water system

DHW system type	Definition
Indirect natural gas, LPG and oil-fired systems	A system in which the water is supplied to the draw-off points from a device in which water is heated by means of an element, through which the heating medium is circulated in such a manner that it does not mix with the hot water supply. In practice these are likely to be boilers dedicated to the supply of DHW that meet the minimum requirements of the Boiler Efficiency Directive.
Direct-fired storage water heater system (natural gas, LPG and oil-fired)	A system in which the water is supplied to the draw-off points from a hot water vessel in which water is heated by combustion gases from a primary energy source.
Point of use electrically-heated water heater systems	A system in which the water is supplied to the draw-off points from a device in which water is heated by an electric element or elements immersed in the stored water. The water heater is situated in close proximity to the draw-off points (points of use) and should have a storage capacity no greater than 100 litres.
Instantaneous electrically-heated water heater systems	A system in which the water is supplied to the draw-off points from a device in which the water is heated by an electric element or elements that heat the cold water as it flows through the water heater. The water heater is situated in close proximity to the draw-off points. The unit has no storage volume as water is instantaneously heated as it flows through the device.
Local, electrically-heated water heater systems	A system in which the water is supplied to the draw-off points from a device in which water is heated by an electric element or elements immersed in the stored water. The water heater is situated in the locality of the draw-off points and should have a storage capacity of between 100 and 300 litres. Bulk heating of the water heater should be arranged to occur using off-peak electricity supplies.
Centralised electrically-heated water heater systems	A system in which the water is supplied to the draw-off points from a device in which water is heated by an electric element or elements immersed in the stored water. The water heater is situated centrally with a distribution system to supply water to the draw off-points and should have a capacity greater than 300 litres. Bulk heating of the water heater should be arranged to occur using off-peak electricity supplies.

8.3 Definitions

The **Heat Generator Seasonal Efficiency** is defined for each system type in Table 27.

The Effective Heat Generating Seasonal Efficiency is the Heat Generator Seasonal Efficiency plus Heating Efficiency Credits gained by adopting Additional Measures from Table 30.

Table 27: Definition of heat generator seasonal efficiency for DHW systems

DHW system type	Heat generator seasonal efficiency	Components to include in calculation of heat generator seasonal efficiency *
Direct-fired systems (gas and oil-fired)	<p>Equals the thermal efficiency of the heater (gross calorific value) when tested using the procedures in BS EN 89:2000²³.</p> $\text{Gross thermal efficiency} = \frac{\text{Heater output}}{\text{gross input}} \quad \text{Equation 8}$ <p>where</p> $\text{Heater output} = \text{Recovery rate of heater in litres/second} \times \text{specific heat capacity of water} \times \text{temperature rise of the water} \quad \text{Equation 9}$	<p>For direct systems include the water heater and insulation of the allied storage vessel only. Exclude:</p> <ol style="list-style-type: none"> secondary pipework; fans and pumps; diverter valves, solenoids, actuators; supplementary storage vessels.
Indirect-fired systems (gas and oil-fired)	<p>The Heat Generator Seasonal Efficiency of the heat generator (boiler) allied to an indirect storage cylinder should be calculated using Equation 2, 3.1, or 3.2 and 3.3 (as appropriate) in Section 2. If Seasonal Boiler Efficiency values are obtained as net values the conversion factors in Appendix 1 should be used to convert to a gross value.</p>	<p>For indirect cylinder systems include the heat generator only.</p>
Point of use electrically-heated water heater systems	<p>These are assumed 100% thermally efficient in terms of conversion to heat within the building.</p>	
Local electrically-heated water heater systems		
Centralised electrically-heated water heater systems		

* Note: For hot water systems in new buildings, standing losses are calculated in the accredited NCM tool.

8.4 Minimum provisions for domestic hot water systems in new and existing buildings

Domestic hot water systems in new and existing buildings should meet the minimum standards for:

- thermal efficiency (gross calorific value) in Table 29;
- heat losses from DHW storage vessels in Table 28; and
- controls in Table 30.

²³ BS EN 89:2000 *Gas fired water heaters for the production of domestic hot water.*

Table 28: Maximum heat losses from DHW storage vessels

Nominal volume, litres	Maximum heat loss, kWh/24h	Nominal volume, litres	Maximum heat loss, kWh/24h
200	2.1	900	4.5
300	2.6	1 000	4.7
400	3.1	1 100	4.8
500	3.5	1 200	4.9
600	3.8	1 300	5.0
700	4.1	1 500	5.1
800	4.3	2 000	5.2

For guidance on maximum heat losses from DHW storage vessels with a storage volume less than 200 litres, see BS EN 15450:2007²⁴.

Table 29: Minimum thermal efficiencies for domestic hot water systems

DHW system type	Fuel type	Minimum thermal efficiency (gross calorific value)	Effective heat generating seasonal efficiency (gross calorific value)
Direct-fired domestic hot water system	Natural gas	73%	
	LGP	74%	
	Oil	75%	
Indirect-fired systems	Natural gas		80%
	LPG		81%
	Oil		82%
Electric systems	Electricity	100%	

²⁴ BS EN 15450:2007 *Heating systems in buildings – Design of heat pump heating systems.*

Table 30: Minimum Controls Package for domestic hot water systems

Type of DHW system	Minimum controls package			
Gas and oil-fired direct-fired hot water systems	a. Automatic thermostat control to shut off the burner/primary heat supply when the desired temperature of the hot water has been reached; b. time control.			
Gas and oil-fired indirect systems	a. Automatic thermostat control to shut off the burner/primary heat supply when the desired temperature of the hot water has been reached; b. high limit thermostat to shut off primary flow if system temperature too high; c. time control.			
Electric domestic hot water systems				
	Point of use electrically-heated water heater systems	Local electrically-heated water heater systems	Centralised electrically-heated water heater systems	Instantaneous electrically-heated water heater systems
Automatic thermostat control to interrupt the electrical supply when the desired storage temperature has been reached.	Yes	Yes	Yes	x
High limit thermostat (thermal cut-out) to interrupt the energy supply if the system temperature gets too high.	Yes	Yes	Yes	x
Manual re-set in the event of an over-temperature trip.	Yes	Yes	Yes	x
7-day time clock (or BMS interface) to ensure bulk heating of water using off-peak electricity. Facility to boost the temperature using on-peak electricity (ideally by means of an immersion heater fitted to heat the top 30% of the cylinder).	x	Yes	Yes	x
High limit thermostat (thermal cut-out) to interrupt the energy supply if the outlet temperature gets too high. (Note: outlet temperature is controlled by rate of flow through the unit, which on basic units would be by the outlet tap or fitting.)	x	x	x	Yes
Flow sensor that only allows electrical input should sufficient flow through the unit be achieved.	x	x	x	Yes

8.5 Supplementary information on electric water heaters

Table 31 contains supplementary guidance on electric water heaters. The guidance does not need to be followed to meet the minimum energy efficiency standards in building regulations.

Table 31: Supplementary information on electric water heaters

<i>Point of use electrically-heated water heater systems</i>	<i>These should be constructed to comply with BS EN 60335-2-21:1999²⁵ and the heat loss should not exceed $1.28 \times (0.2 + 0.051V^{2/3})$ kWh where V is the cylinder's nominal capacity in litres.</i>
<i>Instantaneous electrically-heated water heater systems</i>	<i>These should be constructed to comply with BS EN 60335-2-35:2002²⁶.</i>
<i>Local electrically-heated water heater systems should be constructed to comply with</i>	<i>Vented systems should be constructed to comply with either BS EN 60335-2-21 or BS 1566-1:2002²⁷ or BS 3198:1981²⁸. Unvented systems should be constructed to comply with BS 7206 or be certified by the BBA, WRC-NSF or other accredited body as complying with Building Regulation G3 for unvented systems. The heat loss should not exceed $1.28 \times (0.051V^{2/3})$ kWh where V is the nominal capacity of the cylinder in litres.</i>
<i>Centralised electrically-heated water heater systems</i>	<i>The vessel should be constructed to comply with BS 853²⁹. Bulk heating of the water should utilise off-peak electricity where possible. When using off-peak electricity a "Boost Heater" should be fitted to allow "on-peak" heating. The "Boost Heater" should heat the top 30% of the cylinder and be rated to approximately 30% of the main off-peak heater battery. The kW load will depend on the recovery time required. The heater battery should either be of removable core or rod element construction. Removable core construction allows elements to be changed without removing the heater from the vessel or draining the system. For removable core construction, the maximum element watts density should not exceed 3 W/cm² for copper tubes or 2.5 W/cm² for stainless steel tubes. For rod element construction, elements should be of Nickel Alloy 825 sheath, be U-bent and have a maximum watts density of 10 W/cm². Temperature control should be by means of "on/off" control of the heater battery utilising stage ramping for loadings above 30 kW. Thermostatic control is an ideal solution.</i>

²⁵ BS EN 60335-2-21:1999 Specification for safety of household and similar electrical appliances. Particular requirements for storage water heaters.

²⁶ BS EN 60335-2-35:2002 Specification for safety of household and similar electrical appliances. Particular requirements for instantaneous water heaters.

²⁷ BS 1566-1:2002 Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test method.

²⁸ BS 3198:1981 Specification for copper hot water storage combination units for domestic purposes.

²⁹ BS 853-1: Calorifiers and storage vessels for central heating and hot water supplies.

Table 31: Supplementary information on electric water heaters (*continued*)

<i>Centralised electrically-heated water heater systems</i>	<i>The control sensor should be mounted in the cylinder at an angle of approximately 45° to the heater and at a level just above the heating bundle. The over-temperature sensor (high limit) should be mounted in the top 30% of the cylinder directly above the heater bundle. A manual reset should be required in the event of an over-temperature trip. For loadings greater than 6 kW, temperature sensors should not be fitted to the heater bundle. This is to prevent thermostat and contactor cycling which will lead to premature failure of the equipment and poor temperature control.</i>
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8.6 Heating Efficiency Credits for DHW systems in new and existing buildings

Heating Efficiency Credits are available for the optional measures listed in Table 32. If these measures are adopted, Heating Efficiency Credits can be added to the Heat Generator Seasonal Efficiency to give the Effective Heat Generating Seasonal Efficiency, which is the value entered into the accredited NCM tool in order to calculate the carbon dioxide emission rate for the proposed building.

Effective Heat Generating Seasonal Efficiency = Heat Generator Seasonal Efficiency + Heating Efficiency Credits

where the Heat Generator Seasonal Efficiency is:

- the thermal efficiency for direct-fired systems; or
- the Seasonal Boiler Efficiency for indirect gas or oil-fired systems.

Table 32: Heating Efficiency Credits for measures applicable to domestic hot water systems

System type	Measure	Heating efficiency credits %
All system types	De-centralisation	2, but not applicable to systems in new buildings
Direct-fired	Integral combustion circuit shut-off device	1
	Fully automatic ignition controls	0.5
All system types	Correct size of unit confirmed using manufacturer's technical help line and sizing software	2

Example: Using Heating Efficiency Credits to exceed the minimum Effective Heat Generating Seasonal Efficiency for a direct-fired system

Step 1: Calculating thermal efficiency of direct-fired DHW system

- recovery rate of heater = 0.4694 litres/s;
- gross input rate of heater = 128 kW;
- specific heat capacity of water = 4.187 kJ/kgK;
- temperature rise of water inside heater = 50°C.

Using Equation 9:

$$\begin{aligned} \text{Heater output} &= \text{Recovery rate of heater in litres/second} \times \text{specific heat capacity of water} \times \text{temperature rise of the water} \\ &= 0.4694 \times 4.187 \times 50 = 96.26 \text{ kW} \end{aligned}$$

Using Equation 8:

$$\begin{aligned} \text{Gross thermal efficiency} &= \text{Output of the heater divided by the gross input} \\ &= 96.26 \div 128 = 0.76 \end{aligned}$$

Step 2: Adding Heating Efficiency Credits for Additional Measures

The heater has been sized to closely match the system demand by using the manufacturer's sizing guide and it will be fitted with fully automatic controls.

Table 33 shows how credits would be assigned in this example.

Table 33: Example to illustrate allocation of Heating Efficiency Credits for a DHW system	
Measure	Heating efficiency credits % points
Sized according to manufacturer's guidance	2
Fully automatic ignition controls	0.5
Total credits	2.5

Effective Heat Generating Seasonal Efficiency = Gross Thermal Efficiency + Heating Efficiency Credits

$$= 76 + 2.5 = 78.5\%$$

In this example, the value 0.785 would be entered in the NCM tool.

Section 9: Comfort cooling

9.1 Introduction

This section gives guidance on specifying comfort cooling for new and existing buildings to meet minimum energy efficiency standards in building regulations. It includes guidance on using SBEM to calculate the carbon dioxide emissions associated with comfort cooling from new buildings.

9.2 Scope of guidance

This section covers the specification of refrigeration plant efficiency in terms of the Seasonal Energy Efficiency Ratio (SEER – see definition below), which is the value used by SBEM to calculate the carbon dioxide emission rate for a new building. SBEM allocates standard correction factors³⁰ to the performance of cooling plant to account for the use of the different systems of distributing cooling to the spaces. Evaporative cooling and desiccant cooling systems are not within the scope of this guidance.

9.3 Definitions

Cooling plant means that part of a cooling system that produces the supply of cooling medium. It does not include means of distributing the cooling medium or the delivery of the cooling into the relevant zone. It may consist, for example, of a single chiller or a series of chillers.

Cooling system means the complete system that is installed to provide the comfort cooling to the space. It includes the cooling plant and the system by which the cooling medium effects cooling in the relevant zone and the associated controls. This will in some cases be a complete packaged air conditioner.

Energy efficiency ratio (EER) means for chillers the ratio of the cooling energy delivered into the cooling system divided by the energy input to the cooling plant as determined by BS EN 14511³¹.

In the case of packaged air conditioners, the EER is the ratio of the energy removed from air within the conditioned space divided by the effective energy input to the unit as determined by BS EN 14511 or other appropriate standard procedure. The test conditions for determining EER are those specified in BS EN 14511.

Part load energy efficiency ratio means the ratio of the cooling energy delivered into the cooling system divided by the energy input to the cooling plant. Part load performance for individual chillers is determined assuming chilled water provision at 7°C out and 12°C in, under the following conditions:

³⁰ The SBEM Technical Manual is available for download from www.2010ncm.bre.co.uk

³¹ BS EN 14511-2:2007 *Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling. Test conditions.*

Percentage part load	25%	50%	75%	100%
Air-cooled chillers ambient entering air (°C)	20	25	30	35
Water-cooled chillers entering condenser water (°C)	18	22	26	30

Seasonal energy efficiency ratio (SEER) means the ratio of the total amount of cooling energy provided divided by the total energy input to the cooling plant (which may comprise more than one cooling unit), summed over the year.

Where an industry approved test procedure for obtaining performance measurements of cooling plant at partial load conditions exists, the SEER of the cooling plant may be estimated from the EER of the cooling plant measured at partial load conditions, adjusted for the cooling load profile of the proposed building.

Equation 10 illustrates how to determine the seasonal efficiency of the cooling plant at four steps of load control for a single chiller well matched to the applied load:

$$SEER = a(EER_{25}) + b(EER_{50}) + c(EER_{75}) + d(EER_{100}) \quad \text{Equation 10}$$

where

EER_x is the EER measured at the defined partial load conditions of 100%, 75%, 50% and 25%

and

a, b, c, and d are the load profile weighting factors relevant to the proposed application.

9.4 Minimum provisions for comfort cooling in new and existing buildings

For comfort cooling systems in new and existing buildings:

- a. the full load Energy Efficiency Ratio (EER) of each cooling unit of the cooling plant should be no worse than in Table 34; and
- b. controls should be no worse than in Table 35.

Table 34: Minimum Energy Efficiency Ratio (EER) for comfort cooling

Type		Minimum cooling plant full load EER
Packaged air conditioners	Single duct types	2.5
	Other types	2.5
Split and multi-split air conditioners		2.5
Variable refrigerant flow systems		2.5
Vapour compression cycle chillers, water cooled <750 kW		3.85
Vapour compression cycle chillers, water cooled >750 kW		4.65
Vapour compression cycle chillers, air cooled <750 kW		2.5
Vapour compression cycle chillers, air cooled >750 kW		2.6
Water loop heat pump		3.2
Absorption cycle chillers		0.7
Gas engine driven variable refrigerant flow		1.0

Table 35: Minimum controls for comfort cooling in new and existing buildings

	Minimum controls
Cooling Plant	a. Multiple cooling modules should be provided with controls to provide the most efficient operating modes for the combined plant.
Cooling System	a. Each terminal unit capable of providing cooling should be capable of time and temperature control either by its own or by remote controls. b. In any given zone simultaneous heating and cooling should be prevented by a suitable interlock.

9.5 Calculating the Seasonal Energy Efficiency Ratio for SBEM

The value of the SEER to be used in the SBEM tool can be calculated in a number of ways according to the availability of information and the application. The following section describes how the SEER may be calculated for situations where suitable data exist to a greater or lesser extent. The situations are:

- chillers with no part load performance data;
- unknown load profiles;
- office type buildings;
- other building types with known load profile data.

For chillers that have no part load data

For chillers that have no part load data, the SEER is the full load EER.

When load profile is not known

For applications where the load profile under which the cooling plant operates is not known but there are some data on chiller part load EER, then:

- a. for chillers where the full and half load (50%) EERs are known, the SEER is the average of the EERs, ie the 100% and 50% are equally weighted;
- b. for chillers with four points of part load EER, the SEER is calculated using Equation 10 with each EER weighted equally, ie a, b, c and d each equal to 0.25;
- c. if the chiller used does not have data for four steps of load, then the weights are apportioned appropriately.

For office type accommodation

For applications in general office-type accommodation, the weighting factors in the table below can be taken as representative of the load profile:

a	b	c	d
0.20	0.36	0.32	0.12

Other buildings with known load profile

If the load profile is known from detailed simulation or prediction, the SEER may be derived as above using appropriate weights and EERs at given loads.

Examples

1. For a single chiller with EER of 2.9 (known at full load only):

$$\text{SEER} = 2.9.$$

2. For a chiller with 100% and 50% EERs of 2.0 and 2.5 respectively in a building with unknown load profile:

$$\text{SEER} = 2.25.$$

3. For a chiller with unknown application load profile and part load EERs of $\text{EER}_{100} = 4.89$, $\text{EER}_{75} = 4.42$, $\text{EER}_{50} = 3.93$, and $\text{EER}_{25} = 2.59$:

$$\text{SEER} = 0.25 \times 2.59 + 0.25 \times 3.93 + 0.25 \times 4.42 + 0.25 \times 4.89 = 3.96$$

4. If the above chiller is used in an office and the typical UK weighting factors used:

$$\text{SEER} = 0.2 \times 2.59 + 0.36 \times 3.93 + 0.32 \times 4.42 + 0.12 \times 4.89 = 3.93$$

Multiple-chiller systems

For systems with multiple-chillers for use in office buildings, combined EER values may be calculated based on the sum of the energy consumptions of all the operating chillers. In this case care must be taken to include all the factors that can influence the combined performance of the multiple-chiller installation. These will include:

- degree of oversizing of the total installed capacity;
- sizing of individual chillers;
- EERs of individual chillers;
- control mode for the multiple-chiller – eg parallel or sequential;
- load profile of the proposed cooling load.

When these are known it may be possible to calculate a SEER which matches more closely the proposed installation than by applying the simplifications described earlier.

Systems with free cooling or heat recovery

Systems that have the ability to use free cooling or heat recovery can achieve greater SEERs than more conventional systems. In these cases the SEER must be derived for the specific application under consideration.

Absorption chillers and district cooling

Absorption chillers may be used in conjunction with on-site CHP or a community or district heating system. The carbon dioxide emissions are calculated in the same way as when using CHP for heating. The control system should ensure as far as possible that heat from boilers is not used to supply the absorption chiller.

The minimum EER of absorption chillers should be no worse than 0.7.

Where a district cooling scheme exists, lower carbon dioxide emissions may result if the cooling is produced centrally from CHP/absorption chillers, heat pumps or high efficiency vapour compression chillers. The district cooling company will provide information on the carbon dioxide content of the cooling energy supplied, and this figure can then be used to calculate the carbon dioxide emission rate for the building.

9.6 Supplementary information on comfort cooling systems

BS EN 15243:2007³² provides additional guidance on calculating the seasonal efficiency of cold generators and chillers in air conditioning systems. The guidance does not need to be followed to meet the minimum energy efficiency standards in building regulations.

³² BS EN 15243:2007 *Ventilation for buildings – Calculation of room temperatures and of load and energy for buildings with room conditioning systems*

Section 10: Air distribution systems

10.1 Introduction

This section gives guidance on specifying air distribution systems for new and existing buildings to meet minimum energy efficiency standards in building regulations.

10.2 Scope of guidance

The guidance applies to the following types of air distribution system:

- central air conditioning systems;
- central mechanical ventilation systems with heating, cooling or heat recovery;
- all central systems not covered by the above two types;
- zonal supply systems where the fan is remote from the zone, such as ceiling void or roof-mounted units;
- zonal extract systems where the fan is remote from the zone;
- local supply and extract ventilation units such as window, wall or roof units serving a single area (eg toilet extract);
- other local ventilation units, eg fan coil units and fan assisted terminal VAV units.

Gas and oil-fired air heaters installed within the area to be heated are not within the scope of this section.

10.3 Definitions

Air conditioning system means a combination of components required to provide a form of air treatment in which temperature is controlled or can be lowered, possibly in combination with the control of ventilation, humidity and air cleanliness.

Ventilation system means a combination of components required to provide air treatment in which temperature, ventilation and air cleanliness are controlled.

Central system means a supply and extract system which serves the whole or major zones of the building.

Local unit means an unducted ventilation unit serving a single area.

Zonal system means a system which serves a group of rooms forming part of a building, ie a zone, where ducting is required.

Demand control is a type of control where the ventilation rate is controlled by air quality, moisture, occupancy or some other indicator for the need of ventilation.

Specific fan power of an air distribution system (SFP) means the sum of the design circuit-watts of the system fans that supply air and exhaust it back outdoors, including losses through switchgear and controls such as inverters (ie the total circuit-watts for the supply and extract fans), divided by the design air flow rate through that system.

For the purposes of this guide, the specific fan power of an air distribution system should be calculated according to the procedure set out in EN BS 13779:2007³³ Annex D *Assessing the power efficiency of fans and air handling units – Calculating and checking the SFP, SFP_E and SFP_V*.

Equation 11

$$SFP = \frac{P_{sf} + P_{ef}}{q}$$

where:

SFP is the specific fan power demand of the air distribution system (W/l/s);

P_{sf} is the total fan power of all supply air fans at the design air flow rate, including power losses through switchgear and controls associated with powering and controlling the fans (W);

P_{ef} is the total fan power of all exhaust air fans at the design air flow rate including power losses through switchgear and controls associated with powering and controlling the fans (W);

q is the design air flow rate through the system, which should be the greater of either the supply or exhaust air flow (l/s). Note that for an air handling unit, q is the largest supply or extract air flow through the unit.

External system pressure drop means the total system pressure drop excluding the pressure drop across the air handling unit (AHU).

10.4 Minimum provisions for air distribution systems in new and existing buildings

Air distribution systems in new and existing buildings should meet the following minimum standards:

- a. air handling systems should be capable of achieving a specific fan power at 25% of design flow rate no greater than that achieved at 100% design flow rate;

³³ EN BS 13779:2007 *Ventilation for non-residential buildings – Performance requirements for ventilation and room-conditioning systems*.

- b. in order to aid commissioning and to provide flexibility for future changes of use, reasonable provision would be to equip with variable speed drives those fans that are rated at more than 1100 W and which form part of the environmental control system(s), including smoke control fans used for control of overheating. The provision is not applicable to smoke control fans and similar ventilation systems only used in abnormal circumstances;
- c. In order to limit air leakage, ventilation ductwork should be made and assembled so as to be reasonably airtight. Ways of meeting this requirement would be to comply with the specifications given in:
 - i. HVCA DW144³⁴. Membership of the HVCA specialist ductwork group or the Association of Ductwork Contractors and Allied Services is one way of demonstrating suitable qualifications; or
 - ii. British Standards such as BS EN 1507:2006³⁵, BS EN 12237:2003³⁶ and BS EN 13403:2003³⁷.
- d. in order to limit air leakage, air handling units should be made and assembled so as to be reasonably airtight. Ways of meeting this requirement would be to comply with Class L2 air leakage given in BS EN 1886:1998³⁸;
- e. the specific fan power of air distribution systems at the design air flow rate should be no worse than in Table 36 for new buildings and in Table 39 for existing buildings;
- f. where the primary air and cooling is provided by central plant and an air distribution system which includes the additional components listed in Table 37, the allowed specific fan powers may be increased by the amounts shown in Table 37 to account for the additional resistance;
- g. pressure drops for air distribution systems in new buildings should not exceed the values given in Table 36;
- h. a minimum controls package should be provided in new and existing buildings as in Table 38.

³⁴ Ductwork Specification DW/144 *Specifications for sheet metal ductwork – Low, medium and high pressure/velocity air systems* (Appendix M revision 2002), HVCA, 1998.

³⁵ BS EN 1507:2006 *Ventilation for buildings – Sheet metal air ducts with rectangular section – Requirements for strength and leakage*.

³⁶ BS EN 12237:2003 *Ventilation for buildings – Ductwork – Strength and leakage of circular sheet metal ducts*.

³⁷ BS EN 13403:2003 *Ventilation for buildings – Non-metallic ducts – Ductwork made from insulation ductboards*.

³⁸ BS EN 1886:1998 *Ventilation for buildings – Air handling units – Mechanical performance*.

Table 36: Maximum specific fan powers and pressure drop in air distribution systems in new buildings

System type	Maximum SFP, W/l/s	Maximum external system pressure drop, Pa
Central mechanical ventilation system including heating and cooling	1.8	400 supply 250 extract
Central mechanical ventilation system including heating only	1.6	400 supply 250 extract
All other central mechanical ventilation systems	1.4	400 supply 250 extract
Zonal supply system where the fan is remote from the zone, such as ceiling void or roof mounted units	1.2	200
Zonal extract system where the fan is remote from the zone	0.6	200
Zonal supply and extract ventilation units such as ceiling void or roof units serving a single room or zone with heating and heat recovery	2.0	150
Local supply and extract ventilation system such as wall/roof units serving a single area with heating and heat recovery	1.8	150
Local supply or extract ventilation units such as window/wall/roof units serving a single area (eg toilet extract)	0.4	30
Other local ventilation units	0.6	30
Fan assisted terminal VAV unit	1.2	30
Fan coil units (rating weighted average*)	0.6	30
Notes: * The rating weighted average is calculated by the following formula $\frac{P_{\text{mains},1} \cdot \text{SFP}_1 + P_{\text{mains},2} \cdot \text{SFP}_2 + P_{\text{mains},3} \cdot \text{SFP}_3 + \dots}{P_{\text{mains},1} + P_{\text{mains},2} + P_{\text{mains},3} + \dots}$ where P_{mains} is useful power supplied from the mains, W.		

Table 37: Extending SFP for additional components

Component	SFP, W/l/s
Additional return filter for heat recovery	+0.1
HEPA filter	+1.0
Heat recovery – thermal wheel system	+0.15
Heat recovery – other systems	+0.3
Humidifier/dehumidifier (air conditioning system)	+0.1

Example

For a central mechanical ventilation system including heating and cooling together with heat recovery via a plate heat exchanger, the SFP:

- = 1.8 W/l/s for the central mechanical ventilation system including heating and cooling
- + 0.3 W/l/s for the plate heat exchanger
- = 2.1 W/l/s

Table 38: Minimum controls for air distribution systems in new and existing buildings from BS EN 15232:2007³⁹

System type		Minimum controls package
Central mechanical ventilation system including heating, cooling or heat recovery	Air flow control at the room level	Time control
	Air flow control at the air handler level	On/off time control
	Heat exchanger defrosting control	With defrosting control – during cold periods a control loop enables to warranty that the air temperature leaving the heat exchanger is not too low to avoid frosting
	Heat exchanger overheating control	With overheating control – during cooling periods where the effect of the heat exchanger will no more be positive a control loop stops modulates or bypass the heat exchanger
	Supply temperature control	Variable set point with outdoor temperature compensation
Central mechanical ventilation system including heating or heat recovery	Air flow control at the room level	Time control
	Air flow control at the air handler level	On/off time control
	Heat exchanger defrosting control	With defrosting control – during cold periods a control loop enables to warranty that the air temperature leaving the heat exchanger is not too low to avoid frosting
	Heat exchanger overheating control	With overheating control – during cooling periods where the effect of the heat exchanger will no more be positive a control loop stops modulates or bypass the heat exchanger

³⁹ BS EN 15232:2007 *Energy performance of buildings – Impact of building automation, controls and building management.*

Table 38: Minimum controls for air distribution systems in new and existing buildings from BS EN 15232:2007 (continued)

System type		Minimum controls package
	Supply temperature control	Demand control
Zonal system	Air flow control at the room level	On/off time control
	Air flow control at the air handler level	No control
	Supply temperature control	No control
Local system	Air flow control at the room level	On/off
	Air flow control at the air handler level	No control
	Supply temperature control	No control

Table 39: Maximum specific fan powers in existing buildings

System type	Maximum SFP, W/l/s
Central balanced mechanical ventilation system including heating and cooling	2.2
Central balanced mechanical ventilation system including heating only	1.6
All other central balanced mechanical ventilation systems	1.8
Zonal supply system where the fan is remote from the zone, such as ceiling void or roof mounted units	1.5
Zonal extract system where the fan is remote from the zone	0.6
Zonal supply and extract ventilation units such as ceiling void or roof units serving a single room or zone with heating and heat recovery	2.0
Local balanced supply and extract ventilation system such as wall/roof units serving a single area with heating and heat recovery	1.8
Local supply or extract ventilation units such as window/wall/roof units serving a single area (eg toilet extract)	0.5
Other local ventilation supply and/or extract units	0.6
Fan assisted terminal VAV unit	1.2
Fan coil units (rating weighted average*)	0.6
Notes: * The rating weighted average is calculated by the following formula	
$\frac{P_{mains,1} \cdot SFP_1 + P_{mains,2} \cdot SFP_2 + P_{mains,3} \cdot SFP_3 + \dots}{P_{mains,1} + P_{mains,2} + P_{mains,3} + \dots}$	
where P_{mains} is useful power supplied from the mains, W.	

10.5 Minimum provisions for heat recovery in air distribution systems in new and existing buildings

Air supply and extract ventilation systems including heating or cooling should be fitted with a heat recovery system. The application of a heat recovery system is described in 6.5 of BS EN 13053:2006⁴⁰. The methods for testing air-to-air heat recovery devices are given in BS EN 308:1997⁴¹.

The minimum dry heat recovery efficiency with reference to the mass flow ratio 1:1 should be no less than given in Table 40.

Table 40: Minimum dry heat recovery efficiency for heat exchangers in new and existing buildings

Heat exchanger type	Dry heat recovery efficiency, %
Plate heat exchanger	50
Heat pipes	60
Thermal wheel	65
Run around coil	45

10.6 Calculating the specific fan power for SBEM

SBEM assumes a value of SFP for the fan coil system, so this figure should not be added to the SFP for the fan coil units when entering the data into SBEM.

HEPA filtration is recognised as an option in SBEM. The pressure drop can be specified or SBEM will assume a default value from the NCM activity database.

⁴⁰ BS EN 13053:2006 *Ventilation for buildings – Air handling units – Rating and performance for units, components and sections.*

⁴¹ BS EN 308:1997 *Heat exchangers – Test procedures for establishing the performance of air to air and flue gases heat recovery devices.*

Section 11: Pipework and ductwork insulation

11.1 Introduction

This section gives guidance on insulating pipework and ducting serving space heating, hot water and cooling systems in new and existing buildings to meet minimum energy efficiency standards in building regulations.

The insulation of pipework and ducting is essential to minimise heating system heat losses and cooling system heat gains.

For cooling systems, it is also important to ensure that the risk of condensation is adequately controlled. Condensation control is not within the scope of this section, but is covered by the *TIMSA HVAC Guide for achieving compliance with Part L of the building regulations*.

11.2 Scope of guidance

The guidance in this section covers insulation for the following types of pipework and ductwork serving space heating, domestic hot water and cooling systems:

- Pipework: direct hot water, low, medium and high temperature heating, and cooled;
- Ductwork: heated, cooled and dual-purpose heated and cooled.

11.3 Minimum provisions for insulation of pipes and ducts in new and existing buildings

Insulation of pipes and ducts serving heating and cooling systems should meet the following minimum standards:

a. Direct hot water and heating pipework

- i. Pipework serving space heating and hot water systems should be insulated in all areas outside of the heated building envelope. In addition, pipes should be insulated in all voids within the building envelope and within spaces which will normally be heated if there is a possibility that those spaces might be maintained at temperatures different to those maintained in other zones. The guiding principles are that control should be maximised and that heat loss from uninsulated pipes should only be permitted where the heat can be demonstrated as “always useful”.
- ii. In order to demonstrate compliance, the heat losses shown in Table 41 for different pipe sizes and temperatures should not be exceeded.

b. Cooled pipework

- i. Cooled pipework should be insulated along its whole length in order to provide the necessary means of limiting heat gain. Control should be maximised and heat gain to uninsulated pipes should only be permitted where the proportion of the cooling load relating to distribution pipework is proven to be less than 1% of total load.
- ii. In order to demonstrate compliance, the heat gains in Table 42 for different pipe sizes and temperatures should not be exceeded.
- iii. Although unrelated to meeting minimum energy efficiency standards in building regulations, provision should also be made for control of condensation by following TIMSA guidance⁴².

c. Hot and cooled ductwork

- i. Ducting should be insulated along its whole length in order to provide the necessary means of limiting heat gains or heat losses.
- ii. The heat losses or gains per unit area should not exceed the values in Table 43. Where ducting may be used for both heating and cooling, the limits for chilled ducting should be adopted since these are more onerous. (Heat gains are shown as negative values.)
- iii. As with pipework, additional insulation may be required to provide adequate condensation control, as detailed in TIMSA guidance.

⁴² TIMSA HVAC Guide for achieving compliance with Part L of the Building Regulations.

Table 41: Maximum permissible heat losses (W/m) for direct hot water and heating pipes

Outside pipe diameter (mm)	Maximum heat loss, W/m			
	Hot water ¹	Low temperature heating ²	Medium temperature heating ³	High temperature heating ⁴
		≤ 95°C	96°C to 120°C	121°C to 150°C
17.2	6.60	8.90	13.34	17.92
21.3	7.13	9.28	13.56	18.32
26.9	7.83	10.06	13.83	18.70
33.7	8.62	11.07	14.39	19.02
42.4	9.72	12.30	15.66	19.25
48.3	10.21	12.94	16.67	20.17
60.3	11.57	14.45	18.25	21.96
76.1	13.09	16.35	20.42	24.21
88.9	14.58	17.91	22.09	25.99
114.3	17.20	20.77	25.31	29.32
139.7	19.65	23.71	28.23	32.47
168.3	22.31	26.89	31.61	36.04
219.1	27.52	32.54	37.66	42.16
273.0 & above	32.40	38.83	43.72	48.48

To ensure compliance with maximum permissible heat loss criteria, insulation thicknesses should be calculated according to BS EN ISO 12241 using standardized assumptions:

¹ Horizontal pipe at 60°C in still air at 15°C
² Horizontal pipe at 75°C in still air at 15°C
³ Horizontal pipe at 100°C in still air at 15°C
⁴ Horizontal pipe at 125°C in still air at 15°C

Table 42: Maximum permissible heat gains for cooled water supplies

Outside diameter of steel pipe on which insulation has been based (mm)	Maximum heat gain, W/m		
	Temperature of contents (°C)		
	>10 ⁵	4.9 to 10.0 ⁶	0 to 4.9 ⁷
17.2	2.48	2.97	3.47
21.3	2,72	3,27	3.81
26.9	3.05	3.58	4.18
33,7	3.41	4.01	4.60
42.4	3.86	4.53	5.11
48.3	4.11	4.82	5.45
60,3	4,78	5,48	6.17
76.1	5.51	6.30	6.70
88.9	6.17	6.90	7.77
114.3	7.28	8.31	9.15
139.7	8.52	9.49	10.45
168.3	9.89	10.97	11.86
219.1	12.27	13.57	14.61
273.0 and above	14.74	16.28	17.48

Note: Thicknesses given are calculated specifically to meet the criteria given in the table. Adopting these thicknesses may not necessarily satisfy other design requirements such as control of condensation. To ensure compliance with maximum permissible heat gain criteria, insulation thicknesses should be calculated according to BS EN ISO 12241 using standardized assumptions:
⁵ Horizontal pipe at 10°C in still air at 25°C
⁶ Horizontal pipe at 5°C in still air at 25°C
⁷ Horizontal pipe at 0°C in still air at 25°C

Table 43: Maximum permissible heat losses and gains for insulated heating, cooling and dual purpose ducts

	Heated duct ⁸	Dual purpose ⁹	Cooled duct ¹⁰
Heat transfer (W/m ²)	16.34	-6.45	-6.45

To ensure compliance with maximum permissible heat transfer criteria, insulation thicknesses should be calculated according to BS EN ISO 12241 using standardized assumptions:
⁸ Horizontal duct at 35°C, with 600 mm vertical sidewall in still air at 15°C
⁹ Horizontal duct at 13°C, with 600 mm vertical sidewall in still air at 25°C
¹⁰ Horizontal duct at 13°C, with 600 mm vertical sidewall in still air at 25°C

Section 12: Wind-powered electricity generating systems

12.1 Introduction

This section gives guidance on specifying wind-powered electricity generating systems for new and existing buildings to meet minimum energy efficiency standards in Building Regulations.

12.2 Scope of guidance

The guidance covers building-integrated wind turbines that require a 3-phase grid connection to operate, and fall under Engineering Recommendation G59 for grid protection⁴³.

The scope is limited to turbines with a Reference Power output of less than 50 kW at 11m/s wind speed.

The *Domestic building services compliance guide* contains guidance for wind turbines that do not require a 3-phase grid connection to operate, and fall under Engineering Recommendation G83.

12.3 Definitions

Reference power means the wind turbine's power output at 11.0 m/s (24.6 mph) to the power curve in BS EN 61400-12-1⁴⁴ and as defined by the BWEA *Small wind turbine performance and safety standard*⁴⁵.

Horizontal axis wind turbine means a wind turbine whose rotor axis is substantially horizontal.

Vertical axis wind turbine means a wind turbine whose rotor axis is vertical.

Rated wind speed means the wind turbine's power output at the wind speed specified by the manufacturer.

Note 1: Specified wind speeds vary with the technology.

Note 2: In the UK, small wind systems with an output of less than 50 kW are rated at a wind speed of 11m/s.

⁴³ Engineering Recommendation G59/1 (ER G59/1) *Recommendations for the connection of embedded generating plant to the Regional Electricity Companies' distribution systems*.

⁴⁴ BS EN 61400-2:2006 *Wind turbines – Part 1: Design requirements*.

⁴⁵ www.bwea.com

Integrated generation means generation directly into the electrical distribution network of a building or site, ie into the wiring on the consumer side of the main fuses. Integrated power generation technologies are usually designed to reduce the building or site's grid power demand. Typically the majority of the energy will be used on site rather than exported back to the grid.

Annual mean wind speed (AMWS) means the yearly average wind speed for the site calculated either from CIBSE test reference year or from the NOABL database. In either case corrections for height and roughness should be applied to the original figure.

Power curve means a manufacturer's published data for instantaneous power output against wind speed.

Annual energy performance (AEP) means a curve or table indicating how a turbine's annual energy yield will vary with the site's Annual Mean Wind Speed. This is not to be confused with the turbine's power curve. The Annual Energy Performance should indicate grid delivered power including inverter losses.

Swept area means the area of a wind turbine perpendicular to the direction of the wind in m². It typically equals πr^2 for a horizontal axis wind turbine (where r is the radius of the circle swept by the turbine blades), and height x diameter for a vertical axis wind turbine.

12.4 Minimum provisions for wind turbines in new and existing buildings

For building-integrated wind energy systems in new and existing buildings, the minimum Annual Energy Performance per m² of swept area of a wind-powered turbine in a 5 m/s Annual Mean Wind Speed should be no worse than 175 kWh/m²/year.

This figure is obtained by dividing the published reference Annual Energy Performance at 5 m/s (measured in accordance with the BWEA *Small wind turbine safety and performance standard*) by the Swept Area of the wind turbine.

12.5 Supplementary information

The NCM calculates the annual electricity produced by the wind turbine and the carbon dioxide emissions displaced by this electricity using the Average Power Density Method. This estimates the amount of electricity produced by the wind turbine knowing the turbine's conversion efficiency and using CIBSE hourly wind speed data to determine the average power density of the wind throughout the year.

Connection to the public network must be in accordance with Engineering Recommendation G59/1.⁴⁶

Wind energy systems should be designed and installed in accordance with BS EN 61400-2:2006.

⁴⁶ G59/1 Recommendations for the connection of generating plant to public electricity suppliers' distribution systems, 1991.

Section 13: Solar photovoltaic systems

13.1 Introduction

This section gives guidance on specifying building-integrated photovoltaic (PV) systems for new and existing buildings to meet minimum energy efficiency standards in building regulations.

13.2 Scope of guidance

The guidance in this section covers solar photovoltaic systems with an electrical output of more than 5 kW_e.

Guidance for solar photovoltaic systems with an electrical output of less than 5 kW_e is contained in the *Domestic building services compliance guide*.

13.3 Definitions

Photovoltaic cell means a semiconductor device that converts light to electricity using the photovoltaic effect.

Photovoltaic module means the smallest complete, environmentally protected assembly of interconnected photovoltaic cells.

13.4 Minimum provisions for solar photovoltaic systems in new and existing buildings

To meet minimum energy efficiency standards in building regulations, solar photovoltaic systems in new and existing buildings should have a conversion efficiency which is no worse than in Table 45.

Table 45: Minimum conversion efficiencies of solar PV modules in new and existing buildings

PV module type	Minimum conversion efficiency, %
Monocrystalline silicon	15
Polycrystalline	12
Thin-film – amorphous silicon	6
Thin-film – cadmium telluride	8
Thin-film – copper indium diselenide	8

13.5 Calculating CO₂ emissions from photovoltaic modules

In calculating the total CO₂ emissions from a proposed new building to show compliance with building regulations, the following data should be entered into accredited NCM tools such as SBEM:

- a. the type of the photovoltaic module. Each technology has associated with it a conversion efficiency;
- b. the area in m² of the photovoltaic modules, excluding the supporting construction;
- c. the orientation of the PV modules;
- d. the inclination of the PV modules in degrees from the horizontal.

From these parameters, the NCM tool will calculate the annual electricity produced by the photovoltaic modules (Q_{PV}) and the CO₂ emissions displaced by this system.

The annual electricity produced by the photovoltaic modules (Q_{PV}) is:

$$Q_{PV} = I \cdot K_E \cdot (1 - K_S) \cdot A \text{ kWh}$$

where:

I = the global solar radiation at the module surface, kWh/m²

K_E = the module efficiency of conversion, %

K_S = the system losses, %

A = area of the photovoltaic modules, excluding the supporting construction, m².

The CO₂ emission displaced by the electricity (C_{WT}) generated by the photovoltaic modules is:

$$C_{PV} = Q_{PV} \cdot C_D$$

where:

C_D = the amount of CO₂ displaced by each unit of electricity produced by the photovoltaic modules, kgCO₂.

For detailed information on the calculation method, refer to *A Technical Manual for SBEM*⁴⁷ (or other accredited NCM model technical manuals).

⁴⁷ Available for download from www.2010ncm.bre.co.uk

13.6 Supplementary information

The methodology to calculate the electricity generated by a photovoltaic system is given in BS EN 115316-4-6:2007.⁴⁸

The performance calculation method given in “Low and zero carbon energy sources: Strategic guide”⁴⁹ should be used to calculate the potential of PV systems to contribute towards lowering the carbon dioxide emissions of a building.

Connection to the public network must be in accordance with Engineering Recommendation G59/1⁵⁰

Solar PV systems should be designed and installed in accordance with the DTI guide.⁵¹

⁴⁸ BS EN 115316-4-6:2007 *Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Heat generation systems, photovoltaic system.*

⁴⁹ *Low and zero carbon energy sources: Strategic guide*, CLG, May 2006.

⁵⁰ *G59/1 Recommendations for the connection of generating plant to public electricity suppliers' distribution systems*, 1991.

⁵¹ *Photovoltaics in buildings – Guide to the installation of PV systems*, DTI 2nd Edition 2006.

Section 14: Lighting

14.1 Introduction

This section provides guidance on specifying lighting for new and existing buildings to meet minimum energy efficiency standards in building regulations.

14.2 Scope of guidance

The guidance in this section applies to the following types of lighting:

- general interior lighting;
- display lighting.

14.3 Definitions

Office area means a space that involves predominantly desk-based tasks, eg a classroom, seminar or conference room.

Daylit space means any space:

- a. within 6 m of a window wall, provided that the glazing area is at least 20% of the internal area of the window wall; or
- b. below rooflights provided that the glazing area is at least 10% of the floor area.

The normal light transmittance of the glazing should be at least 70%; if the light transmittance is below 70%, the glazing area should be increased proportionately for the space to be defined as daylit.

Space classification for control purposes⁵²:

Owned space means a space such as a small room for one or two people who control the lighting, eg a cellular office or consulting room.

Shared space means a multi-occupied area, eg an open-plan office or factory production area.

Temporarily owned space means a space where people are expected to operate the lighting controls while they are there, eg a hotel room or meeting room.

⁵² These definitions are given in more detail in BRE Information Paper IP6/96 *People and lighting controls* and BRE Digest 498 *Selecting lighting controls*.

Occasionally visited space means a space where people generally stay for a relatively short period of time when they visit the space, eg a storeroom or toilet.

Unowned space means a space where individual users require lighting but are not expected to operate the lighting controls, eg a corridor or atrium.

Managed space means a space where lighting is under the control of a responsible person, eg a hotel lounge, restaurant or shop.

Local manual switching means, in local or flexible manual switching, the distance on plan from any local switch to the luminaire it controls should generally be not more than six metres, or twice the height of the light fitting above the floor if this is greater. Where the space is a daylit space served by side windows, the perimeter row of lighting should in general be separately switched.

Photoelectric control is a type of control which switches or dims lighting in response to the amount of incoming daylight.

Presence detection is a type of control which switches the lighting on when someone enters a space, and switches it off, or dims it down, after the space becomes unoccupied.

Absence detection is a type of control which switches the lighting off, or dims it down, after the space becomes unoccupied, but where switching on is done manually.

Lamp lumens means the sum of the average initial (100 hour) lumen output of all the lamps in the luminaire.

Circuit-watt is the power consumed in lighting circuits by lamps and, where applicable, their associated control gear (including transformers and drivers) and power factor correction equipment.

Lamp lumens per circuit-watt is the total lamp lumens summed for all luminaires in the relevant areas of the building, divided by the total circuit-watts for all the luminaires.

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

Luminaire lumens per circuit-watt is the (lamp lumens x LOR) summed for all luminaires in the relevant areas of the building, divided by the total circuit-watts for all the luminaires.

14.4 Minimum provisions for lighting in new and existing buildings

- a. Lighting in new buildings should meet the minimum standards for efficacy (averaged over the whole area of the applicable type of space in the building) in Table 46.
- b. Lighting in existing buildings should meet the minimum standards for efficacy (averaged over the whole area of the applicable type of space in the building) in Table 47.
- c. Metering of lighting for new and existing buildings (to record the lighting energy consumption) should meet the minimum standards in Table 49.
- d. Lighting controls in new and existing buildings should meet the minimum standards in Table 50, or follow the guidance in BRE Digest 498 *Selecting lighting controls*. Display lighting, where provided, should be controlled on dedicated circuits that can be switched off at times when people will not be inspecting exhibits or merchandise or being entertained.

Table 46: Minimum lighting efficacy in new buildings

Lighting type	Minimum lighting efficacy, %
General lighting in office, industrial and storage areas	The average initial efficacy should be not less than 55 luminaire lumens per circuit-watt.
General lighting in other types of space	The average initial efficacy should be not less than 55 lamp lumens per circuit-watt.
Display lighting	The average initial efficacy should be not less than 22 lamp lumens per circuit-watt.

Table 47: Minimum lighting efficacy in existing buildings

Lighting type	Minimum lighting efficacy, %
General lighting in office, industrial and storage areas	The average initial efficacy should be not less than 55 luminaire lumens per circuit-watt. In calculating the average luminaire lumens per circuit-watt, the circuit-watts for each luminaire may first be multiplied by the control factors in Table 48.
General lighting in other types of space	The average initial efficacy should be not less than 55 lamp lumens per circuit-watt.
Display lighting	The average initial efficacy should be not less than 22 lamp lumens per circuit-watt.

Table 48: Luminaire control factors for use in existing buildings

Light output control	Control Factor
c. The luminaire is in a daylit space and its light output is controlled by photoelectric switching or dimming control, with or without override.	0.9
d. The luminaire is in a space that is likely to be unoccupied for a significant number of operating hours, and where a sensor switches off the lighting in the absence of occupants but switching on is done manually except where this would be unsafe.	0.9
e. Circumstances a and b combined.	0.85
f. None of the above.	1.0

Table 49: Minimum provisions for metering of general and display lighting in new and existing buildings

	Minimum provision
Metering for general or display lighting	<ul style="list-style-type: none"> a. kWh meters on dedicated lighting circuits in the electrical distribution; or b. local power meter coupled to or integrated in the lighting controllers of a lighting or building management system; or c. a lighting management system that can calculate the consumed energy and make this information available to a building management system or in an exportable file format. (This could involve logging the hours run and the dimming level, and relating this to the installed load.)

Table 50: Controls for general and display lighting in new and existing buildings

Space classification ⁵³	Control type
Owned	Manual by door.
Shared	Flexible manual switching, eg local pull cords or wireless transmitter.
Temporarily owned	Local manual.
Occasionally visited	Presence or absence detection.
Unowned	<ul style="list-style-type: none"> a. Time switching; or b. presence or absence detection; or c. photoelectric switching or dimming (if daylit space).
Managed	<ul style="list-style-type: none"> a. Time switching; or b. centralised manual; or c. photoelectric switching or dimming (if daylit space).

⁵³ The definitions are given in BRE Information Paper IP6/96 and BRE Digest 498.

Section 15: Heating system glandless circulators and water pumps

15.1 Introduction

Hot water glandless circulators and water pumps as part of the HVAC system of non-domestic buildings operate for extensive periods and can be responsible for considerable energy use.

This section provides guidance on specifying circulators and water pumps for new and existing buildings to limit their energy consumption and meet minimum energy efficiency standards in building regulations.

15.2 Scope of guidance

This section covers heating system glandless circulators and water pumps when used in closed systems. The guidance does not apply to circulators integrated within the boiler housing.

15.3 Definitions

Heating system glandless circulator means a circulator is a pump used to circulate hot water in closed circuit heating systems. The glandless (or wet rotor) circulator is a centrifugal pump with an integral motor and no mechanical seal. It can have an integrated motor drive unit for variable speed operation.

Water pump (also known as “dry rotor” or “direct coupled” pump) means a centrifugal pump driven by an electric motor and generally having mechanical seals. Common pump types include in-line, end suction and vertical multistage. The first two are usually single stage pumps having single entry volute. By design they can all be used as circulators for all HVAC applications depending on configuration and duty.

15.4 Minimum provisions for glandless circulators and water pumps in new and existing buildings

For heating system glandless circulators and water pumps in new and existing buildings, the minimum provisions in Table 51 should be adopted.

Table 51: Minimum provisions for heating system glandless circulators and water pumps in new and existing buildings**Minimum provisions**

- a. When used in heating systems, all glandless circulators up to 2.5 kW should be labelled under the Europump Labelling Scheme and should have a minimum rating of Band C.
- b. Variable speed glandless circulators should be used on variable volume systems.
- c. If a water pump is used on a closed loop circuit and the motor is rated at more than 750 W, then it should be fitted with or controlled by an appropriate variable speed controller on any variable volume system. On water pump booster sets with an open loop circuit, the static head should be checked before an appropriate variable speed controller is used.

15.5 Supplementary information

Further information and guidance is available from www.bpma.org.uk where a list of approved glandless circulators and water pumps can be found.

Section 16: Compliance Checklist and data for input into National Calculation Methodology tool

The Compliance Checklist in Appendix 2 is a spreadsheet which summarises the key criteria for assessing compliance with minimum energy efficiency standards for building services required by building regulations. This consultation version of the checklist covers heating, hot water, cooling and air distribution systems within the scope of this guide. The checklist does not currently cover insulation for pipes and ducts, biomass boilers, lighting, wind turbines or photovoltaic panels, which are also within the scope of this guide.

The Compliance Checklist can be used:

- by building control officers as a simple means of checking for compliance with minimum requirements in building regulations;
- by users of accredited National Calculation Methodology tools to determine the correct building services parameters to be entered. As it is not possible to cover all possible accredited NCM tools, this compliance checklist focuses on the data required by SBEM⁵⁴.

Data required by other NCM tools are identified in the relevant sections of this guide.

16.1 How to use the Compliance Checklist

It is important for designers to consult all relevant sections of this guide as using the Compliance Checklist alone will not give a full appreciation of the minimum requirements for compliance with building regulations.

The checklist is divided into six columns:

Column 1: Technology

This column lists all the space heating systems for primary heating, DHW systems, cooling and air distribution systems covered by this guide.

Column 2: Efficiency check

This column shows the minimum acceptable efficiency for each type of heating or cooling system and the maximum permissible specific fan power for air distribution systems. These minimum (or for fans, maximum) acceptable efficiency values are designated Value A1 to Value A11. The actual design values can be entered in the adjacent sub-column – the design values are designated Value B1 to Value B11. The final sub-column is to record that the appropriate check has been made.

⁵⁴ www.2010ncm.bre.co.uk

Column 3: Minimum Controls Package check

This column displays all the control measures which should be specified as part of the Minimum Controls Package. An entry can be made in the adjacent sub-column to indicate that the check has been made.

Column 4: Additional Controls – Heating Efficiency Credits check

This column shows all the measures that are additional to the Minimum Controls Package, for which Heating Efficiency Credits can be gained. The values assigned to each additional measure can be checked and summed to obtain the Total Heating Efficiency Credits. The values for the Total Heating Efficiency Credits are designated Value C2 to Value C5, and C7 to C8.

Note that Heating Efficiency Credits are not defined for all types of technologies. In some cases it may be acceptable for Values C2 or C3, C4 etc to be zero. This would be the case if the value of the Heat Generator Seasonal Efficiency meets or exceeds the minimum acceptable Effective Heat Generating Seasonal Efficiency as defined in the relevant section of this guide.

Column 5: Summary compliance check

This column describes the key compliance requirements and prompts the user for additional checks where these are not already covered in Columns 2, 3 and 4.

Column 6: Data for input to SBEM check

This column indicates the efficiency value that should be entered into SBEM. It also indicates the name of the field in SBEM in which the value should be entered.

Note that the Compliance Checklist only covers data required by SBEM for building services covered in this guide.

Appendix 1: Conversion factors

The conversion factors in Table 1 can be used to convert efficiencies based on calorific value from net to gross and gross to net:

- to convert from net efficiency to gross, multiply by the factor for the appropriate fuel. As an example take a boiler at 80% net efficiency firing LPG. To convert to gross = $80 \times 0.921 = 73.68\%$;
- to convert from gross efficiency to net, divide by the factor for the appropriate fuel. As an example take a boiler at 73.68% gross efficiency firing LPG. To convert to net = $73.68 \div 0.921 = 80.0\%$.

Table 1: Factors for converting efficiencies⁵⁵

Fuel type	Conversion factor
Natural Gas	0.901
Liquefied Petroleum Gas (LPG)	0.921
Oil	0.937

⁵⁵ Conversion factors are derived from *The Government's Standard Assessment Procedure for Energy Rating of Dwellings* 2009 edition (Table E3 in Appendix E).

Appendix 2: Compliance Checklist

Note: The Compliance Checklist in Appendix 2 of the May 2006 edition of the *Non-domestic heating, cooling and ventilation compliance guide* will be updated for 2010 and inserted here.

Proposals for amending Part L and Part F of the Building Regulations – Consultation consists of three volumes:

Volume 1: Proposals for amending Part L and Part F of the Building Regulations Consultation

Volume 2: Proposed technical guidance for Part L

Volume 2: Proposed technical guidance for Part F

Volumes should not be despatched separately

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