

Building Regulations (Northern Ireland) 2011

Proposed Guidance Edition

of

Technical Booklet F1

**Conservation of fuel and power
in dwellings**

Draft for Consultation

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Introduction

Technical Booklets

Purpose of the Technical Booklets

This Technical Booklet is one of a series that has been prepared by the Department of Finance and Personnel (the Department) for the purpose of providing practical guidance with respect to the technical requirements of the Building Regulations (Northern Ireland) 20xx (the Building Regulations).

Technical Booklets give practical guidance for most of the more common building situations. If this guidance is followed there will be a presumption of compliance with the requirements of the Building Regulations covered by the guidance. However, this presumption can be overturned, so simply following guidance does not guarantee compliance. For example, if one particular case is unusual in some way, then 'normal' guidance may not be applicable. It is also important to note that there may be alternative ways of achieving compliance with the relevant requirements. There is therefore no obligation to follow the methods or comply with the standards set out in a Technical Booklet if you prefer to meet the requirements in some other way.

This Technical Booklet

Requirements

The guidance contained in this Technical Booklet relates only to the requirements of regulations F2, F3, F4, F5, F6, F7, F8, F9 and F10. The work will also have to comply with all other requirements of the relevant Building Regulations.

British Standards and European Technical Specifications

The Building Regulations are made for the following specific purposes: securing the health, safety, welfare and convenience of people; furthering the conservation of fuel and power; furthering the protection and enhancement of the environment; and promoting sustainable development. Standards and technical approvals are relevant guidance to the extent that they relate to these purposes. However, they may also address other aspects of performance such as serviceability, or aspects which although they relate to health and safety are not covered by the Building Regulations.

In this introduction and throughout this Technical Booklet any reference to a British Standard shall be construed as a reference to –

- (a) a British Standard or British Standard Code of Practice;
- (b) a harmonised standard or other relevant standard of a national standards body of any Member State of the European Economic Area;
- (c) an international standard recognised for use in any Member State of the European Economic Area;

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- (d) any appropriate, traditional procedure of manufacture of a Member State of the European Economic Area which has a technical description sufficiently detailed to permit an assessment of the goods or materials for the use specified; or
- (e) a European Technical Approval issued in accordance with the Construction Products Directive,

provided that the proposed standard, code of practice, specification, technical description or European Technical Approval provides, in use, equivalent levels of safety, suitability and fitness for purpose as that provided by the British Standard.

The Department intends from time to time to review the guidance in its Technical Booklets to reflect emerging European harmonised 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 co-existence period the national standard will be withdrawn.

Products conforming with a European Council Directive

Any product designed and manufactured to comply with the requirements of a European Council Directive does not have to comply with any other standard or part of a standard, whether British, International or other, which relates to the same characteristic or specific purpose as the EC Directive.

CE marked construction products

Any construction product (within the meaning of the Construction Products Directive) which bears a CE marking shall be treated as if it satisfied the requirements of any appropriate British Standard, British Standard Code of Practice or British Board of Agrément Certificate relating to such a product, where the CE marking relates to the same characteristic or specific purpose as the Standard, Code of Practice or Certificate.

(It is the intention of the Department to review this Introduction to recognize the implementation of new arrangements regarding construction products and CE marking under Regulation (EU) No 305/2011 which will come fully into effect on 1 July 2013.)

Named standards

Where this Technical Booklet makes reference to a named standard, the relevant version of the standard is the one listed in Appendix D. However, if this version has been replaced or updated by the issuing standards body, the new version may be used as a source of guidance provided that it continues to address the relevant requirements of the Building Regulations.

Materials and workmanship

Any work to which a requirement of the Building Regulations applies must, in accordance with Part B of the Building Regulations, be carried out with suitable materials and in a workmanlike manner. You will find guidance in relation to this in Technical Booklet B (Materials and workmanship).

Interaction with other legislation

The Workplace (Health, Safety and Welfare) Regulations (Northern Ireland) 1993

The Workplace (Health, Safety and Welfare) Regulations (Northern Ireland) 1993 (the Workplace Regulations) contain some requirements which affect building design. The main requirements are now covered by the Building Regulations, but for further information see – The Workplace Regulations and the *Workplace Health, Safety and Welfare Approved Code of Practice*.

The Workplace Regulations 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. Where the requirements of the Building Regulations that are covered by this Part do not apply to dwellings, the provisions may still be required in the situations described above in order to satisfy the Workplace Regulations.

The Energy Performance of Buildings Directive

Part F implements Articles 3 to 6 of Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings.

Part F Regulations

It should be noted that the following regulations are the requirements of Part F of the Building Regulations (Northern Ireland) 20xx. All parts of the regulations should be read in conjunction with Part A: “Interpretation and general” of those regulations.

PART F

Conservation of fuel and power

F1 Application and interpretation

(1) This Part shall apply to any building in which energy is used to condition the indoor climate and, where a building contains one or more dwellings, to each dwelling separately.

(2) Regulation F3 shall only apply to—

- (a) the erection of a building; and
- (b) the extension of a building other than a dwelling, where the extension has a total useful floor area that is both—
 - (i) greater than 100 m²; and
 - (ii) greater than 25% of the total useful floor area of the existing building.

(3) In this Part—

CHANGE OF ENERGY STATUS means any change which results in a building becoming a building to which this Part applies where previously it was not;

NATIONAL CALCULATION METHODOLOGY means—

- (a) in relation to a dwelling, the Government’s Standard Assessment Procedure (SAP) for Energy Rating of Dwellings: 2009 edition; and
- (b) in relation to a building other than a dwelling—
 - (i) the Simplified Building Energy Model (SBEM): 2010 edition; or
 - (ii) a Dynamic Simulation Model (DSM),

that is implemented with Government approved software.

PIPES, DUCTS AND VESSELS means any pipe, any duct and any vessel in a space heating or space cooling system that is intended to carry a heated or chilled liquid or gas and includes any associated fittings;

RENOVATION OF A THERMAL ELEMENT means the provision of a new layer to a thermal element or the replacement of an existing layer but does not include thin decorative surface finishes;

SPACE COOLING SYSTEM does not include a system or that part of a system which cools or stores water solely for a commercial or industrial process;

SPACE HEATING SYSTEM does not include a system or that part of a system which heats or stores water solely for a commercial or industrial process;

TARGET CARBON DIOXIDE EMISSIONS RATE means the rate of carbon dioxide emissions measured in kilograms of carbon dioxide per square metre of floor area per year.

THERMAL ELEMENT means a wall, floor or roof (but does not include windows, doors, roof windows or rooflights) which separates a thermally 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) thermally unconditioned;
 - (ii) an extension falling within class 8 of Schedule 2; or
 - (iii) in the case of a building other than a dwelling, 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; and

TOTAL USEFUL FLOOR AREA means the total area of all enclosed spaces measured to the inside face of the external walls, that is, the gross floor area, and in the case of sloping surfaces such as staircases, galleries, raked auditoria and tiered terraces shall be taken as their area on plan but shall exclude areas that are not enclosed such as open floors, covered ways and balconies.

F2 Conservation measures

Reasonable provision shall be made for the conservation of fuel and power in any building 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;
- (b) providing energy efficient fixed building services with effective controls; and
- (c) commissioning the fixed building services.

F3 Target carbon dioxide emissions rate

(1) Without prejudice to the requirements of regulation F2, where a building is to be erected or extended as described in regulation F1(2)(b), a target carbon dioxide emissions rate for that building shall be calculated using a National Calculation Methodology.

(2) The building shall be so designed and constructed as not to exceed its calculated target carbon dioxide emissions rate.

F4 Consequential improvements

Where it is proposed to execute building work in relation to any existing building with a total useful floor area greater than 1000 m² and that work consists of or includes—

- (a) an extension; or
- (b) the initial provision of any fixed building service; or
- (c) an increase in the capacity of any fixed building service,

consequential improvements to the existing building shall be carried out to ensure that the building complies with the requirements of regulation F2 so far as this is technically, functionally and economically feasible.

F5 Change of energy status

Where there is a change of energy status such work shall be carried out as is necessary to ensure that the building complies with the requirements of regulation F2(a)(i).

F6 Renovation of thermal elements

Where a thermal element is renovated such work shall be carried out as is necessary to ensure that the whole thermal element complies with the requirements of regulation F2(a)(i).

F7 Notice of air pressure test

Where an air pressure test is undertaken for the purposes of demonstrating compliance with regulation F3(2), the person carrying out the work shall give to the district council, not more than 5 days after completion of the testing, a notice in writing confirming the result of the air pressure test.

F8 Notice of commissioning

The person carrying out the work shall give to the district council and to the owner of the building, not more than 5 days after completion of the commissioning, a notice in writing confirming that the fixed building services have been satisfactorily commissioned.

F9 Notice of emissions rate

Where a calculation is carried out for the purposes of demonstrating compliance with regulation F3(2), the person carrying out the work shall give to the district council, not more than 5 days after completion, a notice in writing that gives—

- (a) the target carbon dioxide emissions rate for the building;
- (b) the calculated carbon dioxide emissions rate for the building as constructed; and
- (c) the list of specifications to which the building is constructed and which are critical to achieving compliance, where these differ from the design specifications.

F10 Provision of information

The person carrying out the work shall, not more than 5 days after completion—

- (a) give the building owner sufficient information about the building, its fixed building services and their maintenance requirements so that the building can be operated and maintained to conserve fuel and power; and
- (b) notify the district council in writing that the requirements of (a) above have been met.

Guidance Performance

Regulation F2 Conservation measures

- 0.1 Reasonable provisions should be made for the conservation of fuel and power in any building by limiting heat gains and losses through thermal elements and other parts of the building fabric and from pipes, ducts and vessels used for space heating, space cooling and hot water services.

Energy efficient fixed building services should be provided with controls to allow efficient operation and these services should be effectively commissioned.

Regulation F3 Target carbon dioxide Emissions Rate

- 0.2 To comply with Articles 3 and 4 of Directive 2002/91/EC of the European Parliament and of the Council energy performance requirements for new buildings should be set and should be calculated by a methodology that complies with a general framework set out in that Directive.

Using a National Calculation Methodology, the building should be designed and constructed so as not to exceed its target carbon dioxide emissions rate.

Regulation F4 Consequential improvements

- 0.3 Where an existing building greater than 1000 m² is extended or has new building services installed for the first time or there is an increase in the capacity of building services, consequential improvements to the existing building may be required to improve the building's conservation of fuel and power (so long as these improvements are technically, functionally and economically feasible).

Regulation F5 Change of energy status

- 0.4 Where a building, or part of a building, is no longer exempt from Part F, this is a change of energy status. Work may be required to ensure that the thermal envelope of the building is sufficiently insulated, or compensating measures provided.

Regulation F6 Renovation of thermal elements

- 0.5 Where a thermal element is renovated (by adding a new layer or replacing an existing layer) additional insulation may be required.

Regulation F7 Notice of air pressure test

- 0.6 The person carrying out the work shall give the results of any air pressure test to the district council not more than 5 days after completion of the testing. These test results are provided as evidence in support of the calculation of the building's carbon dioxide emissions.

Regulation F8 Notice of commissioning

- 0.7 Not more than 5 days after completion of the commissioning, the person carrying out the work shall provide written confirmation to the district council and the owner of the building that the fixed building services have been satisfactorily commissioned.

Regulation F9 Notice of emissions rate

- 0.8 In a new building (or large extension to a building other than a dwelling), not more than 5 days after completion, the person carrying out the work shall give to the district council the following output from the National Calculation Methodology software –
- (a) the target carbon dioxide emissions rate for the building;
 - (b) the calculated carbon dioxide emissions rate for the building as constructed; and
 - (c) the list of specifications to which the building is constructed and which are critical to achieving compliance, where these differ from the design specifications.

Regulation F10 Provision of information

- 0.9 Not more than 5 days after completion, the person carrying out the work shall give the building owner sufficient information about the building, its fixed building services and their maintenance requirements so that the building can be operated and maintained to conserve fuel and power; they shall also notify the district council in writing that these requirements have been met.

Section 1 General

Definitions

1.1 Any reference to a building includes a reference to part of a building.

1.2 In this Technical Booklet the following definitions apply –

Air permeability – the air leakage rate in cubic metres per hour per square metre of envelope area $\{m^3/(h.m^2)\}$ at a pressure difference of 50 Pascals.

Change of energy status – any change which results in a building becoming a building to which this Part applies where previously it was not.

Commissioning – 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 that 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, the recording of the system settings and the performance test results that have been accepted as satisfactory.

Conservatory – a part or extension of a building attached to and having a door giving access from the attached building and having not less than three-quarters of the area of its roof and not less than one-half of the area of its external walls made of translucent material.

Controlled service or fitting – any service or fitting to which the Building Regulations apply.

DER – the Dwelling carbon dioxide Emissions Rate measured in kilograms of carbon dioxide per square metre of floor area per year.

Design air permeability – the value for air permeability selected by the designer to calculate the DER or BER before commencement of work.

Dwelling – a house, flat or maisonette and includes any accommodation therein of not more than 50 m² in total floor area, forming part of the dwelling and used by a resident of the dwelling for the purposes of any business, profession or calling.

Note: buildings exclusively containing rooms for residential purposes (see definition) are not dwellings, and Technical Booklet F2 applies to them.

Dwelling type – for the purposes of air tightness testing, is the allocation of each dwelling on a development to a generic dwelling type by the person carrying out the air tightness testing. To be classed as of the same dwelling type the dwelling should comply with all of the following –

- (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;
- (v) have the same principal construction details (as identified by Accredited Construction Details or bespoke construction detail reference codes);
- (vi) have a similar (+/-1) total number of significant penetrations, (i.e. windows, doors, flues/chimneys, supply/exhaust terminals and waste water pipes); and
- (vii) have envelope areas that do not differ by more than 10%.

Envelope area – the total area of all wall, floor and ceiling elements that enclose the internal volume subject to an air permeability test. This includes walls and floors below external ground level. Overall internal dimensions are used to calculate this area. No subtractions are made for the area at junctions of internal elements (partitions and intermediate floors) with external elements (exterior walls, floors and ceilings).

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

Fixed building service – 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.

Low or zero carbon energy sources – include biofuels, heat pumps, micro-hydro, photovoltaics, solar hot water and wind power.

Material change of use – has the meaning assigned to it in Part A of the Building Regulations.

National Calculation Methodology – (NCM) means –

- (a) in relation to a dwelling, the Government's Standard Assessment Procedure (SAP) for Energy Rating of Dwellings: 2009 edition; and
- (b) in relation to a building other than a dwelling –
 - (i) the Simplified Building Energy Model (SBEM): 2010 edition; or
 - (ii) a Dynamic Simulation Model (DSM),

that is implemented with Government approved software.

Porch – a single storey enclosure providing protection to an access door to a building.

Provision of a service or a fitting – in relation to any building includes the installation of any service or fitting to which these regulations apply or the alteration or the extension of any such service or fitting.

Renovation of a thermal element – means the provision of a new layer to a thermal element or the replacement of an existing layer but does not include thin decorative surface finishes.

Room for residential purposes – a room, or a suite of rooms, which is not a dwelling-house, flat or maisonette and which is used by one or more persons to live and sleep and includes a room in a hostel, a 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.

Note: for the purposes of this definition, a “cluster” is a group of rooms for residential purposes which is not designed to be occupied by a single household and which is separated from the rest of the building in which it is situated by a door which is designed to be locked.

SAP – the Government’s Standard Assessment Procedure for Energy Rating of Dwellings: 2009 edition.

SBEM – the Simplified Building Energy Model (the National Calculation Methodology for buildings other than dwellings): 2010 edition.

Simple payback – the number of years 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, for example, 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 given to the district council and be confirmed in a report signed by a suitably qualified person;
- (c) the annual energy savings should be estimated using an approved energy calculation tool; and
- (d) for the purposes of this Technical Booklet, the energy prices that are current at the time of the application to the district council should be used when evaluating the annual energy savings. Current energy prices can be obtained from the Department of Energy and Climate Change (DECC) website <http://www.decc.gov.uk/en/content/cms/statistics/publications/prices/prices.aspx> .

Space cooling system – does not include a system or that part of a system which cools or stores water solely for a commercial or industrial process;

Space heating system – does not include a system or that part of a system which heats or stores water for a commercial or industrial process;

TER – the rate of carbon dioxide emissions measured in kilograms of carbon dioxide per square metre of floor area per year.

Thermal element – a wall, floor or roof (but does not include windows, doors, roof windows or rooflights) which separates a thermally conditioned space from –

- (a) the external environment including the ground; and
- (b) in the case of floors and walls, another part of the building which is –
 - (i) thermally unconditioned;
 - (ii) an extension falling within class 8 of Schedule 2 [of the Building Regulations]; or
 - (iii) in the case of a building other than a dwelling, 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.

Thermal separation – any wall, floor, window or door that is intended to reduce heat loss from a heated part of a building into another part of the building designed to be unheated or only occasionally heated. The thermal separation should have U-values and airtightness provisions of at least the same standard as the building's thermal envelope.

Total useful floor area – the total area of all enclosed spaces measured to the inside face of the external walls, that is, the gross floor area, and in the case of sloping surfaces such as staircases, galleries, raked auditoria and tiered terraces shall be taken as their area on plan but shall exclude areas that are not enclosed such as open floors, covered ways and balconies.

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

General rules

Area of elements

- 1.3 The area of a building element is that of its internal surface measured between the finished internal faces of the enclosing fabric of the building and, in the case of a roof, is measured in the plane of the ceiling. The area includes the areas where internal elements abut the internal surface of the wall, floor or roof.

Area of windows, doors and rooflights

- 1.4 The area of window, door and rooflight openings in a wall or roof is measured internally between reveals and from head to sill.

Service openings in walls and roofs

- 1.5 An opening in a wall to accommodate building services, such as a waste pipe or ventilator, should be regarded as part of the wall and assumed to have the same U-value as the wall.
- 1.6 An opening in a roof to accommodate building services, such as a flue pipe or passive stack ventilator, should be regarded as part of the roof and assumed to have the same U-value as the roof.

Technical risks

- 1.7 Building work should satisfy all of the requirements of the Building Regulations, however the requirements of Part C (Site preparation and resistance to contaminants and moisture), Part G (Resistance to the passage of sound), Part K (Ventilation) and Part L (Combustion appliances and fuel storage systems) are particularly interrelated in the whole building approach adopted by this Part.
- 1.8 The incorrect application of energy efficiency measures can cause technical problems such as an increased risk of rain penetration or interstitial condensation. Measures to avoid the risks that might arise are given in BRE Report BR 262: *Thermal insulation: avoiding risks*.

Calculation of U-values

- 1.9 U-values should be calculated in accordance with the methods and conventions given in BRE's BR 443: *Conventions for U-value calculations* except where stated otherwise.

Use of England & Wales documents

- 1.10 Where the *Domestic building services compliance guide* refers to Part L (Conservation of fuel and power) of the building regulations for England & Wales and associated Approved Documents L1A and L1B, it should be read as referring to the corresponding references in Part F (Conservation of fuel and power) of the Building Regulations (Northern Ireland) 20xx and this Technical Booklet.

Section 2 New dwellings

GENERAL

- 2.1 This Section gives the methodology and limiting values used by the national calculation software (SAP) to calculate the Target carbon dioxide Emissions Rate (TER) and Dwelling carbon dioxide Emissions Rate (DER). In practice, designers are unlikely to find it necessary to refer to all of this Section as the calculation software will automatically calculate the TER and DER when the details of a dwelling are input into the SAP software. The SAP software will automatically flag out-of-range values and check that the DER is no greater than the TER as designed.
- 2.2 On completion of the dwelling, details of the dwelling as built should be re-entered into the software to confirm that the DER for the dwelling as built is no greater than the TER.
- 2.3 Whilst the software covers the calculation aspects of compliance it will still be necessary to demonstrate that Criteria 2 to 5 in this Section are met.

Types of work covered by this Section

- 2.4 This Section provides guidance for the erection of a new dwelling.
- 2.5 Buildings containing rooms for residential purposes, such as a nursing home, student accommodation and similar are not considered, for the purposes of Part F, as dwellings and, in such cases, the provisions in Technical Booklet F2 apply.
- 2.6 Where a building contains living accommodation and also contains space to be used for professional, industrial or commercial purposes (e.g. a doctor's surgery, a workshop or office), the whole building should be treated as a dwelling if the business part could revert to domestic use.

Consequently it should be designed and constructed in accordance with the provisions in this *Technical Booklet*.

This would be the case where all of the following apply –

- (a) there is direct access between the living accommodation and the business part;
- (b) both are contained within the same thermal envelope; and
- (c) the living accommodation occupies the greater proportion of the total floor area of the building.

Sub-paragraph (c) means that a small flat for a manager 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.

- 2.7 When constructing a dwelling as part of a larger building that contains other types of accommodation, this Technical Booklet applies solely to the dwelling. Technical Booklet F2 applies to the non-dwelling parts of the

building such as heated common areas and, in the case of mixed-use developments, the commercial or retail space.

Areas requiring specific consideration

Common areas in buildings with multiple dwellings

- 2.8 The common areas of buildings containing multiple dwellings are not classified as dwellings. These common areas should –
- (a) where they are not heated, comply with the fabric standard provisions of paragraphs 2.31 to 2.33; and
 - (b) where they are heated, comply with the provisions of Technical Booklet F2.

Conservatories and similar highly glazed spaces

- 2.9 Where a new dwelling incorporates a conservatory or similar highly glazed space which does not have thermal separation from the rest of the dwelling, it should be regarded as an integral part of the dwelling and be included in the calculation of the TER and DER and in the air pressure test.
- 2.10 Where a conservatory, constructed as part of a new dwelling, has thermal separation from the dwelling, the TER and DER for the dwelling may be calculated as if the conservatory is not present and the air pressure test should not include this space. However, irrespective of the conservatory being ignored for the purposes of calculating the TER and DER, where the conservatory is heated or cooled by a fixed building service, it should have –
- (a) controlled fittings that comply with the guidance in paragraphs 3.41 to 3.47;
 - (b) thermal elements that comply with the guidance in paragraphs 3.50 and 3.54;
 - (c) where fixed building services are provided these should comply with the guidance in paragraphs 3.29 to 3.40; and
 - (d) where the conservatory or similar highly glazed space is heated, independent temperature and on/off controls.

Swimming pool basins

- 2.11 Where a swimming pool basin is constructed as part of a new dwelling, provisions should be made to limit the heat loss from the pool basin by achieving a U-value of not more than $0.25 \text{ W}/(\text{m}^2\text{K})$, calculated in accordance with BS EN ISO 13370.
- 2.12 When assessing the dwelling under Criterion 1, the dwelling should be assessed as if the pool basin was not there, but the room enclosing the swimming pool should be included in the TER/DER calculations. The area covered by the pool should be assumed to have the same U-value as the pool surround.

Target carbon dioxide emissions rate (TER)

2.13 The Target carbon dioxide Emissions Rate (TER) is the minimum acceptable energy performance for a new dwelling. It is expressed in terms of the mass of carbon dioxide (CO₂) in units of kg per m² of total useful floor area per year emitted as the result of the provision of fixed building services for a standardised household as defined by SAP.

2.14 The TER is calculated in two stages –

- (a) Firstly, calculate the CO₂ emissions for a 2002 notional dwelling of the same shape and size as the proposed dwelling using the reference values given in Appendix R of SAP 2009.

No values may be varied from these reference values when establishing the TER.

The SAP software will output the CO₂ emissions resulting from –

- (i) the provision of heating and hot water (C_H), (which will include the energy used by pumps and fans); and
 (ii) the provision of fixed internal lighting (C_L).
- (b) Secondly, calculate the 20xx TER using the appropriate formula –

For mains gas, B30K, renewable energy, solid multi-fuels and any fuel with a CO₂ emission factor less than that of mains gas –

$$TER_{20xx} = \{(C_H \times FF \times EFA_H) + (C_L \times EFA_L)\} \times (1 - 0.2) \times (1 - 0.25)$$

For all other fuels –

$$TER_{20xx} = \{(1.14 \times C_H \times FF \times EFA_H) + (C_L \times EFA_L)\} \times (1 - 0.2) \times (1 - 0.25)$$

Where FF is the fuel factor taken from Table 2.1 in accordance with the guidance given in paragraph 2.15.

Where EFA is the Emission Factor Adjustment with separate values for heating and lighting. EFA is the ratio of the CO₂ emission factor for the relevant fuel in 2009 (see Table 12 in SAP 2009) divided by the value used in the 2006 edition of Part F (see Table 12 in SAP 2005). For those fuels with a fuel factor of 1.0 the EFA should always be based on mains gas.

Note: the notional dwelling used to determine C_H has a party wall heat loss of zero. This means that the target improvement of 25% in the 20xx amendment to Part F is in addition to treating the party wall heat loss (see paragraphs 2.44 to 2.50).

2.15 The fuel factor used to calculate the TER should be taken from Table 2.1 as follows –

- (a) where all space heating appliances and domestic hot water heating appliances are served by the same fuel, the fuel used in those appliances;
- (b) where the dwelling has more than one appliance for space heating and/or hot water and these are served by different fuels, the fuel

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should be taken to be mains gas if any of the appliances are served by mains gas. In any other circumstances, the fuel used should be taken to be the fuel used by the main space heating system; and

- (c) where the dwelling is served by a community heating scheme, the fuel should be taken to be mains gas if the community heating scheme uses mains gas for any purpose. In any other circumstances the fuel should be taken to be the fuel that provides the most heat to the community scheme.

| Table 2.1 Fuel factors | |
|---|-------------|
| Heating fuel | Fuel factor |
| Mains gas | 1.00 |
| LPG | 1.10 |
| Oil | 1.17 |
| B30K | 1.00 |
| Grid electricity for direct acting and storage systems | 1.47 |
| Grid electricity for heat pumps | 1.47 |
| Solid mineral fuel ⁽¹⁾ | 1.28 |
| Any fuel with a CO ₂ emission factor less than that of mains gas | 1.00 |
| Solid multi-fuel ⁽¹⁾ | 1.00 |
| Note: (1) The specific fuel factor should be used for those appliances that can only burn that particular fuel. Where an appliance is classed as multi-fuel, the multi-fuel factor should be used except where the dwelling is in a Smoke Control Zone. In such cases the solid mineral fuel factor should be used unless the specific multi fuel appliance has been approved for use in a Smoke Control Zone. | |

Buildings containing multiple dwellings

- 2.16 Where a building contains more than one dwelling (such as in a terrace of houses or in a block of flats), an average TER may be calculated for all the dwellings in the building. In such cases, the average TER is the floor-area-weighted average of all the individual TERs calculated using the following formula –

$$TER_{av} = \frac{(TER_1 \times \text{Floor area}_1) + (TER_2 \times \text{Floor area}_2) + \dots}{\text{Floor area}_1 + \text{Floor area}_2 + \dots}$$

The average TER may be compared against the floor-area-weighted average DER.

Block averaging is only permitted for multiple dwellings in the same building. It is not permitted across multiple buildings on the same development.

CRITERION 1 – ACHIEVING THE TER

Calculating the DER for the actual dwelling

General

- 2.17 The DER should be calculated using the same SAP software used to calculate the TER.
- 2.18 On completion of the dwelling, the DER for the dwelling as constructed should be re-calculated to demonstrate that the TER has been achieved or bettered. In calculating the DER for the dwelling as constructed the following should be incorporated –
- (a) any changes to the list of specifications that have been made during construction; and
 - (b) the assessed air permeability. The assessed air permeability should be determined as follows –
 - (i) where the dwelling has been pressure tested, the assessed air permeability is the measure air permeability; or
 - (ii) where the dwelling has not been pressure tested, the assessed air permeability is the average result obtained from pressure tests on other dwellings of the same type on the development increased by a margin of $+2 \text{ m}^3/(\text{h.m}^2)$ at 50 Pa; or
 - (iii) on small developments, where the person carrying out the work has opted to avoid testing the assessed air permeability is $15 \text{ m}^3/(\text{h.m}^2)$ at 50 Pa.
- 2.19 Note: the person carrying out the works can test a greater proportion of their dwellings than required and benefit from the increased robustness of the test data, compared with paragraph 2.18(b)(ii), 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 in England & Wales. The outcome of this change is that the design air permeability should be at most $8.0 \text{ m}^3/(\text{h.m}^2)$ at 50 Pa, so that untested dwellings should achieve an assessed air permeability less than the limiting value of $10 \text{ m}^3/(\text{h.m}^2)$ at 50 Pa. If the design is aiming to achieve a low design air permeability, then the margin added under paragraph 2.18(b)(ii) will have a significant impact on the calculated DER. In such cases, the person carrying out the work should consider testing the dwelling so that the measured permeability can be included in the calculation.

Calculation before commencement of work

- 2.20 A calculation should be carried out that demonstrates that the DER of the dwelling as designed is no greater than the TER. This design-based calculation and list of specifications of the building envelope and the fixed building services used in calculating the DER is required to be given to the district council with the building control application. This specification should be as given in Appendix B.

This design-stage calculation and provision of a list of specifications will assist the district council to confirm that what is being built aligns with the claimed performance. It is expected that software implementations of SAP

2009 will be used to produce the list of specifications and highlight those features of the design that are critical to achieving compliance. These “key features” can be used to prioritise the risk-based inspection of the dwelling as part of confirming compliance. If a provisional energy rating is calculated at this stage and an interim recommendations report is therefore available, the recommendations should be reviewed by the developer to see if further carbon mitigation measures might be incorporated in a cost-effective manner.

Calculation after completion of work

- 2.21 A calculation should be carried out that demonstrates that the DER of the dwelling as constructed is no greater than the TER. Not more than 5 days after completion of the work, the person carrying out the work should notify the district council of the TER and DER and whether the building has been constructed in accordance with the list of specifications given to the district council before work started. If not, a list of any changes to the design-stage list of specifications is required to be given to the district council. As evidence of compliance, a certificate stating that the TER and DER calculations are based on the list of specifications and any changes notified by the person carrying out the work to the district council, should be signed off by a suitably qualified person.

It would be useful in demonstrating compliance to provide additional information to support the values used in the DER calculation and the list of specifications. For example, U-values might be determined from a specific calculation, in which case the details should be provided, or from an accredited source, in which case a reference to that source would be sufficient. For example, for a boiler, the model reference and fuel type is sufficient evidence to allow the claimed performance to be checked against the SEDBUK (Seasonal Efficiencies of Domestic Boilers in the UK) database. It would also be useful if evidence was provided that demonstrates that the dwelling as designed satisfies the provisions in Criteria 2 and 3.

Secondary heating

- 2.22 A secondary heating appliance may meet part of the space heating demand. When calculating the DER, the fraction provided by the secondary heating system should be as defined by SAP 2009 for the particular combination of primary heating system and secondary heating appliance.
- 2.23 One of the following assumptions, in relation to secondary heating appliances, should be made when calculating the DER –
- (a) where a secondary heating appliance is installed, the efficiency of the installed appliance with its appropriate fuel should be used in calculating the DER;
 - (b) where a chimney or flue is provided but no appliance is installed, the presence of the following appliances should be assumed –
 - (i) where a gas point is located adjacent to a hearth, a decorative fuel effect gas fire open to the chimney or flue, with an efficiency of 20%; or
 - (ii) where there is no gas point, an open multi-fuel fire with an efficiency of 37%, unless the dwelling is in a smoke control zone when the fuel should be taken as smokeless solid mineral fuel; or

- (c) where neither of the above are provided it should be assumed that the dwelling has no secondary heating.

Internal lighting

- 2.24 In all cases the DER should be calculated assuming the proportion of low-energy lamps as actually installed in the fixed lighting locations.
- 2.25 The number of low-energy lamps that would be reasonable is given in the *Domestic building services compliance guide*.

Buildings containing multiple dwellings

- 2.26 Where a building contains more than one dwelling (such as in a terrace of houses or in a block of flats), either each individual dwelling should have a DER that is no greater than its TER, or the average DER is no greater than the average TER. These are floor-area-weighted averages.

Block averaging is only permitted for multiple dwellings in the same building. It is not permitted across multiple buildings on the same development.

Low or zero carbon energy sources

- 2.27 Provided that the dwelling satisfies the limits on design flexibility as given 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. SAP includes appropriate algorithms that enable the designer to assess the role LZC technologies can play in achieving the TER.
- 2.28 Where a dwelling is connected to a community energy system, the same percentage reduction in CO₂ emissions should be attributed to each connected dwelling and the submission to the district council should demonstrate that the community energy system has sufficient capacity to deliver the percentage assumed.
- 2.29 To facilitate incorporation of improvements in system efficiencies and the future integration of low and zero carbon technologies, the designer should consider –
 - (a) adopting heating system designs that use low distribution temperatures; and
 - (b) where multiple systems serve the same end use, organise the control strategies so that priority is given to the least carbon-intensive option (e.g. 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; and
- 2.30 The designer should consider making the dwelling easily adaptable by facilitating the integration of additional low and zero carbon technologies at a later date. Providing appropriate facilities at the construction stage can make subsequent enhancements much easier and cheaper (e.g. by providing capped off connections that are ready to link in to a planned community heating scheme).

CRITERION 2 – MINIMUM ACCEPTABLE STANDARDS

U-values

- 2.31 The maximum U-values for each of the elements of the building fabric that separate a normally conditioned space from an unconditioned space or the external environment are given in Table 2.2. The value is the area-weighted average U-value for all elements of that type. In general, achievement of the TER is likely to require better fabric performance than is given in Table 2.2.
- 2.32 The U-values should be calculated using the methods and conventions given in BRE Report BR 443 *Conventions for U-value calculations*, and should be based on the whole unit (e.g. in the case of a window, the combined performance of the glazing and the frame).
- The U-value of a window, roof window, rooflight or glazed door should be taken as the value for –
- the smaller of the two standard windows defined in BS EN 14351-1; or
 - the standard configuration given in BR 443; or
 - the specific size and configuration of the actual unit.
- 2.33 The U-values for roof windows and rooflights given in this Technical Booklet are based on the U-value having been assessed with the roof window or rooflight in the vertical position. Where a unit has been assessed in a plane other than the vertical, the U-value given in this Technical Booklet should be modified by making a U-value adjustment in accordance with BR 443.
- 2.34 SAP 2009 Table 6e gives U-values for different window configurations that may be used in the absence of test data or calculated values.

| Table 2.2 Limiting area weighted average U-values {W/(m²·K)} | |
|--|----------------|
| Element | U-value |
| Wall | 0.30 |
| Floor | 0.25 |
| Roof | 0.20 |
| Party wall | 0.20 |
| Windows, roof windows, glazed rooflights, curtain walling and pedestrian doors | 2.00 |

Air permeability

- 2.35 The maximum permissible air permeability is 10 m³/(h.m²) at 50 Pa (except where paragraph 2.69 applies).

Fixed building service systems

- 2.36 Every fixed building service, including its controls and installation, should be at least as efficient as the minimum acceptable efficiency for that particular type of appliance or fitting given in the *Domestic building services compliance guide*.

This guide recommends that central heating systems should be provided with a minimum of two independent heating zones. It should be noted that each zone should be controlled by a room thermostat, with thermostatic radiator valves on all the radiators in the rooms without a thermostat except bathrooms. For example, one room thermostat could be in the lounge and a second one in a home study. If the floor area is greater than 150 m², each zone should in addition have separate timing controls.

- 2.37 A boiler should have an seasonal efficiency of not less than –
- (a) 88% [SEDBUK 2009] or 90% [SEDBUK 2005] if fired by oil, mains gas or LPG; or
 - (b) 86% [SEDBUK 2009] or 86% [SEDBUK 2005] if an oil-fired combi boiler.

If the SEDBUK efficiency given in the boiler manufacturer's literature does not state whether it is SEDBUK 2005 or SEDBUK 2009, it should be assumed to be SEDBUK 2005.

- 2.38 The efficiency claimed for the fixed building service should be based on the appropriate test standard given in the *Domestic building services compliance guide* and the test data should be certified by an appropriate independent body.

AD L1A 2010 4.24; Not in TB F1 2006

Where a particular technology is not covered by this guide, it should be demonstrated that the proposed technology has a performance that is equivalent to a reference system of the same type whose details are given in this guide.

CRITERION 3 – LIMITING THE EFFECTS OF SOLAR GAINS

- 2.39 Provisions should be made to limit internal temperatures due to excessive solar gains. This can be achieved 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. Where ventilation is provided using a balanced mechanical system, consideration should be given to providing a summer bypass function during warm weather (or allow the dwelling to operate via natural ventilation) so that the ventilation is more effective in reducing overheating.
- 2.40 SAP 2009 Appendix P contains a procedure to enable designers to check whether solar gains are excessive. The designer should ensure that the calculation does not indicate a high risk of high internal temperatures. This assessment should be done whether or not the dwelling has mechanical cooling. Where the dwelling has mechanical cooling the assessment should be based on the design without the cooling system operating but with a

realistic assumption about the effective air change rate through openable windows.

- 2.41 When seeking to limit solar gains consideration should be given to the provision of adequate levels of daylight. BS 8206 gives guidance on maintaining adequate levels of daylight.

The Building Regulations do not require any minimum daylighting provisions. However, reducing window area produces conflicting impacts on the predicted CO₂ emissions: reduced solar gains but increased use of internal lighting. As a general guide, if the area of glazing is significantly less than 20% of the total floor area, some parts of the dwelling may have poor levels of daylight resulting in the increased use of electric lighting.

CRITERION 4 – QUALITY OF CONSTRUCTION AND COMMISSIONING

General

- 2.42 Every dwelling should be constructed such that the thermal and air permeability properties of the building envelope and the fixed building services and controls achieve a calculated Dwelling carbon dioxide Emissions Rate (DER) no greater than the Target carbon dioxide Emissions Rate (TER).

As stated in paragraph 2.21, a recalculation of the DER is required to be given to the district council not more than 5 days after completion of the dwelling taking into account any changes in performance between design and construction and the achieved air permeability and to demonstrate that the dwelling as completed meets its TER.

Building envelope

- 2.43 The building envelope should be constructed to a reasonable standard such that the insulation is reasonably continuous over the whole building envelope and the actual air permeability is within the set limits.

Party walls separating dwellings and other thermal bypasses

- 2.44 Contrary to previous assumptions, cavity walls separating dwellings (hereafter referred to as party walls) may not be zero heat loss walls because air flows in the cavity provide a heat loss mechanism.
- 2.45 Where outside air is able to flow into a party wall 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 depends on external conditions such as wind and temperature 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.
- 2.46 The heat loss can be reduced by measures that restrict air movement through the cavity, either by fully filling the cavity and/or by providing effective sealing around the perimeter of the cavity. Generic solutions to minimising party wall heat loss are available at CLG's www.planningportal.gov.uk. The

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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, the party wall U-values given in Table 2.3 should be used.

Fully filling the cavity may have implications for sound transmission through the party wall.

- 2.47 When calculating the DER for a dwelling, the appropriate party wall U-value should be taken from Table 2.3.
- 2.48 Where edge sealing is adopted to address the party wall bypass, either on its own or in conjunction with a fully filled cavity, it is essential that the edge sealing is effective in restricting air flow and that it is aligned with the thermal envelope. Although effective edge sealing may be part of a cavity barrier which is provided as a fire stop, a cavity barrier on its own may not be effective in restricting air flow. In order to claim a reduced cavity wall 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 essential that the sealing system is applied in such a way as to be in line with the thermal envelope.

For example, in a room-in-the-roof design, the insulation layer is likely to follow the sloping roof to a horizontal ceiling and 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 sloping roof and horizontal ceiling sections. 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.

Table 2.3 U-values for party walls⁽¹⁾ {W/(m²K)}

| Party wall ⁽¹⁾ construction | U-value |
|--|---------|
| Solid | 0.0 |
| Unfilled cavity with no effective edge sealing | 0.5 |
| Unfilled cavity with effective edge sealing around all exposed edges and in line with insulation layers in abutting elements | 0.2 |
| Fully filled cavity with effective edge sealing around all exposed edges and in line with insulation layers in abutting elements | 0.0 |
| Note: (1) These U-values only apply to the separating walls between dwellings and not to thermal elements such as walls separating a dwelling from the unheated common area in buildings with multiple dwellings. | |

- 2.49 In considering heat losses via party walls it is important to be aware 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 occur. This will be the case even when 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 G (Resistance to the passage of sound).

- 2.50 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 touching and the cavity barrier between them is subject to air movement (see paragraph 2.52).

Thermal bridges

- 2.51 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 joints between elements, and at the edges of elements such as those around window and door openings.
- 2.52 Significant reductions in thermal performance can occur where the air barrier and the insulation layer are not touching and there is a cavity between them that is subject to air movement. There is not a problem where the space between the air barrier and the insulation layer is filled with solid material such as in a masonry wall.
- 2.53 Where calculated in support of the approaches given in paragraphs 2.55 and 2.62, linear thermal transmittances and temperature factors should be calculated using the methods and conventions given in BRE Report BR 497 *Conventions for calculating linear thermal transmittance and temperature factors*. It should be demonstrated that the specified details achieve a temperature factor that is no worse than the performance given in BRE Information Paper IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings*.
- 2.54 Similarly, in support of the approaches given in paragraphs 2.55 and 2.56, the person carrying out the work should demonstrate that an appropriate system of site inspection is in place to ensure that the construction processes achieve the required standards of consistency.

Dwellings constructed to quality-assured accredited construction details

- 2.55 Where a dwelling is to be constructed using quality-assured accredited construction details the calculated linear thermal transmittance can be used directly in the calculation of the DER.
- Scheme(s) that provide such construction details also accredit and quality assure the calculation of the linear thermal transmittance, accredit the details in terms of buildability and have an associated quality assurance regime that inspects a sample of sites to confirm that the details are being used correctly.

Dwellings NOT constructed to quality-assured accredited construction details

- 2.56 Where a dwelling is constructed to details that have NOT been subject to independent quality assurance and accreditation, the linear thermal transmittance should be calculated by a person who has suitable expertise and experience in using the methods and conventions given in BR 497. When following this route a process flow sequence should be given to the district council to show the way in which the relevant detail should be constructed. The calculated linear thermal transmittance should be increased by 0.02 W/(m.K) or by 25%, whichever is the greater. This revised value should then be used in the calculation of the DER.

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Evidence of suitable expertise and experience for calculating the 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 given in BR 497 and has achieved results that are within the stated tolerances.

- 2.57 Where the dwelling is constructed to unaccredited details, with no specific quantification of the thermal bridge values, a conservative default ψ -value of 0.15 should be used in the calculation of the DER.
- 2.58 The approaches given in paragraphs 2.56 and 2.57 are not mutually exclusive. For example, a person carrying out the work may use the quality-assured accredited construction detail approach for the majority of junctions, but use a bespoke detail for a window head. In this case, the 0.02 W/(m²K) or 25%, whichever is the greater would apply only to the thermal transmittance of the window head detail.

Air permeability and pressure testing

- 2.59 The procedure for air pressure testing is given in the Air Tightness Testing and Measurement Association (ATTMA) publication *Measuring air permeability of building envelopes (dwellings)*. The manner approved for recording the results and the data on which they are based is given in section 4 of that document. The preferred test method is that trickle ventilators should be temporarily sealed rather than just closed.
- 2.60 The district council should be provided with evidence that the test equipment has been calibrated within the previous 12 months using a UKAS-accredited facility and that the tests have been carried out by a person who has received appropriate training and who is registered to test the specific class of building concerned.
- 2.61 It would not be reasonable to test all dwellings in a development.
- 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.
- 2.62 On each development, an air pressure test should be carried out on three units of each dwelling type (see definition) or 50% of all instances of that dwelling type, whichever is less; and at least one of each type should be tested. The dwellings to be tested should be taken from the first completed batch of units of each dwelling type to confirm the robustness of the designs and the construction procedures.
- 2.63 Each block of flats should be treated as a separate development irrespective of the number of blocks of flats on the site.
- 2.64 The dwellings selected for test should be chosen by the district council in consultation with the pressure tester. They should be selected so that about half of the tests on each dwelling type are carried out during the construction of the first 25% of the dwellings of that type. All tests on dwellings in the sample should be reported to the district council including any test failures (see paragraphs 2.65 to 2.68).

Demonstrating air permeability compliance

- 2.65 Compliance would be demonstrated where –

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- (a) the measured air permeability is no greater than $10 \text{ m}^3/(\text{h.m}^2)$ at 50 Pa; and
- (b) the DER, calculated on completion using the measured air permeability, is no greater than the TER.

2.66 The person carrying out the work is required to give the test results to the district council, not later than 5 days after completion of the pressure testing.

2.67 Where a dwelling fails to achieve the provisions of paragraph 2.65, remedial measures should be carried out such that the dwelling complies with the provisions of paragraph 2.65.

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

2.68 In addition to the remedial work on the dwelling that failed to achieve its design air permeability –

- (a) one additional dwelling of the same type should be tested to increase the overall sample size; and
- (b) other dwellings of the same dwelling type that have not been tested should be examined and, where appropriate, similar remedial measures should be applied.

Alternative to pressure testing on small developments

2.69 Where a development contains not more than two dwellings, the developer may avoid pressure testing by –

- (a) demonstrating that a similar dwelling constructed by the same builder in Northern Ireland within the preceding 12 month period had been pressure tested and had achieved its design air permeability; or
- (b) using a value of $15 \text{ m}^3/(\text{h.m}^2)$ at 50 Pa for the air permeability when calculating the DER, in which case compensating measures will be necessary to achieve the TER.

Commissioning of fixed building services

2.70 The fixed building services should be commissioned by testing and adjustment as necessary to ensure that, for the purposes of the conservation of fuel and power, the system and its controls are handed over in efficient working order..

2.71 A commissioning plan should be prepared, identifying the fixed building services that need to be tested and the tests that will be carried out. This commissioning plan should be sent to the district council at plans submission stage to enable the district council to check the commissioning as it is carried out.

The use of the templates in the *BSRIA Model commissioning plan* provides a means of documenting the commissioning process in an appropriate manner.

2.72 Some fixed building services will not need to be commissioned. With some systems adjustment is not possible because the only controls are “on/off” switches. In some other cases commissioning would be possible but would

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have no effect on energy use. Fixed building services that do not require commissioning should be identified in the commissioning plan and the reason for not requiring commissioning should be stated.

- 2.73 Where commissioning is carried out it should be done in accordance with the following procedures –
- (a) for heating and hot water systems the procedures given in the *Domestic building services compliance guide*; and
 - (b) for ventilation systems the procedures given in the *Domestic ventilation: compliance guide*.

- 2.74 A notice confirming that all fixed building services have been properly commissioned is required to be given to the district council and the building owner not more than 5 days after completion of the commissioning works. The notice should be signed by a suitably qualified person.

The notice 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.

Failure to provide the commissioning notice may mean that the district council is unable to issue a completion certificate.

CRITERION 5 – OPERATING AND MAINTENANCE INSTRUCTIONS

- 2.75 Not more than 5 days after completion of the work, the building owner is required to be given sufficient information, including operational and maintenance instructions, to enable the dwelling and its fixed building services to be operated and maintained in an energy efficient manner. The instructions should be directly related to the specific system(s) installed in the dwelling and should be readily understandable by the occupier. They should be in a durable format that can be kept and referred to over the service life of the system(s).
- 2.76 The district council is required to be notified in writing that the provision in paragraph 2.75 has been met.
- 2.77 Without compromising health and safety requirements, the instructions should explain to the occupier of the dwelling how to operate the systems efficiently. These should include –
- (a) how to make adjustments to the timing and temperature control settings; and
 - (b) what routine maintenance is necessary to enable the systems to be maintained at a reasonable efficiency throughout their service life.
- 2.78 The TER and DER for the dwelling should be included with the operating and maintenance instructions together with the data used to calculate them.
- This should include an electronic copy of the TER/DER data input file for the dwelling to facilitate any future analysis that may be required by the owner when altering or improving the dwelling.

Section 3 Existing dwellings

GENERAL

Types of work covered by this section

- 3.1 This Section gives provisions for altering or extending a dwelling, creating a dwelling through a material change of use or where there is a change of energy status.
- 3.2 This Section gives provisions in relation to the following building works –
- (a) extensions (see paragraphs 3.6 to 3.18);
 - (b) where a dwelling is created through a material change of use (see paragraphs 3.19 to 3.26);
 - (c) where there is a change of energy status (see paragraphs 3.19 to 3.26);
 - (d) the provision or extension of a controlled service (see paragraphs 3.29 to 3.40);
 - (e) the provision or extension of a controlled fitting (see paragraphs 3.41 to 3.48);
 - (f) the provision, replacement or renovation of a thermal element (see paragraphs 3.49 to 3.58); and
 - (g) consequential improvements (see paragraphs 3.61 to 3.63).

Historic and traditional buildings

- 3.3 Special considerations apply where the building on which the work is to be carried out has historic or architectural value and compliance with this Technical Booklet would unacceptably alter the character or appearance of the building.
- 3.4 When undertaking work on or in connection with a building of historic or architectural merit, the aim should be to improve energy efficiency to the extent that it is practicable. Particular issues in relation to work in historic buildings that warrant sympathetic treatment and where specialist advice from conservation experts would be beneficial include –
- (a) restoring the historic character of a building that has been subject to inappropriate alteration (e.g. replacement windows, doors and rooflights);
 - (b) rebuilding a building (e.g. following a fire or filling in a gap site in an historic terrace); and
 - (c) making provisions for the fabric of historic buildings to “breathe” to control moisture and long term decay problems.
- 3.5 The guidance given in the DOE Northern Ireland Environment Agency (NIEA): Built Heritage publication “*Historic buildings and energy efficiency. A guide to Part F of the Northern Ireland Building Regulations*” should be taken into account in determining appropriate energy efficiency improvements.

EXTENSIONS

- 3.6 Where a dwelling is extended there are three approaches –
- (a) the Standards Based Approach (see paragraphs 3.8 to 3.11);
 - (b) the Calculated Trade-off Approach (see paragraph 3.12); or
 - (c) the Equivalent Carbon Target Approach (see paragraphs 3.13 and 3.14).
- 3.7 The Standards Based Approach is somewhat prescriptive. The alternative approaches are more flexible and allow some elements of the design to be relaxed through compensating measures elsewhere.

Standards Based Approach

Fabric standards

- 3.8 An extension to a dwelling should achieve the following performance standards –
- (a) area of openings that comply with paragraph 3.9;
 - (b) doors, windows, roof windows and rooflights that meet the standards given in paragraphs 3.41 to 3.48;
 - (c) newly constructed thermal elements that meet the standards given in paragraphs 3.49 to 3.54; and
 - (d) existing opaque fabric that becomes part of the thermal envelope, where previously it was not, that meets the standards given in paragraphs 3.59 to 3.60.

Area of glazing

- 3.9 The total area of windows, roof windows, rooflights and doors in an extension should be limited so that it does not exceed the sum of –
- (a) 25% of the floor area of the extension; plus
 - (b) the area of any windows, roof windows, rooflights or doors which, as a result of the extension, no longer exist or are no longer exposed.

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

- 3.10 Areas of glazing greater than 25% may be acceptable, especially where this is required to make the extension consistent with the external appearance or character of the building being extended. In such cases, compensating measures should be provided to make up for the otherwise increased heat loss.

Fixed building services

- 3.11 Where a fixed building service is provided or extended as part of constructing the extension, it should comply with the guidance given in paragraphs 3.29 to 3.40.

Calculated Trade-off Approach

- 3.12 The fabric standards referred to in paragraph 3.8 and the glazed areas given in paragraph 3.9 may be varied provided that –
- the area-weighted U-value of all the elements in the extension is no greater than that of an extension of the same shape and size that complies with the U-value standards referred to in paragraph 3.8 and the glazed areas standards in paragraph 3.9; and
 - any fixed building service provided or extended as part of constructing the extension should comply with the standards given in paragraphs 3.29 to 3.40.

The area-weighted U-value is calculated using the following formula –

$$U_{av} = \frac{(U_1 \times A_1) + (U_2 \times A_2) + (U_3 \times A_3) + \dots}{A_1 + A_2 + A_3 + \dots}$$

Equivalent Carbon Target Approach

- 3.13 SAP should be used to demonstrate that the calculated carbon dioxide emissions rate from the existing dwelling with its proposed extension is no greater than for the dwelling with a notional extension of the same shape and size complying with the standards referred to in paragraphs 3.8 to 3.11. The glazed areas in the notional extension should conform with paragraph 3.9 with the door area set equal to the door area of the proposed extension and with the remainder of the openings being regarded as windows. The procedures in SAP Appendix S should be used to estimate the performance of the elements of the existing building that are unknown.
- 3.14 Where upgrades to the existing fabric of the original dwelling are proposed to compensate for lower performance in the extension, those parts of the existing fabric should be treated as retained thermal elements and as such should be upgraded to the standards given in Table 3.3.

Where it is proposed to upgrade the existing dwelling, the standards given in this Section are cost-effective and should be implemented in full. Because they are cost effective consideration should be given to implementing them even if the improvement is greater than required to achieve compliance. In some cases, therefore, the standard of the extended dwelling may be better than that required by paragraph 3.13. Paragraph 3.14 sets limits on design flexibility and ensures that no cost-effective improvement opportunities are traded away.

Highly glazed extensions

Conservatories exempt from the Building Regulations

- 3.59 Some conservatories built as extensions are exempt from the Building Regulations – see Class 8 of Schedule 2 to the Building Regulations.
- 3.16 Where a previously exempt conservatory is no longer exempt and energy is used to condition the indoor climate this is a change of energy status and the guidance in paragraphs 3.27 and 3.28 should be followed.

Conservatories, sun-rooms and other highly glazed spaces

- 3.17 Where a dwelling is extended by a non-exempt conservatory or by a sun-room or other highly glazed space, the extension should have –
- (a) thermal separation;
 - (b) new controlled fittings that comply with the guidance in paragraphs 3.41 to 3.47;
 - (c) no limit on the area of glazing (i.e. paragraph 3.9 does not apply);
 - (d) new thermal elements that comply with the guidance in paragraphs 3.50 and 3.54;
 - (e) retained thermal elements, if any, that comply with the guidance in paragraphs 3.59 and 3.60; and
 - (f) where the extension is heated or cooled, independent temperature and on/off controls.
- 3.18 Alternatively, the extension may be constructed in accordance with one of the approaches given in paragraph 3.6.

MATERIAL CHANGE OF USE OR CHANGE OF ENERGY STATUS

General

- 3.19 Where there is a material change of use to a dwelling or a change of energy status to part of a dwelling, there are two approaches –
- (a) the Standards Based Approach; or
 - (b) the Equivalent Carbon Target Approach.
- 3.20 Where a previously unheated part of a dwelling is to be heated this is a change of energy status.

Standards Based Approach

Common provisions

- 3.21 Where the work involves the provision of a new or replacement thermal element it should comply with the provisions in paragraphs 3.50 to 3.54.
- 3.22 Where a thermal element is to be retained, it should comply with the provisions of paragraphs 3.59 to 3.60. This guidance also applies to an existing element that becomes part of the thermal envelope of the building where previously it was not.
- 3.23 Where controlled fittings or services are being provided or extended, they should comply with the provisions of paragraphs 3.29 to 3.48.
- 3.24 Where any existing window (including roof windows or rooflights) or door that separates a conditioned space from an unconditioned space (or the external environment) has a U-value greater than $3.3 \text{ W}/(\text{m}^2\text{K})$ it should be replaced in accordance with the provisions given in paragraphs 3.41 to 3.47.

Additional provision for a material change of use

- 3.25 In a dwelling newly created by a material change of use, where the area of glazing is more than 25% of the total floor area of the dwelling, either the area of glazing should be reduced to no greater than 25%, or the larger area should be compensated for using the procedure described in paragraph 3.26.

Equivalent Carbon Target Approach

- 3.26 SAP may be used to demonstrate that the carbon dioxide emissions rate from the dwelling as it will become is no greater than that of a notional dwelling of the same shape and size complying with the Standards Based Approach.

This procedure may also be applied to all the dwellings in the building such that the total carbon dioxide emissions from all the dwellings should not be greater than if each individual dwelling complied with the Standards Based Approach.

Previously exempt conservatories and porches

- 3.27 Where a previously exempt conservatory or porch is no longer exempt and energy is used to condition the indoor climate this is a change of energy status. This is the case where –
- (a) the thermal performance of the dwelling is not retained (e.g. if any part of the thermal separation between the dwelling and the extension is removed and not replaced);
 - (b) the dwelling's heating or cooling system is extended into the extension; or
 - (c) a fixed combustion appliance or a fixed cooling appliance is installed in the extension.
- 3.28 In such cases, the previously exempt conservatory or porch should have –
- (a) controlled fittings whose performance is no worse than that given in Table 3.1;
 - (b) thermal elements that have U-values no greater than that given in Table 3.2; and
 - (c) where the conservatory or porch is heated or cooled, independent temperature and on/off controls.

Where any of the above does not meet these standards it should be replaced or upgraded. Alternatively compensating provisions should be made in accordance with Equivalent Carbon Target Approach in paragraph 3.26.

CONTROLLED SERVICES

General

- 3.29 Where the work involves the provision, replacement or extension of a fixed building service, the service should be provided and installed in accordance with the provisions and standards given in the *Domestic building services compliance guide*.
- 3.304 A boiler should have an seasonal efficiency of not less than –
- (a) 88% [SEDBUK 2009] or 90% [SEDBUK 2005] if fired by oil, mains gas or LPG; or
 - (b) 86% [SEDBUK 2009] or 86% [SEDBUK 2005] if an oil-fired combi boiler.
- 3.31 Where replacing an existing appliance the efficiency of the replacement appliance should not be significantly lower than the efficiency of the appliance being replaced. Where the replacement involves a fuel switch the relative carbon emissions associated with the new and existing fuels should be considered when assessing the reasonableness of the proposed new appliance. These assessments should be made in accordance with the procedures given in the *Domestic building services compliance guide*.
- 3.32 In exceptional circumstances, where the CLG *Guide to condensing boiler installation assessment procedure for dwellings* shows that the installation of a non-condensing boiler is appropriate, the seasonal efficiency of the boiler should be not less than –
- (a) 84% [SEDBUK 2009] or 85% [SEDBUK 2005] if an oil fired regular boiler;
 - (b) 78% [SEDBUK 2009 or SEDBUK 2005] if a mains gas or LPG fired boiler; or
 - (c) 82% [SEDBUK 2009 or SEDBUK 2005] if an oil fired combi boiler.
 Correction to be issued to *Domestic building services compliance guide*.
- 3.33 If the SEDBUK efficiency given in the boiler manufacturer's literature does not state whether it is SEDBUK 2005 or SEDBUK 2009, it should be assumed to be SEDBUK 2005.
- 3.34 The efficiency claimed for the fixed building service should be based on the appropriate test standard given in the *Domestic building services compliance guide* and the test data should be independently certified by an accredited body.
- Where a particular technology is not covered by this guide, it should be demonstrated that the proposed technology has a performance that is equivalent to a reference system of the same type whose details are given in this guide.
- 3.35 Where a renewable energy generator attached to a building (such as a wind turbine or photovoltaic array) is being replaced, the new system should have an electrical output that is not less than that of the original installation.
- 3.36 When replacing a heating appliance, consideration should be given to connecting to any existing local heat networks. Where the work involves

pipework changes, it would be advisable to provide capped off connections to facilitate a link up to any local heat network(s) that become available in the future.

Commissioning of fixed building services

- 3.37 The fixed building services should be commissioned by testing and adjustment as necessary to ensure that they use no more fuel and power than is reasonable in the circumstances.
- 3.38 A commissioning plan should be prepared, identifying the fixed building services that need to be tested and the tests that will be carried out. This commissioning plan should be sent to the district council at plans submission stage to enable the district council to check the commissioning as it is carried out.

Some fixed building services will not need to be commissioned. With some systems adjustment is not possible because the only controls are “on/off” switches. In other cases commissioning would be possible but would have no effect on energy use. Fixed building services that do not require commissioning should be identified in the commissioning plan and the reason for not requiring commissioning should be stated.

- 3.39 Where commissioning is carried out it should be done in accordance with the following procedures –
- (a) for heating and hot water systems the procedures given in the *Domestic building services compliance guide*; and
 - (b) for ventilation systems the procedures given in the *Domestic ventilation compliance guide*.
- 3.40 A notice in writing confirming that all fixed building services have been properly commissioned is required to be given to the district council and the building owner not more than 5 days after completion of the commissioning works. The notice should be signed by a suitably qualified person.

The notice 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 the performance is reasonably in accordance with the design requirements.

Failure to provide the commissioning notice may mean that the district council is unable to issue a completion certificate.

CONTROLLED FITTINGS

- 3.41 The term “controlled fitting” in relation to a window, roof window, rooflight or door means the unit as a whole (i.e. it includes the frame). Consequently, the replacement of a broken window pane is not the provision of a controlled fitting.
- 3.42 Where windows, roof windows, rooflights or doors are to be provided, they should be draught-proofed units whose area-weighted average performance should be no worse than that given in Table 3.1. When replacing controlled fittings, insulated cavity closers should be provided where appropriate.
- 3.43 Where, because of the need to maintain the external appearance of a building, replacement windows are unable to meet the standards given in Table 3.1, the replacement windows should have a centre pane U-value of not more than $1.2 \text{ W}/(\text{m}^2\text{K})$. Alternatively, single glazing may be used in combination with low-e secondary glazing with the weather stripping on the secondary glazing to minimise condensation risk between the primary and secondary glazing.
- 3.44 U-values should be calculated using the methods and conventions given in BRE Report BR 443 *Conventions for U-value calculations*, and should be based on the whole unit (e.g. in the case of a window, the combined performance of the glazing and frame).

The U-value for the window, roof window, rooflight or glazed door should be taken as the value for –

- (a) the smaller of the two standard windows defined in BS EN 14351-1; or
- (b) the standard configuration given in BR 443; or
- (c) the specific size and configuration of the actual unit.

SAP 2009 Table 6e gives values for different window configurations that may be used in the absence of test data or calculated values.

- 3.45 The U-values for roof windows and rooflights given in this Technical Booklet are based on the U-value having been assessed with the roof window or rooflight in the vertical position. Where a unit has been assessed in a plane other than the vertical, the standards given in this Technical Booklet should be modified by making an adjustment that is dependent on the slope of the unit following the guidance given in BR 443.

| Table 3.1 Standards for controlled fittings | |
|---|---|
| Fitting | Standard |
| Window, roof window or rooflight | WER Band C or better (see paragraph 3.46; or U-value = 1.6 W/(m ² K) |
| 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) |

3.46 The Window Energy Rating (WER) is given by the following equation –

$$\text{WER} = 196.7 \times ((1 - f) \times g_{\text{glass}}) - 68.5 \times (U + (0.0165 \times \text{AL}))$$

where –

f is the frame factor (i.e. the percentage of the window obscured by frame and gaskets);

g_{glass} is the normal total solar energy transmittance of the glass as determined by BS EN 410;

U is the whole window U-value as given in paragraphs 3.44 to 3.45.

AL is the air leakage through the window in m³/(h·m²) at 50 Pa pressure difference based on testing to BS 6375-1:2009.

Note: AL is based on the whole window area, not per unit length of opening light.

The following window rating bands define the window energy rating label –

| | |
|--------|-----------------|
| Band A | WER ≥ 0 |
| Band B | 0 > WER ≥ -10 |
| Band C | -10 > WER ≥ -20 |
| Band D | -20 > WER ≥ -30 |
| Band E | -30 > WER ≥ -50 |
| Band F | -50 > WER ≥ -70 |
| Band G | -70 > WER |

3.47 As evidence of compliance, a WER declaration from a certification scheme that provides a quality-assured process and supporting audit trail from calculating the performance of the window to installation, may be given to the district council.

3.48 Where a window is enlarged or a new window opening is created, the total area of windows, roof windows, rooflights and doors should not exceed 25% of the total floor area of the dwelling unless compensating measures are made elsewhere in the dwelling.

NEW, RENOVATED AND RETAINED THERMAL ELEMENTS

- 3.49 Where thermal elements are newly constructed, replaced or renovated, provision should be made to limit heat gains and losses through those elements.

New thermal elements

- 3.50 New thermal elements, or thermal elements constructed as replacements for existing elements, should have a U-value no greater than that given in Table 3.2.

| Table 3.2 U-values for new thermal elements {W/(m ² ·K)} | |
|--|------------------------|
| Element ⁽¹⁾ | U-value ⁽²⁾ |
| Wall ⁽³⁾ | 0.28 |
| Pitched roof with insulation at ceiling level | 0.16 |
| Pitched roof with insulation at rafter level | 0.18 |
| Flat roof or roof with integral insulation | 0.18 |
| Floor ⁽⁴⁾ | 0.22 |
| Swimming pool basin (walls and floor) ⁽⁵⁾ | 0.25 |
| Notes: | |
| (1) "Roof" includes the roof parts of dormer windows and "wall" includes the wall parts (dormer cheeks) of dormer windows. | |
| (2) Area-weighted average value. | |
| (3) A lesser provision may be appropriate where meeting the provision 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 the provision would create significant problems in relation to adjoining floor levels. The U-value of the floor of the extension may be calculated using the exposed perimeter and floor area of the dwelling and its extension. | |
| (5) As calculated according to BS EN ISO 133709. | |

Continuity to limit thermal bridging and air leakage

- 3.51 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 joints between elements, and at the edges of elements such as those around door and window openings.
- 3.52 The building fabric should be constructed to minimise air leakage through the new or replacement parts of thermal envelope.
- 3.53 Significant reductions in thermal performance can occur where the air barrier and the insulation layer are not touching and there is a cavity between them

that is subject to air movement. There is not a problem where the space between the air barrier and the insulation layer is filled with solid material such as in a masonry wall.

- 3.54 A reasonable approach to demonstrating compliance with the above would be to adopt the Accredited Construction Details which can be accessed at www.planningportal.gov.uk.

Renovated thermal elements

- 3.55 The renovation of a thermal element is defined as “the provision of a new layer in the thermal element or the replacement of an existing layer but does not include thin decorative surface finishes”. However, only the following renovation works require the thermal element to be upgraded in accordance with paragraphs 3.56 to 3.58 –

- (a) cladding or rendering the external surface of a thermal element;
- (b) dry-lining the internal surface of a thermal element;
- (c) stripping down the element to expose the basic structure (brick/blockwork, timber/metal frame, joists, rafters, etc.) and rebuilding; or
- (d) replacing the waterproof membrane on a flat roof.

Note: windows and doors are excluded from the definition of a thermal element.

- 3.56 When undertaking the renovation of thermal elements, special considerations apply to buildings of historical or architectural value and to buildings of traditional construction that need to “breathe”. See paragraphs 3.3 to 3.5.
- 3.57 Where more than 50% of the surface area of an individual thermal element or more than 25% of the total building envelope is being renovated (through undertaking an activity listed in paragraph 3.55), the whole of that element should be upgraded to the improved U-value given in column (b) of Table 3.3.

When assessing this area proportion, the area of the element should be taken as that of the individual element, not the area of all the elements of that type in the building. The area of an element should be taken in the context of whether the element is being renovated from inside or outside. For example, if the renovation involves stripping plaster from the inside of a solid brick wall, the area of the element is the area of the external wall in that room; however, if the renovation is stripping external render the area is the area of the elevation of which that wall is part.

This means that if all the roofing on the flat roof of an annex to a dwelling is being stripped down, the area of the element is the roof area of the annex, not the total roof area of the dwelling. Similarly, if the rear wall of a single-storey extension was being re-rendered, it should be upgraded to the standards of Table 3.3 column (b), even if it was less than 50% of the total area of the building elevation when viewed from the rear. 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 external elevation which contains that wall section. This is because the marginal cost of dry-lining with insulated plasterboard rather than plain plasterboard is small.

| Table 3.3 Upgrading of renovated or retained thermal elements | | |
|---|--|---------------------|
| Element⁽²⁾ | U-value W/(m²·K)⁽¹⁾ | |
| | (a) Threshold | (b) Improved |
| Wall – cavity insulation ⁽³⁾ | 0.70 | 0.55 |
| Wall – external or internal insulation ⁽⁴⁾ | 0.70 | 0.30 |
| Pitched roof – insulation at ceiling level | 0.35 | 0.16 |
| Pitched roof – insulation at or between rafters ⁽⁵⁾ | 0.35 | 0.18 |
| Flat roof or roof with integral insulation ⁽⁶⁾ | 0.35 | 0.18 |
| Floor ^(7,8) | 0.70 | 0.25 |
| <p>Notes:</p> <p>(1) Area-weighted average value.</p> <p>(2) “Roof” includes the roof parts of dormer windows and “wall” includes the wall parts (cheeks) of dormer windows.</p> <p>(3) This applies only 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”.</p> <p>(4) 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.</p> <p>(5) A lesser provision may be appropriate where meeting such a standard would create limitations on head room. In such cases, the depth of the insulation plus any required air gap should be at least than the depth of the rafters, and the thermal performance of the chosen insulant should be such as to achieve the best practicable U-value.</p> <p>(6) A lesser provision may be appropriate if there are particular problems associated with the load-bearing capacity of the frame or the upstand height.</p> <p>(7) The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged building.</p> <p>(8) A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels.</p> | | |

- 3.58 Where upgrading to the above standards is not technically or functionally feasible or would not achieve a simply payback of 15 years or less, the element should be upgraded to the best practicable standard that is technically and functionally feasible which can be achieved within a simple payback period of 15 years. Guidance on this approach is given in Appendix C.

Retained thermal elements

- 3.59 Where an existing thermal element being part of a building subject to a material change of use or a change of energy status, or an existing element becomes part of the thermal envelope where previously it was not, and where it has a U-value greater than the threshold value given in column (a) of Table 3.3, the element should be upgraded to the standard given in column (b) of Table 3.3 provided that this is technically, functionally and economically feasible. A reasonable test of economically feasible is to achieve a simple payback period of 15 years or less.
- 3.60 Where upgrading to the standards required by the preceding paragraph is not technically, functionally or economically feasible, the element should be upgraded to the best practicable standard that is technically and functionally feasible that can be achieved within a simple payback period of 15 years. Guidance on this approach is given in Appendix C. However, this lesser standard should be no greater than $0.7 \text{ W}/(\text{m}^2\text{K})$.

Examples of where a lesser provision than column (b) of Table 3.3 might apply are, where the thickness of the additional insulation would reduce the usable floor area by more than 5%, or where the additional insulation would create difficulties with adjoining floor levels, or where the additional insulation could not be supported by the existing structure.

CONSEQUENTIAL IMPROVEMENTS

General

- 3.61 Consequential improvements should be made to any existing building having a total useful floor area greater than 1000 m^2 , where any of the following apply –
- (a) it is extended;
 - (b) any fixed building service (other than a renewable energy generator) is installed for the first time; or
 - (c) an existing fixed building service (other than a renewable energy generator) is increased in capacity.
- 3.62 Consequential improvements need only be carried out where they are technically, functionally and economically feasible.
- 3.63 Only a very small number of existing dwellings will exceed 1000 m^2 in size. Where consequential improvements are required, suitable guidance is given in *Technical Booklet F2: Conservation of fuel and power in buildings other than dwellings*.

OPERATING AND MAINTENANCE INSTRUCTIONS

- 3.64 Not more than 5 days after completion of the work, the owner of the dwelling is required to be given sufficient information about the dwelling, including details of the installed building services and controls, and other details 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.
- 3.65 The district council is required to be notified in writing that the provision in paragraph 3.64 has been met.
- 3.66 Where work involves the provision of fixed building services, this information should include operational and maintenance instructions which should be directly related to the specific system(s) installed in the dwelling and should be readily understandable by the occupier. The instructions should be provided in a durable format that can be kept and referred to over the service life of the system(s).
- This provision applies only 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).
- 3.67 Without compromising health and safety requirements, the instructions should explain to the occupier of the dwelling how to operate the systems efficiently. These should include –
- (a) how to make adjustments to the timing, temperature and flow control settings; and
 - (b) what routine maintenance is necessary to enable the systems to be maintained at a reasonable efficiency throughout their service life.

Appendix A Model designs

A1 The person carrying out the work may prefer to adopt model design solutions rather than develop their own. These model packages of fabric U-values, boiler seasonal efficiencies, window opening allowances, etc. will have been shown to achieve overall compliance within certain parameters.

The construction industry may develop model designs for this purpose and provisions have been made to register the designs on the internet at www.modeldesigns.info.

A2 It will still be necessary to demonstrate compliance with the TER in each individual case by complying with the procedures described in paragraphs 2.17 to 2.26 and to follow the rest of the guidance in this Technical Booklet.

Appendix B Reporting evidence of compliance

- B1 To facilitate effective communication between the person carrying out the work and district council, it would be beneficial to adopt a standardised format for presenting the evidence that demonstrates compliance with Part F (see paragraph 2.20).
- Other than the CO₂ target, which is mandatory, the other compliance criteria represent reasonable provisions in normal circumstances. In unusual circumstances, alternative limits may represent reasonable provision, but this would have to be demonstrated for that particular case.
- B2 Since the data in SAP 2009 and the results they calculate can provide a substantial proportion of the evidence in support of the compliance demonstration, it is anticipated that software implementations of SAP 2009 will produce this report as a standard output option.
- B3 It is anticipated that two versions of the standardised report would be produced by software implementations of SAP 2009: the first before commencement of works to include the TER/DER calculation plus supporting list of specifications and the second after completion to include the as-built TER/DER calculation plus any changes to the list of specifications. The first design-stage report and accompanying list of specifications can then be used by the district council to assist checking that what has been designed is actually built. A standardised report should enable the source of the evidence to be indicated, and allow the credentials of those submitting the evidence to be declared.
- B4 An important part of demonstrating compliance is to make a clear connection between the product specifications and the data inputs required by the compliance software (e.g. what is the wall construction that delivers the claimed U-value?). Examples as to how compliance software might provide this link are –
- (a) by giving each data input a reference code that can be mapped against a separate submission by the person carrying out the work that details the specification corresponding to each unique reference code in the data input;
 - (b) by providing a free-text entry facility along with each input parameter that has a unique reference code, thereby allowing the software to capture the specification of each item and so include the full details in an integrated output report; and
 - (c) by including one or more utility programs that derive the data input from the specification (e.g. a U-value calculator that conforms to BR 443 and that calculates the U-value based on the layer thicknesses and conductivities, repeating thermal bridge effects, etc.). Outputs from such a utility program could then automatically generate the type of integrated report described at (b) above. It would also help the district council if the software included a facility to compare the “as designed” and “as constructed” data input files and automatically produce a schedule of changes.

- B5 The report should highlight any items whose specification is better than typically expected values. The district council can then give particular attention to such “key features”, as their appropriate installation will be critical in achieving the TER. The district council should give particular attention to those aspects where the claimed specification delivers an energy efficiency standard better than that defined in the following schedule.

| Parameter | Values |
|---|--|
| Wall U-value | 0.20 W/(m ² K) |
| Roof U-value | 0.13 W/(m ² K) |
| Floor U-value | 0.20 W/(m ² K) |
| Window/door U-value | 1.50 W/(m ² K) |
| Party wall U-value | 0.20 W/(m ² K) |
| Thermal bridging value | 0.04 W/(m ² K) |
| Design air permeability | 5.0 m ³ /(h.m ²) at 50 Pa |
| Any secondary heating appliance | |
| Any item involving SAP Appendix Q | |
| Use of any low carbon or renewable energy technology | |
| <p>Note: Solutions using electric resistance heating may have to better several of these fabric parameters if the design does not include an element of renewable energy provision.</p> | |

Appendix C Work to thermal elements

- C1 Where work involves the renovation of a thermal element, an opportunity arises for cost-effective insulation improvements at marginal additional cost. This Appendix provides guidance on the cost-effectiveness of insulation measures when applied to the renovation of various types of thermal elements.
- C2 Table C1 gives the circumstances and level of performance that should be reasonable in normal circumstances. However, each scheme needs to be considered individually and some flexibility in the application of the standards will be necessary to suit particular cases. Where it is not reasonable in the context of the works project to achieve the performance set out in Table C1 the level of performance achieved should be as close to this as practically possible. Table C1 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.
- C3 It is essential to consider the practicability and technical risks that might arise when modifying a thermal element so as not to introduce risks that were not there before or to exacerbate existing problems or to cause impacts on adjoining buildings. BR 262 *Thermal insulation: avoiding risks*, gives useful guidance on minimising or avoiding risks due to the provision of thermal insulation.
- C4 When undertaking the renovation of thermal elements, special considerations apply to buildings of historical or architectural value and to buildings of traditional construction that need to “breathe” (see paragraphs 3.3 to 3.5).

| Table C1 Cost-effective U-value targets when undertaking renovation works to thermal elements | | | |
|---|--|---|---|
| Proposed works | Target U-value W/(m²K) | Typical construction | Comments (reasonableness, practicability and cost effectiveness) |
| Pitched roof constructions [Specification of thickness of insulation is based on lambda values (conductivity) of 0.4 W/(m ² K)] | | | |
| 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 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 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 |
| 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 | 0.18 | 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) Practical considerations with respect to an increase in structural thickness (particularly in terraced dwellings) may necessitate a lower performance target |
| 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 |

| Table C1 Cost-effective U-value targets when undertaking renovation works to thermal elements | | | |
|---|---|--|---|
| Proposed works | Target U-value W/(m²·K) | Typical construction | Comments (reasonableness, practicability and cost effectiveness) |
| 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 | 0.18 | 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 | 0.18 | 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 |
| Solid wall constructions | | | |
| Renewal of internal finish to external wall or applying a finish for the first time | 0.30 | 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 Insulated wall board fixed to internal wall surface to achieve the required U-value – thickness dependent on material used | 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 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 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 |
| 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.) |

Appendix D Publications referred to

Air Tightness Testing and Measurement Association (ATTMA)

www.attma.org

Measuring air permeability of building envelopes (dwellings),
Technical Standard L1, 2010
Available to download free from – www.bindt.org

BRE

www.bre.co.uk

BR 262 Thermal insulation: avoiding risks, 2001.
ISBN 978 186081 515 7

BRE Report BR 443 Conventions for U-value calculations, 2006.
Available to download from – www.bre.co.uk/uvalues

BRE Report BR 497 Convention for Calculating Linear Thermal
Transmittance and Temperature Factors 2007, ISBN 978 1 86081 986 5

Information Paper IP1/06 Assessing the effects of thermal bridging at
junctions and around openings in the external elements of buildings, 2006.
ISBN 978 1 86081 904 9

BSI

<http://shop.bsigroup.com/>

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

BS EN 14351-1:2006 Windows and doors. Product standard, performance
characteristics. Windows and external pedestrian doorsets without resistance
to fire and/or smoke leakage characteristics.

BS EN ISO 13370:2007 Thermal performance of buildings. Heat transfer via
the ground. Calculation methods.

BS EN ISO 13788:2002 Hygrothermal performance of building components
and building elements.

BS 6375-1:2009 Performance of windows and doors. Classification for
weathertightness and guidance on selection and specification.

BS 5250:2002 Code of practice for control of condensation in buildings.

BS 6229:2003 Flat roofs with continuously supported coverings. Code of
practice.

BSRIA

www.bsria.co.uk

BSRIA BG 8/2009 Model Commissioning Plan

Department for Communities and Local Government (CLG)

www.communities.gov.uk and www.thebuildingregs.com

Accredited Construction Details for Part L

Available to download from

www.planningportal.gov.uk/england/professionals/en/1115314255826.html

Domestic Building Services Compliance Guide, 2010

Domestic Ventilation Compliance Guide, 2010

Guide to condensing boiler installation assessment procedure for dwellings, 2005

All available to download from www.planningportal.gov.uk

Department for Energy and Climate Change (DECC)

www.decc.gov.uk

The Government's Standard Assessment Procedure for energy rating of dwellings, SAP 2009.

Available at www.bre.co.uk/sap2009

SEDBUK Boiler Efficiency Database

Available at www.sedbuk.com

Energy Saving Trust (EST)

www.est.org.uk

Energy Efficient Glazing – guidance

Available at www.energysavingtrust.org.uk/Home-improvements-and-products/Home-insulation-glazing/Glazing

Northern Ireland Environment Agency: Built Heritage

Historic buildings & energy efficiency. A guide to Part F of the Northern Ireland Building Regulations

Available to download from –

http://www.ni-environment.gov.uk/a_guide_to_part_f_of_the_northern_ireland_building_regulations_2006-3.pdf