Building Regulations (Northern Ireland) 2011

Proposed Guidance Edition

of

Technical Booklet F2

Conservation of fuel and power in buildings other than dwellings

Draft for Consultation

June 2011

Contents

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;

(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 C. 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 m^2; 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 m^2 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 m^2 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.

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

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.

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

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

Display window – an area of glazing, including glazed doors, intended for the display of products or services on offer within the building, positioned at the external perimeter of the building and at an access level and immediately adjacent to a pedestrian thoroughfare. Where there is a workspace within one glazing height of the perimeter, it should not be considered to be a "display window". Glazing that extends to a height of more than 3 m above an access level should not be considered as part of a display window except –

(a) where the items on display require a greater height of glazing;

(b) in existing buildings, when replacing display windows that already extend to a greater height; or

(c) where windows of a greater height are required as a result of a planning condition.

Dwelling –a house, flat or maisonette and includes any accommodation therein of not more than 50 m^2 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 this Technical Booklet applies to them.

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

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).

Fit-out work – that work needed to complete the internal layout and/or building services within the building shell to meet the specific needs of incoming occupiers. The building shell is the structural and non-structural envelope of a building provided at a primary stage (usually as a speculative development) for a subsequent project to fit out.

Fit-out work can be carried out at the same time as the construction of the building or some time after the shell has been completed.

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.

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

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.

Principal works – the work necessary to achieve the client's purposes in extending the building and/or increasing the installed capacity of any fixed building services.

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.

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 submitted 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;

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

TER – 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 *Non-domestic building services compliance guide* and the *National Calculation Methodology (NCM) modelling guide (for buildings other than dwellings in England and Wales),* refers to Part L (Conservation of fuel and power) of the building regulations for England & Wales and associated Approved Documents L2A and L2B, 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 buildings other than dwellings

GENERAL

2.1 This Section gives the methodology and limiting values used by the national calculation software (as listed on the Department's website) to calculate the Target carbon dioxide Emissions Rate (TER) and Building carbon dioxide Emissions Rate (BER). 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 BER when the details of a building are input to the approved software. The software will automatically flag out-of-range values and check that the BER is no greater than the TER as designed.

2.2 On completion of the building, details of the building as built should be entered into the software to confirm that the BER for the building 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 buildings other than dwellings for the following works –

(a) the erection of a new building;

(b) fit-out works either included as part of the erection of a building, or the first fit-out of a shell and core development where the shell is sold or let before the fit-out work is carried out.
(Section 3 applies to fit-out works in other circumstances); and

(c) the extension of an existing building where the total useful floor area of the extension is both greater than 100 m^2 and greater than 25% of the total useful floor area of the existing building, is treated as the erection of a new building.

2.5 Section 3 applies to work to an existing building or where a building is subject to a material change of use or where there is a change of energy status.

2.6 The provisions in this Technical Booklet also apply to buildings containing rooms for residential purposes which are not considered as dwellings.

2.7 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 *Technical Booklet F1*.

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.

2.8 When constructing a building that contains dwellings, account should also be taken of the guidance in *Technical Booklet F1*. *Technical Booklet F1* should be used for guidance relating to the work on the individual dwellings, with this Technical Booklet giving guidance relating to the of 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.

Buildings requiring specific consideration

2.9 Specific considerations apply to the following building types –

(a) buildings with low energy demand – the guidance specific to such buildings is given in paragraphs 2.10 to 2.12;

(b) industrial buildings and non-exempt agricultural buildings – the guidance specific to such buildings is given in paragraph 2.13;

(c) modular and portable buildings – the guidance specific to such buildings is given in paragraphs 2.14 to 2.19; and

(d) shell and core developments – the guidance specific to such buildings is given in paragraphs 2.20 and 2.22.

Buildings with low energy demand

2.10 For the purposes of this Section, buildings with low energy demand are taken to be those buildings or parts thereof where –

(a) fixed building services for heating and/or cooling are either not provided, or are provided only to heat or cool a localised area rather than the entire enclosed volume of the space concerned (e.g. localised radiant heaters at a workstation in a generally unheated space); or

(b) fixed building services are used to heat spaces in the building to temperatures substantially lower than those normally provided for human comfort (e.g. to provide condensation protection or frost protection in a warehouse).

In such situations, no TER/BER calculation is required. Also, it is not reasonable to expect the entire building envelope to be insulated to the standard expected for more normal buildings; it should be insulated to a degree that is reasonable in the particular case.

Where some general heating is provided (case (b) above), it would be reasonable that no part of the opaque fabric had a U-value greater than 0.7 W/m^{2}K. In addition, reasonable provision would be for every fixed building service that is installed to meet the energy efficiency standards given in CLG's *Non-domestic building services compliance guide*.

2.11 If a part of a building with low energy demand is partitioned off and heated normally (e.g. an office area in an unheated warehouse), the separately heated area should be treated as a separate "building" and the normal

procedures for demonstrating compliance (including a TER/BER calculation) apply to the heated and enclosed space.

2.12 Where a building with low energy demand subsequently changes such that the space is generally conditioned, this is likely to involve the initial provision of a fixed building service or an increase in the installed capacity of a fixed building service. Such activities may trigger consequential improvements, which would require the building envelope to be upgraded and possibly other consequential improvements to be made (see paragraphs 3.73 to 3.82); a process that is likely to be much more expensive than incorporating suitable levels of insulation at the new-build stage. Alternatively, if the building shell was designed as a building with low energy demand and the first occupier of the building wanted to install, for example heating, this would be first fit-out works. This means that a full TER/BER submission would then be required (see paragraph 2.4(b)).

Industrial buildings and non-exempt agricultural buildings

2.13 Special considerations may apply in these buildings (e.g. where a CO_2 target is established through other regulatory frameworks such as the carbon reduction commitment, or where it is impractical for the generic National Calculation Methodology to adequately account for the particular industrial processes or agricultural use without leading to the possibility of negative impacts on cost-effectiveness and/or increased technical risk). In such cases, reasonable provision would be to provide a building envelope and fixed building services that satisfy the standards given in Section 3.

Modular and portable buildings

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

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

Note: temporary buildings which are not intended to remain erect for more than 28 days are exempt from the Building Regulations. Site huts are also exempt from the Building Regulations.

At a given location

2.16 Compliance with Part F should be demonstrated by showing that satisfactory performance has been achieved against each of the five compliance criteria given in this Technical Booklet. However, if more than 70% of the external envelope of the building is to be created from sub-assemblies manufactured prior to the date this Technical Booklet comes into operation, the TER should be adjusted by the relevant factor from Table 2.1. One way of demonstrating the date of manufacture of each sub-assembly is by relating the serial number to the manufacturer’s records. If the units are to be refurbished as part of the process, then the guidance in Section 3 applies in terms of the

standards to be achieved (e.g. when replacing windows or installing new lighting).

Table 2.1 TER multiplying factor for modular and portable buildings

Date of manufacture of 70% of modules making up the external envelope	TER multiplying factor
After the date this Technical Booklet comes into operation	1.00
30 November 2006 – the date this Technical Booklet comes into operation	1.33
Pre 30 November 2006	1.75
For buildings with a planned time of use in a given location of less than 2 years	2.35

2.17 Modular and portable buildings with an intended planned time of use of less than 2 years at a location are often “distress purchases” (e.g. following a fire), and the buildings need to be up and operational in a matter of days. In such cases, the guidance in the following paragraphs applies. An example of the evidence that the planned time of use at a location is less than 2 years would be the hire agreement for the unit.

2.18 In the case of a modular or portable building intended to be sited in a given location for less than 2 years, a TER/BER calculation should be carried out when the module is first constructed and can be based on a standard generic configuration. This calculation can then be provided to demonstrate compliance whenever the building is moved to a new location, always provided its intended time of use in that new location is less than 2 years. In addition to the details of the calculation, the supplier should provide written confirmation that –

(a) the modules as actually provided meet or exceed the elemental energy standards of the generic module on which the calculation was based; and

(b) the activities assumed in the generic module are reasonably representative of the planned use of the actual module.

2.19 It is recognised that in situations where the planned time of use in a given location is less than 2 years, the only practical heating technology is electric resistance heating. In such cases, reasonable provision would be to provide energy efficiency measures that are 15% better than if using conventional fossil fuel heating. This can be demonstrated by assuming that the heating in the generic configuration used for the TER/BER calculation is provided by a gas boiler with an efficiency of 77%. Post initial erection, any work on the module should meet the standards given in Section 3 of this Technical Booklet. If a TER/BER calculation is not available for a module constructed prior to the date this Technical Booklet comes into effect, reasonable provision would be to demonstrate that the BER is no greater than the TER (calculated with a 2010 National Calculation Methodology) adjusted by the relevant factor from Table 2.1.

Shell and core developments

2.20 If a building is offered to the market for sale or let as a shell for specific fit-out work by the incoming occupier, the developer should demonstrate via the design-stage TER/BER submission how the building shell as offered could meet the requirements of Part F. For those parts of the building where certain systems are not installed at the point the building is to be offered to the market, the model that is used to derive the BER will have to assume efficiencies for those services that will be installed as part of the first fit-out work. The specification provided to the district council (see paragraph 2.36) should identify which services have not been provided in the shell, and the efficiency values assumed for each such system. This will enable the district council to ensure that the necessary infrastructure needed to deliver the assumed fit-out specification is provided as part of the shell.

2.21 At practical completion of the shell, the as-built TER/BER calculation should be based only on the building and systems as actually constructed and the assumed efficiencies for those services that are planned to be installed as part of the first fit-out work; the fit-out areas should be assumed to be conditioned to temperatures appropriate to their designated use, but no associated energy demand included.

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

Areas requiring specific consideration

Conservatories and similar highly glazed spaces

2.23 Where a new building incorporates a conservatory or similar highly glazed space which does not have thermal separation from the rest of the building it should be regarded as an integral part of the building and be included in the calculation of the TER and BER and in the air pressure test.

2.24 Where a conservatory, constructed as part of a new building, has thermal separation from the building, the TER and BER for the building 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 BER, 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 3.53 to 3.57;

(b) thermal elements that comply with the guidance in paragraph 3.62;

(c) where fixed building services are provided these should comply with the guidance in paragraphs 3.36 to 3.52; and

(d) where the conservatory or similar highly glazed space is heated, independent temperature and on/off controls.

Swimming pool basins

2.25 Where a swimming pool is constructed as part of a new building, provisions should be made to limit heat loss from the pool basin by achieving a U-value of not more than 0.25 W/m^2.K, calculated according to BS EN ISO 13370.

2.26 When assessing the building under Criterion 1, the building should be assessed as if the pool basin were not there, but the room enclosing the swimming pool should be included in the TER/BER 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)

2.27 The Target carbon dioxide Emissions Rate (TER) is the minimum acceptable energy performance for a new building. It is expressed in terms of the mass of carbon dioxide (CO_2) in units of kg per m^2 of total useful floor area per year emitted as the result of the provision of fixed building services in the building.

2.28 The TER should be calculated using one of the following types of software application approved by the Department as a National Calculation Methodology (NCM) for buildings other than dwellings –

(a) for those buildings whose design features are capable of being adequately modelled by the Simplified Building Energy Model (SBEM), software applications approved by the Department which interface to the SBEM 2010 edition; or

(b) Dynamic Simulation Model (DSM) software applications approved by the Department.

As part of the submission for Building Regulations approval the applicant should show that the software used is appropriate to the application.

2.29 The TER is established by using an approved software implementation of a NCM to calculate the CO_2 emissions rate from a notional building of the same size and shape as the actual building, but with specified properties. These specified properties should be as given in CLG's 2010 *National Calculation Methodology (NCM) modelling guide (for buildings other than dwellings in England and Wales),* in the section headed "Detailed definition of Notional Building for buildings other than dwellings". The TER is set equal to the CO_2 emissions from this notional building, with no further adjustment being made.

Note: the TER is no longer based on a 2002 notional building and an improvement factor. For 2010 it is based on a building of the same size and shape as the actual building, constructed to a concurrent specification. This specification for Part F 20xx (in Northern Ireland) is given in the 2010 *NCM modelling guide* (the same as for England & Wales). Developers are still given the freedom to vary the specification, provided that the same overall level of CO_2 emissions is not exceeded. This approach to target setting has been adopted because the level of improvement that can be reasonably expected varies significantly by building sector, and so a blanket improvement factor would be inequitable. The specification delivers an

overall 25% reduction in CO_2 emissions across the new-build mix for the non-dwellings sector (the so-called "aggregate approach"). Some building types will be required to improve by more than 25%, some by less, but all should achieve the required level of improvement at approximately the same cost of carbon mitigation.

2.30 To demonstrate that an acceptable CO_2 emissions rate has been achieved, the building as constructed should have a Building carbon dioxide Emissions Rate (BER) no greater than the TER calculated in accordance with paragraphs 2.27 to 2.29.

CRITERION 1 – ACHIEVING THE TER

Calculating the BER for the actual Building

General

2.31 The BER should be calculated using the same approved software used to calculate the TER.

2.32 In order to determine the BER, the CO_2 emission factors should be as specified in the paper published by DECC (see Table 12 at www.bre.co.uk/sap2009).

Multi-fuel systems

2.33 Where systems are capable of being fired by more than one fuel, then –

(a) where a biomass heating appliance is supplemented by an alternative appliance (e.g. gas), the CO_2 emission factor for the overall heating system should be based on a weighted average for the two fuels based on the anticipated usage of those fuels. The BER submission should be accompanied by a report, signed by a suitably qualified person, detailing how the combined emission factor has been derived;

(b) where the same appliance is capable of burning both biomass fuel and solid fossil fuel, the CO_2 emission factor for dual fuel appliances should be used, except where the building is in a smoke control area, where the anthracite figure should be used; and

(c) in all other cases, the fuel with the highest CO_2 emission factor should be used.

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

District or community heating or cooling systems

2.34 Where thermal energy is supplied from a district or community heating or cooling system, the emission factors should be determined based on the particular details of the scheme. The assessment should take account of the annual average performance of the whole system (i.e. the distribution circuits and all the heat generating plant, including any combined heat and power (CHP), and any waste heat recovery or heat dumping). The electricity generated by any CHP or trigeneration scheme is always credited at an emission factor equal to the grid average. CO_2 emissions associated with the

thermal energy streams of a trigeneration scheme should be attributed in proportion to the output energy streams.

2.35 The BER submission should be accompanied by a report, signed by a suitably qualified person, detailing how the emission factors have been derived.

This means that if a trigeneration scheme burns F kWh of input fuel to produce E kWh of electricity, H kWh of useful heat and C kWh of useful cooling, the emission factor for the heat and coolth output should both be taken as –

$$\frac{(F \times CO_{2F}) - (E \times CO_{2E})}{H + C}$$

where CO_{2F} is the emission factor for the input fuel, and CO_{2E} the factor for grid electricity.

See NCM Modelling Guide at www.communities.gov.uk .

Calculation before commencement of work

2.36 A calculation should be carried out that demonstrates that the BER for the building 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 BER 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 compliance software 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 building 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

2.37 A calculation should be carried out that demonstrates that the BER of the building as constructed is no greater than the TER. Not more than 5 days after completion of the work, the person carrying out the work is required to notify the district council of the TER and BER and whether the building has been constructed in accordance with the list of specifications submitted 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 BER 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 BER 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 building as designed satisfies the provisions in Criteria 2 and 3.

Enhanced management and control features

2.38 Certain management and control features give improved energy efficiency. Where these are operational in a building, the BER may be reduced by an amount equal to the product of the adjustment factor in Table 2.2 and the CO_2 emissions for the system(s) to which the feature is applied.

For example, if the CO_2 emissions due to electrical energy consumption were 70 $kgCO_2/(m^2 \cdot year)$ without power factor correction, the provision of correction equipment to achieve a power factor of 0.95 would enable the BER to be reduced by 70 x 0.025 = 1.75 $kgCO_2/(m^2 \cdot year)$.

Table 2.2 Enhanced management and control features

Feature	Adjustment factor
Automatic monitoring and targeting with alarms for out of range values(1)	0.050
Power factor correction to achieve a whole building power factor > 0.90(2)	0.010
Power factor correction to achieve a whole building power factor > 0.95(2)	0.025

Notes:

(1) Automatic monitoring and targeting with alarms for out of range values means a complete installation that measures, records, transmits, analyses, reports and communicates meaningful energy management information to enable the operator to manage the energy it uses.

(2) The power factor adjustment can be taken only if the whole building power factor is corrected to the level stated. The two levels of power factor correction are alternative values, not additive.

Low or zero carbon energy sources

2.39 Provided that the building 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. The approved compliance tools include appropriate algorithms that enable the designer to assess the role LZC technologies can play in achieving the TER.

2.40 To facilitate incorporation of improvements in system efficiencies and the integration with LZC technologies, the designer should consider –

(a) adopting heating and cooling systems that use distribution temperatures as close to ambient temperatures as practicable; and

(b) where multiple systems serve the same end use, organising the control strategies such 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.

2.41 The designer should consider making the building easily adaptable by facilitating the integration of additional LZC technologies at a later date. Providing appropriate facilities at the construction stage can make subsequent enhancements much easier and cheaper (e.g. providing capped off connections that can link into a planned community heating scheme).

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

CRITERION 2 – MINIMUM ACCEPTABLE STANDARDS

U-values

2.42 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 2.3. 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 2.3.

2.43 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 element or 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 –

(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 particular size and configuration of the actual unit.

2.44 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.

2.45 For domestic-type construction, SAP 2009 Table 6e gives U-values for different window configurations that can be used in the absence of test data or calculated values.

Table 2.3 Limiting area weighted average U-values {W/(m^2.K)}	
Element	**U-value**
Wall	0.35
Floor	0.25
Roof	0.25
Windows, roof windows, rooflights(1), curtain walling and pedestrian doors(2,3)	2.20
Vehicle access and similar large doors	1.50
High-usage entrance doors	3.50
Roof ventilators (including smoke vents)	3.50
Swimming pool basin (walls and floor)(4)	0.25

Notes:

1 The relevant rooflight U-value for checking against these limits is that based on the developed area of the rooflight, not the area of the roof aperture.

2 Excluding display windows and similar glazing. There is no limit on design flexibility for these exclusions but their impact on CO_2 emissions should be taken into account in calculations.

3 Where a building has high internal heat gains, a less demanding area-weighted average U-value for the glazing may be an appropriate way of reducing overall CO_2 emissions and hence the BER. Where this can be demonstrated, the area-weighted average U-value for windows, doors and rooflights may be relaxed from the values given above. However, values should not exceed 2.7 W/m^2.K.

4 See paragraphs 2.25 and 2.26

Air permeability

2.46 The maximum permissible air permeability is 10 m^3/(h.m^2) @ 50 Pa (except where paragraph 2.84(a) applies).

2.47 Where the conditions given in paragraph 2.74(a) apply, the air permeability may be varied from the value given in the previous paragraph provided that compensating provisions are made such that the TER is achieved or bettered.

Fixed building service systems

System efficiencies

2.48 Every fixed building service should be at least as efficient as the minimum acceptable efficiency for that particular type of appliance or fitting given in the *Non-domestic building services compliance guide*.

The efficiency claimed for the fixed building service should be based on the appropriate test standard given in this guide and the test data should be certified by an appropriate independent 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.

Controls

2.49 The following provisions should be made for heating, ventilation and air-conditioning system controls –

(a) the fixed building services system(s) should be subdivided into separate control zones to correspond to each area of the building that has a significantly different solar exposure, or occupancy period or type of use;

(b) each separate control zone should be capable of independent timing and temperature control and, where appropriate, ventilation and air circulation rate;

(c) the service should respond to the requirements of the space it serves. Where both heating and cooling are provided, they should be controlled so as not to operate simultaneously; and

(d) central plant should operate only as and when the zone systems require it. The default condition should be “off”.

Energy meters

2.50 Energy meters should be provided to enable at least 90% of the estimated annual energy consumption of each fuel to be assigned to the various end-use categories (heating, lighting, etc.). Detailed guidance on how this can be achieved is given in CIBSE’s TM 39 *Building energy metering*.

In addition to this the following provisions apply –

(a) meters should be provided to separately monitor the performance of any low or zero carbon energy system(s);

(b) in buildings with a total useful floor area greater than 1000 m^2, the metering system should enable automatic meter reading and data collection; and

(c) the metering should be designed so as to facilitate the benchmarking of energy performance to the CIBSE’s TM 46 *Energy benchmarks*.

Centralised switching of appliances

2.51 Consideration should be given to the provision of centralised switches to allow the facilities manager to switch off appliances when they are not needed (e.g. overnight and at weekends). Where appropriate, these should be automated (with manual override) so that energy savings are maximised.

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

CRITERION 3 – LIMITING THE EFFECTS OF SOLAR GAINS

General

2.52 The following guidance applies to all buildings, irrespective of whether they are air-conditioned or not. The intention is to limit solar gains during the summer period to –

(a) avoid the need for air-conditioning;

(b) reduce the need for air-conditioning; or

(c) reduce the installed capacity of any air-conditioning system that is to be installed.

2.53 If this criterion (given in the provisions in paragraph 2.54) is satisfied in the context of a naturally ventilated building, it is not evidence that the internal environment of the building will be satisfactory, since many factors that are not covered by the compliance assessment procedure will have a bearing on the incidence of overheating (incidental gains, thermal capacity, ventilation provisions, etc.). Therefore the developer should work with the design team to specify what constitutes an acceptable indoor environment in the particular case, and carry out the necessary design assessments to develop solutions that meet the agreed brief. Some ways of assessing overheating risk are given in CIBSE's TM37 *Design for improved solar shading control* and, for education buildings, in Department for Education and Skills' BB101 *Ventilation of school buildings*.

Demonstrating compliance

2.54 Demonstrate that, for each space in the building that is either occupied or mechanically cooled, the solar gains through the glazing aggregated over the period from April to September inclusive, are no greater than would occur through one of the following reference glazing systems with a defined total solar energy transmittance (g-value) calculated according to BS EN 410 –

(a) for every space that is defined in the NCM database as being side lit, the reference case is an east-facing façade with full-width glazing to a height of 1.0 m having a framing factor of 10% and a normal solar energy transmittance (g-value) of 0.68;

(b) for every space that is defined in the NCM database as being top lit, and whose average zone height is no greater than 6 m, the reference case is a horizontal roof of the same total area that is 10% glazed as viewed from the inside out and having rooflights that have a framing factor of 25% and a normal solar energy transmittance (g-value) of 0.68; or

(c) for every space that is defined in the NCM database as being top lit and whose average zone height is greater than 6 m, the reference case is a horizontal roof of the same total area that is 20% glazed as viewed from the inside and having rooflights that have a framing factor of 15% and a normal solar energy transmittance (g-value) of 0.46.

In double-height industrial-type spaces, dirt on the rooflights and internal absorption within the rooflight reduce solar gains. These effects, combined with temperature stratification, will reduce the impact of solar gains in the occupied space and so an increase in rooflight area may be justified. In such situations, the developer should pay particular attention to the design assessments referred to in paragraph 2.54(b).

For the purpose of this specific guidance, an occupied space means a space that is intended to be occupied by the same person for a substantial part of the day. This excludes circulation spaces, and other areas of transient occupancy, such as toilets, as well as spaces that are not intended for occupation (e.g. display windows).

CRITERION 4 – QUALITY OF CONSTRUCTION AND COMMISSIONING

General

2.55 Every building 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 Building carbon dioxide Emissions Rate (BER) no greater than the Target carbon dioxide Emissions Rate (TER).

As stated in paragraph 2.37, a recalculation of the BER is required to be submitted to the district council not more than 5 days after completion of the building taking into account any changes in performance between design and construction and the achieved air permeability, ductwork leakage and commissioned fan performance and to demonstrate that the building as completed meets its TER.

Building envelope

2.56 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 buildings and other thermal bypasses

2.57 Contrary to previous assumptions, cavity walls separating buildings (hereafter referred to as party walls) may not be zero heat loss walls because air flows in the cavity provide a heat loss mechanism.

2.58 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.

2.59 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 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 2.4 should be used.

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

2.60 When calculating the BER for a building, the appropriate party wall U-value should be taken from Table 2.4.

Table 2.4 U-values for party walls {W/(m^2·K)}

Party wall 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

2.61 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 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.

2.62 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.

2.63 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 2.65).

Thermal bridges

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

2.65 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.

2.66 Where calculated in support of the approaches given in paragraphs 2.68 and 2.69, 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*.

2.67 Similarly, in support of the approaches given in paragraphs 2.68 and 2.69, 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.

Buildings constructed to quality-assured accredited construction details

2.68 Where a building is to be constructed using quality-assured accredited construction details, the calculated linear thermal transmittance can be used directly in the calculation of the BER.

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.

Buildings NOT constructed to quality-assured accredited construction details

2.69 Where a building 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 BER.

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.

2.70 Where the building is constructed to unaccredited details, with no specific quantification of the thermal bridge values, the generic linear thermal bridge values as given in BRE paper IP 1/06 increased by 0.04 W/m.K or 50% whichever is greater should be used in the calculation of the BER.

2.71 The approaches given in paragraphs 2.68 and 2.69 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/(m·K) or 25%, whichever is the greater would apply only to the thermal transmittance of the window head detail.

Air permeability and pressure testing

2.72 The procedure for air pressure testing is given in the Air Tightness Testing and Measurement Association (ATTMA) publication *Measuring air permeability of building envelopes (non-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.

2.73 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.

2.74 All buildings other than dwellings (including extensions that are being treated as new buildings for the purposes of complying with Part F) should be air pressure tested, with the following variations –

(a) buildings of less than 500 m^2 in total useful floor area, where the developer may choose to avoid air pressure testing by assuming that the design air permeability is 15 $m^3/(h.m^2)$ at 50 Pa for the purposes of calculating the BER, in which case compensating measures will be required;

(b) factory-made modular buildings of less than 500 m^2 floor area, with a planned service life of more than 2 years (at one or more sites), and where no site assembly work is needed other than making linkages between standard modules using standard link details. A notice should be given to the district council confirming that the building as installed conforms to one of the standard configurations of modules and link details for which the installer has certified pressure test data from a minimum of 5 in-situ measurements incorporating the same module types and link details as utilised in the actual building. The results should indicate that the average test result is better than the design air permeability as specified in the BER calculation by not less than 1.0 $m^3/(h.m^2)$ at 50 Pa;

(c) large extensions, whose compliance with Part F is being assessed as if they were new buildings, and where sealing off the extension from the existing building is impractical. *Measuring air permeability of building envelopes* gives recommendations on how extensions can be tested and on situations where pressure tests are inappropriate. Where it is agreed with the district council that testing is impractical, the extension should be treated as a large, complex building and the provisions in paragraph 2.74(d) apply;

(d) large complex buildings (such as an airport terminal or large shopping centre), where due to building size or complexity, it may be impractical to carry out pressure testing of the whole building. *Measuring air permeability of building envelopes* indicates those situations where this might apply. Before adopting this approach, developers should produce in advance of construction work and in

accordance with the approved procedure, a detailed justification of why pressure testing is inappropriate. This justification should be endorsed by a suitably qualified person.

Where the district council accepts that air pressure testing is impracticable, compliance could be demonstrated where a suitably qualified person undertakes a detailed programme of design development, component testing and site supervision to give confidence that a continuous air barrier will be achieved. When following this route, it would not be possible to claim an air permeability lower than 5.0 $m^3/(h.m^2)$ at 50 Pa. One example of such a suitably qualified person would be an ATTMA member. The 5.0 $m^3/(h.m^2)$ at 50 Pa limit has been set because at better standards the actual level of performance becomes too vulnerable to single point defects in the air barrier; or

(e) compartmentalised buildings, where the building is divided into self-contained units with no internal connections, it may be impractical to carry out whole building pressure tests. In such circumstances, it would be reasonable to carry out a pressure test on a representative section of the buildings as detailed in the ATTMA publication. In the event of a test failure, the provisions of paragraphs 2.75 and 2.77 would apply and a further test should be carried out on another representative section of the building to confirm that the required standard is achieved in all parts of the building.

Demonstrating air permeability compliance

2.75 Compliance would be demonstrated where –

(a) the measured air permeability is no greater than 10 $m^3/(h.m^2)$ at 50 Pa; and

(b) the BER, calculated on completion using the measured air permeability, is no greater than the TER.

Where it proves impractical to meet the design air permeability, any shortfall should be compensated for through improvements to subsequent fit-out activities. The person carrying out the work may therefore wish to schedule pressure tests early enough to facilitate remedial work on the building fabric (e.g. before suspended ceilings are installed).

2.76 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.

2.77 Where a building fails to achieve the provisions of paragraph 2.75, remedial measures should be carried out such that the building complies with the provisions of paragraph 2.75.

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

Commissioning of fixed building services

General

2.78 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.

2.79 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.

2.80 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 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.

2.81 Where commissioning is carried out it should be done in accordance with the following procedures –

(a) CIBSE *Commissioning code M: Commissioning management*; and

(b) the procedures for leakage testing of ductwork given in paragraphs 2.82 to 2.85.

Air leakage testing of ductwork

2.82 Air leakage testing of ductwork should be carried out in accordance with the procedures given in HVCA's DW/143 *Practical guide to ductwork leakage testing* on systems served by fans with a design flow rate greater than 1 m^3/s and for those sections of ductwork where –

(a) the pressure class is such that DW/143 recommends testing; or

(b) the BER calculation assumes a leakage rate for a given section of ductwork that is lower than the standard for its particular pressure class. In such circumstances, any low-pressure ductwork should be tested using the testing provisions given in DW/143 for medium-pressure ductwork. The pressure classes are given in Table 2.5.

Table 2.5 Ductwork pressure classes

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

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

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

2.85 Where a ductwork system fails to meet the required standard, remedial work should be carried out as necessary to achieve satisfactory performance in retests and further ductwork sections should be tested in accordance with DW/143.

Notice of completion of commissioning

2.86 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.

For HVAC systems, a member of the Commissioning Specialists Association or the Commissioning Group of the HVCA, may be regarded as a suitably qualified person. For lighting control systems, a person accredited under the Lighting Industry Commissioning Scheme may be regarded as a suitably qualified person.

2.87 The notice should confirm that –

(a) a commissioning plan has been followed such that every system has been inspected and commissioned in an appropriate sequence and to a reasonable standard; and

(b) the results of tests confirm that the performance is reasonably in accordance with the actual building designs, including written commentaries where it is proposed to accept excursions (variations).

2.88 The use of the templates in the BSRIA *Model commissioning plan* is a way of documenting the process in an appropriate way.

2.89 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

2.90 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 building and its fixed building services to be operated and maintained in an energy efficient manner.

2.91 The district council is required to be notified in writing that the provision in paragraph 2.90 has been met.

2.92 A building logbook should be provided in the format given in CIBSE TM 31 *Building log book toolkit*. The information should be presented in templates as or similar to those in TM 31. The information could draw on or refer to

information available as part of other documentation, such as the operation and maintenance manuals and the health and safety file.

2.93 The TER and BER for the building should be included with the log book together with the data used to calculate them.

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

Section 3 Existing buildings other than dwellings

GENERAL

Types of work covered by this Section

3.1 This Section gives provisions for altering or extending a building, where a building is subject to a material change of use, or where there is a change of energy status.

3.2 This Section gives guidance relating to the following building works –

(a) extensions (see paragraphs 3.11 to 3.25);

(b) where there is a material change of use (see paragraphs 3.26 to 3.34);

(c) where there is a change of energy status (see paragraphs 3.26 to 3.35);

(d) the provision or extension of a controlled service (see paragraphs 3.36 to 3.52);

(e) the provision or extension of a controlled fitting (see paragraphs 3.53 to 3.60);

(f) the provision, renovation or the replacement of a thermal element (see paragraphs 3.62 to 3.70); and

(g) consequential improvements (see paragraphs 3.73 to 3.82).

3.3 When building works are in relation to an existing building, it may be more appropriate to utilise the guidance from Section 2, or to follow only a limited amount of the guidance in this Section. The following sub-paragraphs identify some of the circumstances where the use of Section 2 might be appropriate –

(a) where the work involves the first fitting out of a new building built to comply with Section 2, the initial fit-out works should comply with Section 2 as if it were part of the initial construction work. In all other circumstances the fit-out works should comply with Section 3;

(b) where the work involves a large extension the work should comply with the provisions in Section 2 (see paragraph 3.12). However, where consequential improvements are required these should comply with Section 3;

(c) where the work involves the construction of an extension to an existing building using sub-assemblies that have been obtained from a centrally held stock or from the disassembly or relocation of buildings, the works should comply with Section 2. Where consequential improvements apply, the consequential improvements should comply with Section 3.

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

(d) where the work involves a building that either before the work or after the work is completed contains one or more dwellings, the provisions of *Technical Booklet F1* apply to dwellings.

Buildings requiring Specific consideration

3.4 Specific considerations apply to the following building types –

(a) historic and traditional buildings – the considerations that apply to such existing buildings are given in paragraphs 3.5 to 3.7;

(b) buildings with low energy demand – the guidance specific to such buildings is given in paragraphs 3.8 to 3.10;

(c) modular and portable buildings with a planned service life of more than 2 years (at one or more sites) – the guidance in Section 2 applies. Any changes to the building fabric or fixed building services should comply with this Section.

Historic and traditional buildings

3.5 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.

3.6 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.

3.7 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.

Buildings with low energy demand

3.8 For the purposes of this Section, buildings with a low energy demand are taken to be those buildings or parts thereof where –

(a) fixed building services for heating and/or cooling are either not provided, or are provided only to heat or cool a localised area rather than the entire enclosed volume of the space concerned (e.g. localised radiant heaters at a workstation in an otherwise unheated space); or

(b) fixed building services are used to heat spaces in the building to temperatures substantially lower than those normally provided for human comfort (e.g. to provide condensation protection or frost protection in a warehouse).

In such situations, it is not reasonable to expect the entire building envelope to be insulated to the standard expected for more normal buildings. Therefore, if an existing building with low levels of heating is extended or parts of the fabric renovated, the new or renovated building envelope should be insulated only to a degree that is reasonable in the particular case.

Where some general heating is provided (case (b) above), it would be reasonable that no part of the opaque fabric had a U-value greater than 0.7 W/m^2.K. In addition, reasonable provision would be for every newly installed fixed building service to meet the energy efficiency standards given in CLG's *Non-domestic building services compliance guide*.

3.9 If a part of a building with low energy demand is partitioned off and heated normally (e.g. an office area in an unheated warehouse), the separately heated area should be treated as a separate "building" and the normal procedures for demonstrating compliance apply to the heated and enclosed space.

3.10 Where a building with low energy demand subsequently changes such that the space is generally conditioned, this is likely to involve the initial provision of a fixed building service or an increase in the installed capacity of an existing fixed building service. Such activities may trigger consequential improvements, which would require the building envelope to be upgraded and possibly other consequential improvements to be made (see paragraphs 3.73 to 3.82). Alternatively, if the building shell was designed as a building with low energy demand and the first occupier of the building wanted to install, for example heating, this would be first fit-out works and Section 2 would apply. This means that a full TER/BER submission would then be required (see paragraph 2.4(b)).

EXTENSIONS

3.11 Where an existing building having a total useful floor area greater than 1000 m^2 is to be extended, consequential improvements should be made to the existing building in accordance with paragraphs 3.73 to 3.82, in addition to following the guidance in the rest of this Section.

Large extensions

3.12 Where a proposed extension has a total useful floor area that is both –

(a) greater than 100 m^2; and

(b) greater than 25% of the total useful floor area of the existing building,

it should be treated as a new building and should be designed to comply with Section 2 of this Technical Booklet. The requirement for consequential improvements, if applicable, should also be met by following the guidance in paragraphs 3.73 to 3.82.

Other extensions

3.13 For other extensions there are three approaches –

(a) the Standards Based Approach (see paragraphs 3.15 to 3.17);

(b) the Calculated Trade-off Approach (see paragraph 3.18); or

(c) the Equivalent Carbon Target Approach (see paragraphs 3.19 to 3.21).

3.14 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

3.15 The extension should achieve the following performance standards –

(a) area of glazing that comply with paragraph 3.16;

(b) doors, windows, roof windows, rooflights and smoke vents that meet the standards given in paragraphs 3.53 to 3.59;

(c) newly constructed thermal elements that meet the standards given in paragraphs 3.61 to 3.66; and

(d) existing opaque fabric that becomes part of the thermal envelope, where previously it was not, that meets the standards given in paragraphs 3.71 and 3.72.

Area of glazing

3.16 The total area of windows, roof windows, rooflights and doors in an extension should not exceed the values given in Table 3.1 unless a greater percentage of glazing is present in the elevations of the adjoining part of the existing building to which the extension is attached. In such cases, the area of glazing may be increased but should not exceed the percentage of glazing in the adjoining part of the existing building.

Table 3.1 Glazed areas in the extension

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

Fixed building services

3.17 Where a fixed building service is provided or extended as part of constructing the extension, it should comply with the guidance in paragraphs 3.36 to 3.52.

Calculated Trade-off Approach

3.18 The fabric standards referred to in paragraph 3.15 and the glazed areas given in paragraph 3.16 may be varied provided that –

(a) the area-weighted U-value of all the elements in the extension is no greater than that of an extension of the same size and shape that complies with the U-value standards referred to in paragraph 3.15 and the glazed area standards in paragraph 3.16; and

(b) any fixed building service provided or extended as part of constructing the extension should comply with the standards given in paragraphs 3.36 to 3.52.

The area-weighted U-value is given by the following formula –

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

Equivalent Carbon Target Approach

3.19 An approved software implementation of a National Calculation Methodology should be used to demonstrate that the calculated carbon dioxide emissions rate from the existing building with its proposed extension is no greater than for the building with a notional extension of the same shape and size complying with the standards referred to in paragraphs 3.15 to 3.17. For the purposes of these calculations, both the proposed and notional buildings should incorporate the measures necessary to comply with the provisions for consequential improvement where these apply (see paragraphs 3.73 to 3.82).

Otherwise all the low-cost measures would have been taken by the compensatory measures, leaving little leeway for overall improvement with the consequential improvements.

3.20 Where additional upgrades (over and above the consequential improvements) are proposed to the existing building 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 3.4.

3.21 Where it is proposed to upgrade the existing building, 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 building may be better than that required by paragraphs 3.15 to 3.17.

Highly glazed extensions

Conservatories exempt from the Building Regulations

3.22 Some conservatories built as extensions are exempt from the Building Regulations – see Class 8 of Schedule 2 to the Building Regulations.

3.23 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 paragraph 3.35 should be followed.

Conservatories, sun-rooms and other highly glazed spaces

3.24 Where a building is extended by a non-exempt conservatory or 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 3.53 to 3.57;

(c) no limit on the area of glazing (i.e. paragraph 3.16 does not apply);

(d) new thermal elements that comply with the guidance in paragraph 3.62.

(e) retained thermal elements that comply with the guidance in paragraphs 3.71 and 3.72; and

(f) where the extension is heated, independent temperature and on/off controls.

3.25 Alternatively, the extension may be constructed in accordance with one of the approaches given in paragraph 3.13.

MATERIAL CHANGE OF USE OR CHANGE OF ENERGY STATUS

General

3.26 Where there is a material change of use to a building or a change of energy status to a building or part of a building, there are two approaches –

(a) the Standards Based Approach; or

(b) the Equivalent Carbon Target Approach.

3.27 Where a previously unheated building (or part of a building) is to be heated this is a change of energy status.

Standards Based Approach

Common provisions

3.28 Where the work involves the provision of a new or replacement thermal element it should comply with the provisions of paragraphs 3.62 to 3.66.

3.29 Where a thermal element is to being retained, it should comply with the provisions of paragraphs 3.71 and 3.72. This guidance also applies to an existing element that becomes part of the thermal envelope of the building where previously it was not.

As an example, this would include the party wall between units in a terrace of industrial units which originally were unheated, but heating is to be provided to one of the units.

3.30 Where controlled fittings or services are being provided or extended, they should comply with the provisions of paragraphs 3.36 to 3.59.

3.31 Where any existing window (excluding display windows but including roof windows or rooflights) or door (excluding high usage entrance doors) that separates a conditioned space from an unconditioned space (or the external environment) has a U-value greater than 3.3 W/(m^2·K) it should be replaced in accordance with the provisions given in paragraphs 3.53 to 3.59.

Additional provision for a material change of use

3.32 In a building subject to a material change of use, where the area of glazing is more than 25% of the total floor area of the building, 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 3.34.

3.33 As well as satisfying Part F in respect of the material change of use or change in energy status, such building work may be one of the triggers for consequential improvements (see paragraphs 3.73 to 3.82).

Equivalent Carbon Target Approach

3.34 An approved software implementation of a National Calculation Methodology may be used to demonstrate that the carbon dioxide emissions rate from the building as it will become is no greater than that of a notional building of the same shape and size complying with the Standards Based Approach.

Previously exempt conservatories and porches

3.35 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 building is not retained (e.g. if any part of the thermal separation between the building and the extension is removed and not replaced);

(b) the building'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.

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 3.34.

CONTROLLED SERVICES

General

3.36 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 *Non-domestic building services compliance guide*. This guide covers the following services –

(a) heating and hot water water systems (including the insulation of pipes, ducts and vessels;

(b) mechanical ventilation;

(c) mechanical cooling/air-conditioning;

(d) fixed internal lighting; and

(e) renewable energy systems.

3.37 When 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 new service uses a different fuel, the efficiency of the new appliance should be multiplied by the ratio of the CO_2 emission factor of the fuel used by the appliance being replaced to that of the fuel used by the new appliance when making this check. The emission factors should be as specified in the paper published by DECC (see Table 12 at www.bre.co.uk/sap2009).

This will prevent an existing low-carbon component being replaced by a lesser provision when fuel switching. For example, where an existing electric chiller with a coefficient of performance (CoP) of 2.5 is replaced with an absorption chiller with a CoP of 0.8 and which is fired by waste heat, the equivalent efficiency of the absorption chiller would be 0.8 x (0.517/0.058) = 7.1, which is greater than the efficiency (CoP) of the existing system (2.5) and therefore criterion in paragraph 3.37 would be satisfied.

The emission factors for electricity and waste heat are 0.517 and 0.058 $kgCO_2/kWh$ respectively.

3.38 The efficiency claimed for the fixed building service should be based on the appropriate test standard as given in the *Non-domestic building services compliance guide* and the test data should be independently certified by an accredited body.

Where a particular technology is not covered in 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.

3.39 New heating, ventilating, and air conditioning (HVAC) systems should be provided with controls that meet the following requirements –

(a) the fixed building services systems should be sub-divided into separate control zones to correspond to each area of the building that has a significantly different solar exposure, occupancy period, or type of use;

(b) each separate control zone should be capable of independent switching and control of set-point;

(c) the service should respond to the requirements of the space it serves. Where both heating and cooling are provided they should be controlled so as not to operate simultaneously;

(d) the central plant should only operate as and when the zone requires it. The default condition should be off; and

(e) in addition to these general control requirements, the systems should meet the specific control requirements and general energy efficiency criteria as given in the *Non-domestic building services compliance guide*.

3.40 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.

3.41 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.

Energy meters

3.42 The aim for buildings as a whole is to enable building occupiers to assign at least 90% of the estimated annual energy consumption for each fuel to the various end-use categories (heating, lighting, etc.).

3.43 Reasonable provision for energy meters in existing buildings would be to install energy metering systems in the building services systems provided as part of the works. Detailed guidance on how this can be achieved is given in CIBSE's TM 39 *Building energy metering*.

In addition the following provisions apply –

(a) meters should be provided to separately meter and monitor the performance of any low or zero carbon energy systems provided as part of the works;

(b) in buildings with a total useful floor area greater than 1000 m^2, the system should enable automatic meter reading and data collection; and

(c) the metering should be designed so as to facilitate the benchmarking of energy performance to the CIBSE's TM 46 *Energy benchmarks*.

Commissioning of fixed building services

General

3.44 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.

3.45 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.

3.46 Where commissioning is carried out it should be done in accordance with the following procedures –

(a) the CIBSE *Commissioning code M: Commissioning management*; and

(b) the procedures for leakage testing of ductwork given in paragraphs 3.47 to 3.49.

Air leakage testing of ductwork

3.47 Air leakage testing of ductwork should be carried out on new or refurbished ducting where practicable in accordance with the procedures given in HVCA's DW/143 *A practical guide to ductwork leakage testing* on systems served by fans with a design flow rate greater than 1 m^3/s and for those sections of ductwork where the pressure class is such that DW/143 recommends testing.

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

3.49 Where a ductwork system fails to meet the required standard, remedial work should be carried out as necessary to achieve satisfactory performance in retests and further ductwork sections should be tested in accordance with DW/143.

Notice of completion of commissioning

3.50 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.

3.51 For HVAC systems, a member of the Commissioning Specialists Association or the Commissioning Group of the HVCA, may be regarded as a suitably qualified person. For lighting control systems, a person accredited under the Lighting Industry Commissioning Scheme may be regarded as a suitably qualified person.

3.52 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

3.53 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.

3.54 Where windows, roof windows, rooflights or doors are to be provided, they should be draught-proofed units whose area-weighted average performance is no worse than that given in Table 3.2. When replacing controlled fittings, insulated cavity closers should be provided where appropriate.

3.55 Where, because of the need to maintain the external appearance of a building, replacement windows are unable to meet the standards given in Table 3.2, the replacement windows should have a centre pane U-value of not more than 1.2 W/m^2·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.

3.56 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 of a 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.

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

3.57 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.

The stated standard for a replacement plastic rooflight as given in Table 3.2 is 1.8 W/m^2·K. This is for the unit assessed in the vertical plane. If the performance of a triple-skin rooflight was assessed in the horizontal plane, then, based on the guidance given in BR 443, the standard would be adjusted by 0.3 W/m^2·K (the value from BR 443 for a horizontal triple-skin rooflight), requiring the rooflight as assessed in the horizontal plane to achieve a standard of 1.8 + 0.3 = 2.1 W/m^2·K.

3.58 In some buildings with high internal heat gains, a less demanding U-value for glazing may be an appropriate way of reducing overall CO_2 emissions. Where this can be demonstrated by calculation, the average U-value for windows, doors and rooflights may be greater than the value given in Table 3.2, but should not exceed 2.7 W/m^2·K.

3.59 The overall U-value of curtain walling including glazing should be not exceed the lesser of 1.8 W/m^2·K or a limiting U-value (U_{limit}) given by –

U_{limit}= 0.8 + {(1.2 + (FOL x 0.5)) x GF}

where FOL is the fraction of opening lights and GF is the glazed fraction.

For example, if the area of curtain walling is 60% glazed and 40% opaque, with 50% opening lights, the overall U-value of the curtain walling should not exceed
0.8 + {(1.2 + (0.5 x 0.5)) x 0.6} = 1.7 W/m^2·K.

Table 3.2 Standards for controlled fittings	
Fitting	**Standard**
Windows, roof windows and glazed rooflights(1)	1.8 W/m^2·K for the whole unit
Alternative option for windows in buildings that are essentially domestic in character(2)	A window energy rating(3) of Band C
Plastic rooflight(4)	1.8 W/m^2·K
Curtain walling	See paragraph 3.59
Pedestrian doors where the door has more than 50% of its internal face area glazed	1.8 W/m^2·K for the whole unit
High-usage entrance doors for people	3.5 W/m^2·K
Vehicle access and similar large doors	1.5 W/m^2·K
Other doors	1.8 W/m^2.K
Roof ventilators (including smoke extract ventilators)	3.5 W/m^2·K
Notes: (1) Excluding display windows. (2) For example, student accommodation, care homes and similar uses where the occupancy levels and internal gains are essentially domestic in character. (3) See *Technical Booklet F1* for more detail on window energy rating. (4) The relevant rooflight U-value for checking against these limits is that based on the developed area of the rooflight, not the area of the roof aperture.	

3.60 If a window, pedestrian door or rooflight is enlarged or a new one created, the total area of windows, pedestrian doors and rooflights expressed as a percentage of the total floor area of the building should not exceed the relevant value from Table 3.1 unless compensating measures are made elsewhere in the building.

NEW, RENOVATED AND RETAINED THERMAL ELEMENTS

3.61 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

U-values

3.62 New thermal elements, or thermal elements constructed as replacements for existing elements, should have a U-value no greater than that given in Table 3.3.

Curtain walling is treated as a controlled fitting and guidance is given in paragraph 3.59.

Table 3.3 U-values for new thermal elements {W/m^2·K}	
Element[1]	**U-value**
Wall[2]	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[3]	0.22
Swimming pool basin (walls and floor)[4]	0.25

Notes:

(1) "Roof" includes the roof parts of dormer windows, and "wall" includes the wall parts (dormer cheeks) of dormer windows.

(2) 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.

(3) 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 an extension may be calculated using the exposed perimeter and floor area of the enlarged building.

(4) As calculated according to BS EN ISO 13370.

Continuity to limit thermal bridging and air leakage

3.63 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.

3.64 The building fabric should be constructed to minimise air leakage through the new or replacement parts of the thermal envelope.

3.65 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.

3.66 The person carrying out the work should demonstrate that an appropriate system of site inspection is in place to ensure that the construction standards achieve the required level of consistency. A report (signed by a suitably qualified person) should be provided to the district council showing that appropriate design details and building techniques have been specified, and that the work has been carried out such that can be expected to achieve reasonable conformity with the specifications. Reasonable provision would be to –

(a) adopt design details published on the Accredited Construction Details website; or

(b) demonstrate that the specified details provide equivalent thermal performance using the guidance in BRE's IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings* and BRE's Report BR 497

Renovated thermal elements

3.67 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 3.68 to 3.70 –

(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.

3.68 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 3.5 to 3.7.

3.69 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 3.67), the whole of that element should be upgraded to the improved U-values given in column (b) of Table 3.4.

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 building is being stripped down, the area of the element is the roof area of the annex, not the total roof area of the building. Similarly, if the rear wall of a single-storey extension was being re-rendered, it should be upgraded to the standards of Table 3.4 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 3.4 Upgrading of renovated or retained thermal elements

Element[1]	U-value W/m^2·K	
	(a) Threshold	(b) Improved
Wall – cavity insulation[2]	0.70	0.55
Wall – external or internal insulation[3]	0.70	0.30
Pitched roof – insulation at ceiling level	0.35	0.16
Pitched roof – insulation at or between rafters[4]	0.35	0.18
Flat roof or roof with integral insulation[5]	0.35	0.18
Floors[6,7]	0.70	0.25

Notes:

(1) "Roof" includes the roof parts of dormer windows, and "wall" includes the wall parts (cheeks) of dormer windows.

(2) This applies only in the case of a cavity wall suitable for the installation of cavity insulation. Where this is not the case it should be treated as "Wall – external or internal insulation".

(3) A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall.

(4) 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 to the depth of the rafters, and the thermal performance of the chosen insulant should be such as to achieve the best practicable U-value.

(5) A lesser provision may be appropriate if there are particular problems associated with the load-bearing capacity of the frame or the upstand height.

(6) The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged building.

(7) A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels.

3.70 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 of *Technical Booklet F1*.

Retained thermal elements

3.71 Where –

(a) an existing thermal element is part of a building subject to a material change of use or a change of energy status;

(b) an existing thermal element is upgraded as part of a consequential improvement; or

(c) 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 3.4, the element should be upgraded to the standard given in column (b) of Table 3.4 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.

3.72 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 of *Technical Booklet F1*. However, this lesser standard should be no greater than 0.7 W/(m^2·K).

Examples of where a lesser provision than column (b) of Table 3.4 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

3.73 Consequential improvements should be made to an 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.

Technical, functional and economic feasibility

3.74 Consequential improvements, in addition to the proposed building work (the principal works), should be carried out where they are technically, functionally and economically feasible. Paragraphs 3.75 to 3.82 below provide guidance on what will constitute technically, functionally and economically feasible consequential improvements in various circumstances.

The principal works should comply with Part F in the normal way.

3.75 Where improvement works (other than the “trigger activities” listed in paragraph 3.73) are planned as part of the building work, these can be used as contributing to the consequential improvements. The exception to this is if additional work is being done to the existing building to compensate for a poorer standard of an extension (see paragraphs 3.19 to 3.20).

For example, if, as well as extending the building, the proposals included total window replacement, then the window replacement work would satisfy the requirement for consequential improvements, provided the cost was at least 10% of the cost of the extension.

3.76 Measures such as those listed in Table 3.5 that achieve a simple payback (see definition) not exceeding 15 years will be economically feasible unless there are unusual circumstances.

For example, if the remaining life of the building is less than 15 years it would be economic to carry out only improvements with payback periods within that remaining life.

Table 3.5 Consequential improvements that in ordinary circumstances are practical and economically feasible

No.	Improvement measure
1	Upgrading heating systems more than 15 years old by the provision of new plant or improved controls
2	Upgrading cooling systems more than 15 years old by the provision of new plant or improved controls
3	Upgrading air-handling systems more than 15 years old by the provision of new plant or improved controls
4	Upgrading general lighting systems that have an average lamp efficacy of less than 40 lamp-lumens per circuitwatt and that serve areas greater than 100 m^2 by the provision of new luminaires or improved controls
5	Installing energy metering following the guidance given in CIBSE TM 39
6	Upgrading thermal elements which have U-values greater than those given in column (a) of Table 3.4 following the guidance in paragraphs 3.71 and 3.72
7	Replacing existing windows, roof windows or rooflights (but excluding display windows) or doors (but excluding high-usage entrance doors) which have a U-value greater than 3.3 $W/m^2 \cdot K$ following the guidance in paragraphs 3.53 to 3.60
8	Increasing the on-site low and zero carbon (LZC) energy-generating systems if the existing on-site systems provide less than 10% of on-site energy demand, provided the increase would achieve a simple payback of 7 years or less
9	Measures specified in the Recommendations Report produced in parallel with a valid Energy Performance Certificate

Notes:

1 to 7 will usually meet the economic feasibility criterion given in paragraph 3.76.

A shorter payback period is given in item 8 because such measures are likely to be more capital intensive or more risky than the others.

On extending a building

3.77 Where an existing building having a total useful floor area greater than 1000 m^2 is to be extended, or the habitable area is increased, consequential improvements should be made to the existing building in accordance with paragraph 3.78 and Table 3.5.

3.78 Measures from Table 3.5 should be adopted to the extent that the total cost of the consequential improvements is not less than 10% of the value of the principal works.

The value of the principal works and the value of the consequential improvements should be established using prices current at the date of deposit of the plans with the district council, and should be confirmed in a report signed by a suitably qualified person.

An example of a suitably qualified person would be a chartered quantity surveyor.

On installing or increasing the capacity of fixed building services

3.79 Where it is proposed to install a fixed building service for the first time or to increase the installed capacity per unit area of an existing service, in an existing building with a total useful floor area greater than 1000 m^2 consequential improvements should be made to –

(a) firstly improve the building fabric in those parts of the building served by the building service in accordance with paragraphs 3.81 and 3.82.

This means for example that if heating systems are to be installed for the first time in a building or part thereof, or the installed heating capacity per unit area of an existing system is to be increased, the fabric should be improved. The aim in these cases is to make cost-effective improvements to the performance of the fabric so that the installed capacity (and the initial cost) of the fixed building services and their subsequent energy consumption are not excessive; and

(b) make additional improvements to the building in accordance with paragraph 3.78 and Table 3.5.

The cost of any improvements made to comply with paragraph 3.79(a) is not limited to 10% of the cost of the principal works, and should not be taken as contributing to the consequential improvements required by paragraph 3.78.

If only the improvements under sub-paragraph (a) were made, then the CO_2 emissions from the building might well increase as a result of the higher level of servicing. By also requiring the general improvements in sub-paragraph (b) an overall improvement should be achieved.

3.80 The installed capacity of a fixed building service is the design output of the distribution system output devices (the terminal units) serving the space in question, divided by the total useful floor area of that space.

This means that if the size of central boiler plant is increased to serve a new extension rather than to increase the heating provision in the existing building, the consequential improvements in paragraph 3.77 would be required but those in the following paragraphs would not apply.

3.81 Where the installed capacity per unit area of a heating system is increased –

(a) the thermal elements (within the heated area served) that have U-values greater than those given in column (a) of Table 3.4 should be improved in accordance with paragraphs 3.71 and 3.72; and

(b) existing windows (excluding display windows), roof windows or rooflights or doors (excluding high usage entrance doors) within the area served, and which have U-values greater than 3.3 $W/(m^2 \cdot K)$, should be replaced by fittings complying with paragraphs 3.53 to 3.59.

3.82 Where the installed capacity per unit area of a cooling system is increased –

(a) the thermal elements (within the cooled areas served) that have U-values greater than those given in column (a) of Table 3.4 should be improved in accordance with paragraphs 3.71 and 3.72; and

(b) where the area of windows (excluding display windows) and roof windows within the area served by the cooling system exceeds 40% of the exposed wall area or the area of rooflights exceeds 20% of the area of the roof and the design solar load exceeds 25 W/m^2, the solar control provisions should be upgraded such that at least one of the following criteria is met –

(i) the solar gain per unit floor area averaged over the period 0630 to 1630 GMT is no greater than 25 W/m^2 when the building is subject to solar irradiances for July as given in the table of design irradiancies in CIBSE Design Guide A;

(ii) the design solar load is reduced by at least 20%;

(iii) the effective g-value is no greater than 0.3; or

(iv) the zone or zones satisfies the Criterion 3 check in Section 2 based on calculations by an approved software tool. This will reduce the solar gain and hence the space cooling demand. Section 5.1 of CIBSE's TM 37 *Design for improved solar shading control* gives guidance on calculating solar gains, and Sections 4.4 and 4.5 give guidance on the effective g-value; and

(c) any general lighting system within the area served by the cooling system which has an average lamp efficacy of less than 45 lamp-lumens per circuit-Watt, should be upgraded with new luminaires and/or controls following the guidance in the *Non-domestic building services compliance guide*. This will reduce the lighting load and hence the space cooling demand.

OPERATING AND MAINTENANCE INSTRUCTIONS

3.83 Not more than 5 days after completion of the work, the owner of the building is required to be given sufficient information about the building, including details of the installed building services and controls, and other details so that the building can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances.

This requirement 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 person carrying out the work to provide details on the operation of the heating system).

3.84 The district council is required to be notified in writing that the provision in paragraph 3.83 has been met.

3.85 A building logbook should be provided in the format given in CIBSE's TM 31 *Building log book toolkit*, or the information added to an existing log book. If an alternative guidance document is followed in preparing the log book, then the information conveyed and the format of presentation should be equivalent to TM 31.

The information should be presented in templates as or similar to those in TM 31. The information should be provided in summary form, suitable for day-to-day use. It could draw on or refer to information available as part of other documentation, such as the operation and maintenance manuals and the health and safety documents.

3.86 The new or updated log book should provide details of –

(a) any newly provided, renovated or upgraded thermal elements or controlled fittings;

(b) any newly provided fixed building services, their method of operation and maintenance requirements;

(c) any newly installed energy meters; and

(d) any other details that collectively enable the energy consumption of the building and building services comprising the works to be monitored and controlled.

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 2.27 to 2.37 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 2.36).

Other than the CO_2 target which is mandatory, the compliance criteria represent reasonable provision in normal circumstances. In unusual circumstances, alternative limits may represent reasonable provision, but this would have to be demonstrated in the particular case.

B2 Since the data in compliance software and the results they calculate can provide a substantial proportion of the evidence in support of the compliance demonstration, it is anticipated that the National Calculation Methodologies will produce this report as a standard output option.

B3. It is anticipated that two versions of the standardised report would be produced by the compliance software: the first before commencement of works to include the TER/BER calculation plus supporting list of specifications and the second after completion to include the as-built TER/BER 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	0.23 W/m^2·K
Roof U-value	0.15 W/m^2·K
Floor U-value	0.20 W/m^2·K
Window/door U-value	1.5 W/m^2·K
Design air permeability	5.0 m^3/h·m^2 at 50 Pa
Fixed Building Service efficiency more than 15% better than that recommended for its type in the *Non-Domestic Building Services Compliance Guide*.	
Use of any low-carbon or renewable energy technology.	

Appendix C Publications referred to

Air Tightness Testing and Measurement Association (ATTMA)

www.attma.org

Measuring air permeability of building envelopes (non-dwellings), Technical Standard L2, 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

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

BRE Report BR 497 Conventions 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

Simplified Building Energy Model (SBEM) User manual and software,
Available to download from – www.2010ncm.bre.co.uk

Available from: BREbookshop, Bucknalls Lane, Garston, Watford, WD25 9XX. Website: www.brebookshop.com

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.

BSRIA

www.bsria.co.uk

BSRIA BG 8/2009 Model Commissioning Plan

CIBSE

www.cibse.org

CIBSE Commissioning Code M Commissioning Management, 2003.
ISBN 978 1 90328 733 0

TM 31 Building Log Book Toolkit, CIBSE, 2006.
ISBN 978 1 90328 771 2

TM 37 Design for improved solar shading control, 2006.
ISBN 978 1 90328 757 6

TM 39 Building energy metering, 2010. ISBN 978 1 90684 611 4

TM 46 Energy benchmarks, 2008. ISBN 978 1 90328 795 8

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

National Calculation Methodology (NCM) modelling guide (for buildings other than dwellings in England and Wales), CLG 2010.

Non-Domestic Building Services Compliance Guide, CLG 2010.

Available to download from – www.planningportal.gov.uk

Department for Education and Skills (DfES)

www.dcsf.gov.uk/

Building Bulletin 101 Ventilation of School Buildings, School Building and Design Unit, 2005.

www.teachernet.gov.uk/iaq

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 to download from – www.bre.co.uk/sap2009

Current Energy Prices
Available to download from –
www.decc.gov.uk/en/content/cms/statistics/publications/prices/prices.aspx

Heating and Ventilating Contractors' Association

http://www.hvca.org.uk/

DW/143 A practical guide to ductwork leakage testing, 2000. ISBN 978 0 90378 330 9

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