Department of Finance
An Roinn Airgeadais
www.finance-ni.gov.uk

Building Regulations (Northern Ireland) 2012

Guidance

Technical Booklet F2

Conservation of fuel and power in buildings other than dwellings

June 2022

Contents

Introduction

Technical Booklets

This Technical Booklet, which takes effect on 30th June 2022, is one of a series that has been prepared by the Department of Finance (the Department) for the purpose of providing practical guidance with respect to the technical requirements of the Building Regulations (Northern Ireland) 2012 (as amended) (the Building Regulations).

At the back of each Technical Booklet is a list of all the Technical Booklets that have been prepared and published by the Department for this purpose (see page 72).

The guidance given in a Technical Booklet includes performance standards and design provisions relating to compliance with specific aspects of the Building Regulations for the more common building situations.

If the guidance in a Technical Booklet is followed there will be a presumption of compliance with the requirements of those Building Regulations covered by that guidance. However, this presumption can be overturned, so simply following the guidance does not guarantee compliance. For example, if a particular circumstance is not one of the more common building situations the design provisions given in the Technical Booklet may not be appropriate.

There are likely to be alternative ways of demonstrating compliance with the relevant requirements of the Building Regulations other than by following a design provision given in a Technical Booklet. There is therefore no obligation to adopt any particular provision set out in a Technical Booklet, should you decide to comply in some other way. However, you will have to demonstrate that your alternative solution meets the relevant requirements of the Building Regulations by those other means.

This Technical Booklet

Requirements

The guidance contained in this Technical Booklet relates only to the requirements of regulations 39, 40, 41, 42, 43, 43A, 43B and 47. The work will also have to comply with all other relevant requirements of the Building Regulations.

Regulation 43B 'Nearly zero-energy requirements for new buildings' (NZEB), came into operation for newly erected buildings occupied and owned by public authorities from 1st January 2019.

NZEB requirements apply to all newly erected buildings from 31st December 2020. This booklet provides guidance on the relevant NZEB standards applicable to new plans applications made from 30th June 2022. For work arising from applications made prior to this refer to the previous editions of this Technical Booklet (amended in 2014) and consider relevant Information Notes published by the Department.

Materials and workmanship

Any building work which is subject to requirements imposed by Part A of the Building Regulations should be carried out in accordance with regulation 23 of those regulations. Guidance on meeting these requirements for materials and workmanship is given in Technical Booklet B which supports Part B.

The Building Regulations are made for specific purposes, primarily securing the health, safety, welfare and convenience of people and for the conservation of fuel and power. 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.

Named standards

Where this Technical Booklet makes reference to a named standard, the relevant version of the standard is the one listed in Appendix B. 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.

Diagrams

The diagrams in this Technical Booklet supplement the text. They do not show all the details of construction and are not intended to illustrate compliance with any other requirement of the Building Regulations. They are not necessarily to scale and should not be used as working details.

Protected buildings

District councils have a duty to take account of the desirability to preserve the character of protected buildings when carrying out their functions under Building Regulations. Therefore, where work is to be carried out to a protected building to comply with Part F or any other Part of the Building Regulations, special consideration may be given to the extent of such work for compliance where it would unacceptably alter the character or appearance of the building. Protected buildings are defined in Article 3A(2) of the Building Regulations (Northern Ireland) Order 1979 (as amended).

Other legislation

The provisions of this Technical Booklet relate to the requirements of Building Regulations and do not include measures which may be necessary to meet the requirements of other legislation. Such other legislation may operate during the design or construction stages or when a building is brought into use and can extend to cover aspects which are outside the scope of the Building Regulations.

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 Part F 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 aspects of Articles 2 to 9 of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.

Other legislation, including the Energy Performance of Buildings (Certificates and Inspections) Regulations (Northern Ireland) 2008 (as amended), has the effect of implementing the remainder of this Directive.

Part F Regulations

Part F (comprising regulations 38 – 47) of the Building Regulations which sets out the requirements for conservation of fuel and power in buildings, has been replicated below for the convenience of the user of this Technical Booklet and is taken directly from the Building Regulations (Northern Ireland) 2012 (as amended at the date of publication of this Technical Booklet).

Any person who intends to demonstrate compliance with the Building Regulations by following the guidance given in this Technical Booklet is advised to ensure that the regulations below are current on the date when plans are deposited or notices given to the district council.

As Part A (comprising regulations 1 – 21) of the Building Regulations sets out the interpretation along with the procedural requirements relating to the application of the regulations, the Department advises that all Parts of the Building Regulations be read in conjunction with Part A of those regulations.

The Building Regulations (Northern Ireland) 2012 and any subsequent amendments may be viewed by following the links from the Department's website at "www.buildingregulationsni.gov.uk".

PART F

Conservation of fuel and power

Application and interpretation

38.—(1) Subject to paragraphs (2), (3) and (4) this Part shall apply to any building and where a building contains one or more dwellings to each dwelling separately.

(2) The energy efficiency requirements shall not apply to—

(a) protected buildings, where compliance with the energy efficiency requirements would unacceptably alter their character or appearance;

(b) buildings used as places of worship and for religious activities;

(c) temporary buildings with a planned time of use of 2 years or less, industrial sites, workshops and non-residential agricultural buildings with a low energy demand; and

(d) stand-alone buildings other than dwellings, with a total useful floor area of less than 50 m^2.

(3) Regulation 40 shall not apply to—

(a) the extension of a dwelling; and

(b) the extension of a building other than a dwelling, unless 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.

(4) Regulation 45 shall not apply to the provision or extension of any fixed building service where commissioning is not possible.

(5) In this Part, the following terms have the same meaning as in European Parliament and the Council Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings (recast)—

(i) "industrial sites";

(ii) "low energy demand";

(iii) "non-residential agricultural buildings";

(iv) "places of worship";

(v) "religious activities";

(vi) "stand-alone"; and

(vii) "workshops".

(6) In this Part—

"Building envelope" in relation to a building, means the walls, floor, roof, windows, doors, roof windows and rooflights;

"Change of energy status" means any change which results in a building becoming a building to which the energy efficiency requirements of these Regulations apply, where previously it was not;

"Cogeneration" means simultaneous generation in one process of thermal energy and one or both of the following—

(a) electrical energy;

(b) mechanical energy;

"District or block heating or cooling" means the distribution of thermal energy in the form of steam, hot water or chilled liquids, from a central source of production through a network to multiple buildings or sites, for the use of space or process heating or cooling;

"Energy efficiency requirements" means the requirements of regulations 39, 40, 41, 43, 43A, 43B and 47;

"Energy from renewable sources" means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases;

"Heat pump" means a machine, a device or installation that transfers heat from natural surroundings such as air, water or ground to buildings or industrial applications by reversing the natural flow of heat such that it flows from a lower to a higher temperature. (For reversible heat pumps, it may also move heat from the building to the natural surroundings.);

"High-efficiency alternative systems" include—

(a) decentralised energy supply systems based on energy from renewable sources;

(b) cogeneration;

(c) district or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources; and

(d) heat pumps;

"Major renovation" means the renovation of a building where more than 25% of the surface area of the building envelope undergoes renovation;

"National calculation methodology" means—

(a) in relation to a dwelling, the Government's Standard Assessment Procedure (SAP) for Energy Rating of Dwellings; and

(b) in relation to a building other than a dwelling—

(i) the Simplified Building Energy Model (SBEM); or

(ii) a Dynamic Simulation Model (DSM),

that is implemented with Government approved software;

"Nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with the National calculation methodology, where the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby;

"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;

"Protected building" has the same meaning as in Article 3A(2) of the Building Regulations (Northern Ireland) Order 1979;

"Renovation of a thermal element" means the provision of a new layer to a thermal element or the replacement of an existing layer (other than where a partial replacement layer is provided solely as a means of patch repair to a flat roof) 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 emission rate" means the rate of carbon dioxide emission measured in kilograms of carbon dioxide per square metre of total useful 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.

Conservation measures

39. 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.

Target carbon dioxide emission rate

40.—(1) Without prejudice to the requirements of regulation 39, where a building is to be erected, or a building other than a dwelling is extended as described in regulation 38(3)(b), minimum energy performance requirements in the form of a target carbon dioxide emission rate for that building shall be calculated and expressed using a national calculation methodology.

(2) The building, or extension as described in regulation 38(3)(b), shall be so designed and constructed as not to exceed its calculated target carbon dioxide emission rate with all carbon dioxide emission rates calculated and expressed using a national calculation methodology.

Consequential improvements

41. 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;

(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 39 so far as this is technically, functionally and economically feasible.

Change of energy status

42. 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 39.

Renovation of thermal elements

43.—(1) Where the renovation of an individual thermal element—

(a) constitutes a major renovation; or

(b) amounts to the renovation of more than 50% of the surface area of the thermal element,

the renovation shall be carried out so as to ensure that the whole of the thermal element complies with the requirement of regulation 39(a)(i) in so far that it is technically, functionally and economically feasible.

(2) Where the whole or any part of an individual thermal element is to be replaced and such work—

(a) constitutes a major renovation; or

(b) in the case of part replacement, amounts to the renovation of more than 50% of the surface area of the thermal element,

the whole of the thermal element shall be replaced to comply with the requirement of regulation 39(a)(i) in so far that it is technically, functionally and economically feasible.

Consideration of high-efficiency alternative systems

43A.—(1) Where a building is to be erected, the person carrying out the work shall, before construction begins, undertake an analysis of and give consideration to the use of available high-efficiency alternative systems in the work. Such systems include—

(a) decentralised energy supply systems based on energy from renewable sources;

(b) cogeneration;

(c) district or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources; and

(d) heat pumps.

(2) The analysis referred to in paragraph (1)—

(a) shall be documented and take into account the technical, environmental and economic feasibility of using high-efficiency alternative systems;

(b) may be carried out for individual buildings or for groups of similar buildings or for common typologies of buildings in the same area; and

(c) in so far as it relates to collective heating and cooling systems, may be carried out for all buildings connected to the system in the same area.

Nearly zero-energy requirements for new buildings

43B.—(1) Where a building is erected, it must be a nearly zero-energy building.

(2) For the purposes of paragraph (1)—

(a) in respect of new buildings occupied and owned by public authorities, this regulation shall apply from 1st January 2019; and

(b) in respect of all new buildings, this regulation shall apply from 31st December 2020.

Notice of air pressure test

44. Where an air pressure test is undertaken for the purposes of demonstrating compliance with regulation 40(2), the person carrying out the work shall give, not more than 5 days after completion of the testing, a notice in writing to the district council stating the result of the air pressure test.

Notice of commissioning

45. Where this regulation applies, the person carrying out the work, for the purpose of ensuring compliance with regulation 39(b) and (c), shall give, not more than 5 days after completion of the commissioning, a notice in writing to—

(a) the building owner stating that the fixed building services have been commissioned; and

(b) the district council stating that the requirements of sub-paragraph (a) have been met.

Notice of emission rate

46. Where a calculation is carried out for the purpose of demonstrating compliance with regulation 40(2), a notice in writing that states—

(a) the target carbon dioxide emission rate for the building;

(b) the calculated carbon dioxide emission rate for the building as constructed; and

(c) the list of specifications to which the building is constructed where these differ significantly from the design specifications used for the calculation of the design-stage carbon dioxide emission rate,

shall be given to the district council not more than 5 days after completion of the building work, by the person carrying out the work.

Provision of information

47. Where regulation 39 applies, the person carrying out the work shall give, not more than 5 days after completion of the work, a notice in writing to—

(a) the building owner giving sufficient information about the building, its fixed building services, and their ongoing maintenance requirements, so that the building can be operated and maintained to conserve fuel and power; and

(b) the district council stating that the requirements of sub-paragraph (a) have been met.

Relevant definitions in regulation 2 in Part A of the Building Regulations.

"Building work"

"Conservatory"

"District council"

"Dwelling"

"Extension"

"Fixed building service"

"Window"

Guidance - Performance and introduction to provisions

Performance - Regulation 39 Conservation measures

0.1 It is the view of the Department that the requirements of regulation 39 will be met when –

(a) provisions are made to limit heat gains and losses through thermal elements and other parts of the building fabric;

(b) provisions are made to limit heat gains and losses from pipes, ducts and vessels in a space heating system or space cooling system including associated fittings;

(c) effective controls are provided to energy efficient fixed building services; and

(d) fixed building services are commissioned.

Performance - Regulation 40 Target carbon dioxide Emission Rate

0.2 It is the view of the Department that the requirements of regulation 40 will be met when a building is designed and constructed so as not to exceed its Target carbon dioxide Emission Rate (TER). The TER must be calculated using one of the types of software approved by the Department as a National Calculation Methodology for buildings other than dwellings.

Regulation 40 implements Articles 3 and 4 of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.

Performance - Regulation 41 Consequential improvements

0.3 It is the view of the Department that the requirements of regulation 41 will be met when work, referred to as consequential improvements, is carried out to enhance an existing building's conservation of fuel and power. The requirement to carry out consequential improvements is limited to existing buildings with a total useful floor area greater than 1000 m^2 where the work consists of or includes an extension, or the initial provision of any fixed building service, or an increase in the capacity of any fixed building service. Such work should also be technically, functionally and economically feasible.

Performance - Regulation 42 Change of energy status

0.4 It is the view of the Department that the requirements of regulation 42 will be met where a previously unconditioned building, or part of a building, becomes conditioned i.e. by heating or cooling and where the work is undertaken to meet the performance requirements of regulation 39.

Performance - Regulation 43 Renovation of thermal elements

0.5 It is the view of the Department that when renovation and/or replacement work to an individual thermal element constitutes a major renovation or the renovation amounts to more than 50% of the surface of the element, the requirements of regulation 43 will be met when work is undertaken to limit heat gains and losses as required by regulation 39(a)(i).

Renovation of a thermal element does not include a partial replacement layer provided solely as a means of patch repair to a flat roof and does not include thin decorative surface finishes.

Performance - Regulation 43A Consideration of high-efficiency alternative systems

0.6 It is the view of the Department that the requirements of regulation 43A will be met when the person carrying out the work undertakes analysis of and gives consideration to incorporating high-efficiency alternative systems in the building.

Note – Part A of the Building Regulations requires a notice to be given to the district council stating that such consideration has been given and that the analysis is available for verification.

Performance - Regulation 43B Nearly zero-energy requirements for new buildings

0.7 It is the view of the Department that the requirements of regulation 43B will be met for new buildings other than dwellings when the BER of the building is at least 15% lower than the TER calculated under regulation 40 (subject to a pro-rata reduction of the 15% where a proportion of the space heating is provided by a heat pump) and when an analysis of the technical, environmental and economic feasibility of using high efficiency alternative systems has been undertaken and considered in compliance with regulation 43A.

Introduction to provisions in Section 2

0.8 The guidance in Section 2 gives Criterion in relation to –

(a) achieving the TER;

(b) minimum acceptable standards;

(c) limiting the effects of solar gain;

(d) quality of construction and commissioning; and

(e) operating and maintenance instructions.

It also gives the methodology and limiting values used by the National Calculation Methodology to calculate the Target carbon dioxide Emission Rate (TER) and the Building carbon dioxide Emission Rate (BER).

Introduction to provisions in Section 3

0.9 The guidance in Section 3 gives provisions to enhance the conservation of fuel and power when altering or extending existing buildings where there is a material change of use, or a change of energy status, or where there are consequential improvements.

Section 1 General

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

Definitions

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 total useful floor area per year.

Building work – is defined in regulation 2 in Part A of the Building Regulations.

Building envelope – is defined in regulation 38 in Part F of the Building Regulations.

Change of energy status – is defined in regulation 38 in Part F of the Building Regulations.

Cogeneration – is defined in regulation 38 in Part F of the Building Regulations.

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 – is defined in regulation 2 in Part A of the Building Regulations.

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.

District council – is defined in regulation 2 in Part A of the Building Regulations.

District or block heating or cooling – is defined in regulation 38 in Part F of the Building Regulations.

Dwelling – is defined in regulation 2 in Part A of the Building Regulations.

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.

Energy efficiency requirements – is defined in regulation 38 in Part F of the Building Regulations.

Energy from renewable sources – is defined in regulation 38 in Part F of the Building Regulations.

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 walls.

Exempted building – is defined in regulation 2 in Part A of the Building Regulations.

Extension – is defined in regulation 2 in Part A of the Building Regulations.

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 – is defined in regulation 2 in Part A of the Building Regulations.

Floor area – is defined in regulation 2 in Part A of the Building Regulations.

Heat pump – is defined in regulation 38 in Part F of the Building Regulations.

High-efficiency alternative systems – is defined in regulation 38 in Part F of the Building Regulations.

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 (LZC) – include biofuels, heat pumps, microCHP, micro-hydro, photovoltaics, solar hot water and wind power.

Low energy demand – is defined in regulation 38 in Part F of the Building Regulations.

Material change of use – is defined in regulation 2 in Part A of the Building Regulations.

Major renovation – is defined in regulation 38 in Part F of the Building Regulations.

National Calculation Methodology – is defined in regulation 38 in Part F of the Building Regulations.

NZEB (Nearly zero-energy building) – is defined in regulation 38 in Part F of the Building Regulations.

Pipes, ducts and vessels – is defined in regulation 38 in Part F of the Building Regulations.

Porch – is defined in regulation 2 in Part A of the Building Regulations.

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.

Protected building – is defined in Article 3A(2) of the Building Regulations (NI) Order 1979.

Provision of a service or fitting – is defined in regulation 2 in Part A of the Building Regulations.

Renovation of a thermal element – is defined in regulation 38 in Part F of the Building Regulations.

Room for residential purposes – means a room or suite of rooms which is not a dwelling, and which is used by one or more persons to live and sleep and includes a room in a hostel, hotel, boarding house, hall of residence or a residential home, whether or not the room is separated from or arranged in a cluster group with other rooms. It excludes a room in a hospital or similar establishment used for patient accommodation.

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 by a door which is designed to be locked.

SAP – the Government's Standard Assessment Procedure for Energy Rating of Dwellings: 2009 edition, or any later edition approved by the Department.

SBEM – the Simplified Building Energy Model (the National Calculation Methodology for buildings other than dwellings): 2010 edition, or any later edition approved by the Department.

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 Business Energy and Industrial Strategy (BEIS).

Space cooling system – is defined in regulation 38 in Part F of the Building Regulations.

Space heating system – is defined in regulation 38 in Part F of the Building Regulations.

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 (Target carbon dioxide Emission Rate) – is defined in regulation 38 in Part F of the Building Regulations.

Thermal element – is defined in regulation 38 in Part F of the Building Regulations.

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 – is defined in regulation 38 in Part F of the Building Regulations.

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

Window – is defined in regulation 2 in Part A of the Building Regulations.

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 in Part F.

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 Report 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) 2012 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 Emission Rate (TER) and Building carbon dioxide Emission 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. Current editions of software will automatically flag values out-of-range with the previous guidance standards and check that the BER is no greater than the TER as designed.

However, until revised software is developed, additional manual checks will be required. These include –

(a) confirmation that the design and as-built constructions align with Table 2.3, which has revised limiting U-values;

(b) confirmation that the air-tightness limit (see paragraph 2.59) has been achieved and that previously acceptable air permeability default values of 15$m^3/(h.m^2)$ have not been entered; and

(c) where the building is subject to regulation 43B (Nearly zero-energy requirements for new buildings), confirmation that the betterment of the TER required by paragraph 2.61 has been achieved (see Notes below).

In addition, where on-site renewable generating technologies are included in the design, confirmation of the nature of the grid connection should be provided. In cases of a non-export grid connection, a report should be provided in accordance with paragraphs 2.38 and 2.39.

Note – These new and additional factors have been developed to provide an updated and more robust NZEB standard pending future adoption of revised software and National Calculation Methodology.

Note – where Section 2 of this guidance applies but the building is not required to fulfil NZEB standards (for example where the building is an extension greater than 100 m^2 and greater than 25% of the existing building), then the betterment of the TER outlined in paragraph 2.61 is not applicable and the requirement for a manual check outlined in paragraph (c) above is unnecessary. However, in such cases the requirements of paragraphs (a) and (b), above, may apply.

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 required emissions standard (see Notes to paragraph 2.1 above and paragraph 2.61).

2.3 Whilst the software covers the majority of 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 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 exempt from the energy efficiency requirements in Part F

2.9 New buildings other than dwellings that use energy to condition the indoor climate must comply with the energy efficiency requirements (i.e. regulations 39, 40, 41, 43, 43A, 43B and 47) of the Building Regulations unless they are exempt from complying with those requirements.

The following classes of new buildings or parts of new buildings are exempt from complying with the energy efficiency requirements in Part F of the building regulations –

(a) buildings used as places of worship, and for religious activities;

(b) temporary buildings with a planned time of use of 2 years or less, industrial sites, workshops and non-residential agricultural buildings with a low energy demand; and

(c) stand-alone buildings other than dwellings, with a total useful floor area of less than 50 m^2.

2.10 The following paragraphs give guidance on classes (a) and (b) that relates to new buildings –

(a) Places of worship: For the purposes of the energy efficiency requirements, places of worship are taken to mean those buildings or parts of a building that are used for formal public worship, including adjoining spaces whose function is directly linked to that use (for example, a vestry in a church). Such parts of buildings of this type often have traditional, religious or cultural constraints that mean that compliance with the energy efficiency requirements would not be possible. Other parts of the building that are designed to be used separately, such as offices, catering facilities, day centres, meeting halls and accommodation, are not exempt.

(b) Temporary buildings: A temporary building with a planned time of use of two years or less does not include a portable or modular building which has a planned service life greater than 2 years, whether on one or more sites.

(c) Industrial sites, workshops and non-residential agricultural buildings with a low energy demand: In relation to this class of building, the low energy demand only relates to the energy used by fixed heating or cooling systems, not to energy required for or created by process needs.

The following are examples of buildings in class (b) that are low energy demand –

(i) buildings or parts of buildings where the space is not generally heated or cooled other than by process heat; and

(ii) buildings or parts of buildings that only require heating or cooling for a short period each year, such as during a critical period in the production cycle (e.g. plant germination, egg hatching) or in very severe weather conditions.

Industrial sites, workshops and non-residential agricultural buildings are exempt only if they meet the low energy demand criterion above. In other cases, such buildings must comply with energy efficiency requirements.

Similarly, other buildings (e.g. some types of warehouse) may have low energy demand but are not exempt because they do not fall into one of the above examples.

Buildings requiring specific consideration

2.11 Specific considerations apply to the following building types –

(a) buildings with low energy demand – the guidance specific to such buildings is given in paragraphs 2.12 to 2.14;

(b) industrial buildings and non-exempt agricultural buildings – the guidance specific to such buildings is given in paragraph 2.15;

(c) modular and portable buildings – the guidance specific to such buildings is given in paragraphs 2.16 to 2.22; and

(d) shell and core developments – the guidance specific to such buildings is given in paragraphs 2.23 to 2.25.

Buildings with low energy demand

2.12 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 the *Non-Domestic Building Services Compliance Guide*.

2.13 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.

2.14 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 3.77 to 3.86); 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

2.15 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

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

2.17 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.

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 applied by software(1)	Additional TER manual adjustment(2)	Total TER adjustment
From 30 June 2022	1.00	1.00	1.00
31 October 2012 – 29 June 2022	1.00	1.15	1.15
30 November 2006 – 30 October 2012	1.33	1.15	1.53
Pre 30 November 2006	1.75	1.15	2.00
For buildings with a planned time of use in a given location of less than 2 years	2.35	1.15	2.70

Note:

(1) SBEM v4 software or equivalent DSMs will provide this adjustment automatically

(2) This additional adjustment may be applied manually where software has not taken this into account.

At one location

2.18 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. This includes the NZEB requirements of paragraph 2.61. 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 total TER adjustment 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).

2.19 Paragraph 2.62 provides an easement where space heating is provided by heat pumps. This should not be used where the factors of Table 2.1 are applicable.

At more than one location in the unit's lifetime

2.20 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.

2.21 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.

2.22 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 factors from both Table 2.1 and paragraph 2.61.

Shell and core developments

2.23 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 2.45) 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.

2.24 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.

2.25 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

2.26 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.

2.27 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 either taken from the main system or provided solely in the conservatory, it should have –

(a) controlled fittings that comply with the guidance in paragraphs 3.57 to 3.64;

(b) thermal elements that comply with the guidance in paragraph 3.66;

(c) where fixed building services are provided these should comply with the guidance in paragraphs 3.40 to 3.56; and

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

Swimming pool basins

2.28 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.

2.29 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 Emission Rate (TER)

2.30 The Target carbon dioxide Emission Rate (TER) 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.

2.31 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.

2.32 The TER is established by using an approved software implementation of a NCM to calculate the CO_2 emission 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 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 based on a building of the same size and shape as the actual building, constructed to a concurrent specification. This specification for Part F 2012 (in Northern Ireland) is given in the 2010 NCM modelling guide (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.

2.33 To demonstrate that an acceptable CO_2 emission rate has been achieved, a NZEB building as constructed should have a Building carbon dioxide Emission Rate (BER) which betters the TER in accordance with paragraph 2.61.

Where a TER applies, but the building is not required to be a NZEB (e.g. where it is an extension greater than 100 m^2 and 25% of the existing building's floor area), its BER should be no greater than the TER, as calculated in accordance with paragraphs 2.30 to 2.32.

Electricity generated by renewable technologies

2.34 The betterment standards of paragraph 2.61 are expected to lead to a greater use of renewable generation technologies

Note – Designers and installers of these should take care to ensure any such technology complies with other parts of the building regulations notably Part E (Fire safety), Part K (Ventilation) and Part L (Combustion appliances) in particular and any other statutory requirements.

2.35 Where renewable generation technologies are used to produce electricity, designers are encouraged to engage at an early stage with Northern Ireland Electricity Networks (NIE) to confirm that an export connection can be provided.

2.36 Where renewable generation technologies producing electricity are specified, confirmation that either an export capable or non-export connection has been designed and installed should be provided to the district council in relevant design and as-built submissions.

Non-export connections

2.37 Where an export connection is not provided, the current software will assume that the full generation capacity of any renewable generation technology is being used and the reduced performance due to the inability to export will not be taken into account.

Designers should note that a performance gap is likely in non-export connection situations. Future versions of software are being developed which may take into account any performance losses.

In these situations, designers may wish to consider alternative routes to compliance, which avoid a non-export connection. Where a renewable generation technology with a non-export connection is retained, designers should consider options such as appropriately sizing any renewable generation technologies, providing appropriate battery storage capacity or other diverter technologies in order to maximise the extent that the energy generating capacity can be beneficially used in practice and minimize the likely performance gap.

Designers should explain any limitation or potential performance gap to the building owner and are encouraged to do this at an early stage in the design development.

2.38 Where paragraph 2.37 applies and the non-export connection is retained, designers should provide a detailed report on the proposed system to the district council. This should be prepared by a suitably qualified person with experience in electrical energy demand profiles of buildings and the performances of the particular renewable generation technology involved.

While no explicit performance improvement is required, the report should be provided at plans application stage and show –

a) how the issues raised in paragraph 2.37 have been considered; and

b) any specific plans or outcomes that can may be expected to further improve utilisation of the system in future.

2.39 A similar statement should be provided to the district council on completion of any building with on-site renewable electrical generation where a non-export connection is provided to take into account any adjustments in the as-built construction. This should include confirmation that the nature and limitations in performance have been notified in the as-built information provided to the building owner in the operating and maintenance instruction manual (see paragraphs 2.103 to 2.106).

Note – These provisions accept a performance gap in the assessment of non-exporting renewable generation technologies. This is accepted on the basis that electrical energy requirements may increase or that future export or on-site storage solutions may become increasingly viable, and this gap may, therefore, narrow over time.

CRITERION 1 – ACHIEVING THE TER

CALCULATING THE BER FOR THE BUILDING AS CONSTRUCTED

General

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

2.41 In order to determine the BER, the CO_2 emission factors should be as specified in Appendix C of the NCM modelling guide.

Multi-fuel systems

2.42 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

2.43 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.

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

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

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

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

See NCM Modelling Guide at “http://www.uk-ncm.org.uk”.

Calculation before commencement of work

2.45 A calculation should be carried out that demonstrates that the BER for the building as designed either –

a) betters the TER by the factor required by paragraph 2.61, if the building is required to be a NZEB; or

b) is no greater than the TER, if NZEB requirements do not apply (see paragraph 2.33 and regulation 43B).

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 A.

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. The NCM software will produce the list of specifications and highlight those features of the design that are critical to achieving compliance, subject to the additional manual checks noted in paragraph 2.1. These “key features” can be used to prioritise the risk-based inspection of the building as part of confirming compliance.

Calculation after completion of work

2.46 A calculation should be carried out that demonstrates that the BER of the building as constructed either –

a) betters the TER by the factor outlined in para 2.61, if the building is required to be a NZEB; or

b) is no greater than the TER, if NZEB requirements do not apply (see paragraph 2.33 and regulation 43B).

Not more than 5 days after completion of the work, the person carrying out the work should give a notice in writing to the district council of the TER and BER and whether the building has been constructed in accordance with the list of specifications given to the district council before work started. If not, a list of any changes to the design stage list of specifications is required to be given to the district council. As evidence of compliance, a certificate stating that the TER and 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 Product Characteristics database. Evidence should also be provided to demonstrate that the building as designed satisfies the provisions in Criteria 2, 3 and 4.

Enhanced management and control features

2.47 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 $kgCO_2/(m^2.year)$ 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 $kgCO_2/(m^2.year)$.

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 (LZC)

2.48 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 emission requirements (see paragraphs 2.33 and 2.61) utilising fabric and system measures and the integration of 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.

Consideration of high-efficiency alternative systems

2.49 The installation of high-efficiency alternative systems or other low or zero carbon systems is not a requirement of building regulations but must be considered when a building is to be erected.

The person carrying out the work should, before construction starts, analyse and take into account the technical, environmental and economic feasibility of using high-efficiency alternative systems (such as the following systems) in the construction, if available –

(a) decentralised energy supply systems based on energy from renewable sources;

(b) cogeneration;

(c) district or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources; and

(d) heat pumps.

The analysis should state whether high-efficiency alternative systems have or have not been included in the building design. The requirement relates to considering using high-efficiency alternative systems, taking into account their technical, environmental and economic feasibility and documenting the analysis.

2.50 The analysis may be carried out for individual buildings, groups of similar buildings or for common types of buildings in the same area. Where a number of buildings are connected to a community energy system, a single analysis may be carried out for all of the buildings connected to the system in the same area as the building to be constructed.

2.51 Procedural regulations require the person carrying out the work to give the district council, at the time of deposit of plans, a notice which states that the analysis has been undertaken, is documented and is available to the district council for verification purposes. The district council may, at any time prior to approval/rejection of plans, require the deposit of the above analysis.

2.52 The documentation of the analysis may contain the following information –

(a) identity of Applicant/Agent;

(b) location of site;

(c) use of building;

(d) if high-efficiency alternative systems are specified;

(e) the proposed systems; and

(f) the rationale influencing the decision to incorporate, or not incorporate, high-efficiency alternative systems.

2.53 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.

2.54 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

2.55 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 emissions requirements is likely to require better fabric performance than is given in Table 2.3 and/or additional measures, such as LZC technologies.

Table 2.3 Limiting U-values (W/m^2.K)

Element	(a) Area-weighted average U-value [5]	(b) Maximum U-value at any point
Wall	0.21	0.60
Floor - ground and exposed	0.21	0.60
Roof - pitched	0.16	0.30
Roof - flat	0.20	0.30
Party wall	0.20	0.60
Windows, roof windows and rooflights[1]	1.60[2][3]	3.00
Curtain walling	1.80[2][3]	3.00
Pedestrian doors	1.60	3.00
Vehicle access and similar large doors	1.50	4.00
High-usage entrance doors	3.50	6.00
Roof ventilators (including smoke vents)	3.50	6.00
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. The developed area of a rooflight is explained in NARM Technical Document NTD 2 (2010) *Assessment of thermal performance of out-of-plane rooflights*.

(2) Excluding display windows and similar glazing. There is no limit on design flexibility for these exclusions but their impact on CO_2 emissions must 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 can be relaxed from the values given above. However, values should not exceed 2.2 W/m^2.K.

(4) See paragraphs 2.28 and 2.29.

(5) Reasonable provision would also be achieved if the total heat loss through the roof, wall and floor elements did not exceed that which would be the case if each of the area weighted average U-value (Um) for these elements set out in Column (a) were achieved individually, subject to the values in column (b) and any other requirements remaining applicable.

2.56 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 element or unit (e.g. in the case of a window, the combined performance of the glazing and the frame).

The U-value of glazing 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.

2.57 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 U-value given in this Technical Booklet should be modified by making a U-value adjustment in accordance with BR 443.

2.58 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.

Air permeability

2.59 The maximum permissible air permeability is 10 $m^3/(h.m^2)$ at 50 Pa, however, it is expected that buildings will normally have an assessed air permeability of 5 $m^3/(h.m^2)$ at 50 Pa or less.

2.60 Consideration should be given to the provisions of Technical Booklet K and advice coming forward with respect to transmission of infection in order to ensure good indoor air quality. This is of increasing importance as air permeability performance improves and may be particularly relevant where a performance of less than 3 $m^3/(h.m^2)$ at 50 Pa is a likely outcome and/or where mechanical ventilation systems which re-circulate air are proposed.

Betterment of the TER

2.61 For the purposes of regulation 43B (Nearly zero-energy requirements for new buildings) a building's BER should better the TER by at least 15%, subject to paragraph 2.62.

For example, if the TER is 30 $kgCO_2/m^2/yr$ then the BER for an NZEB should not be greater than 25.5 $kgCO_2/m^2/yr$, subject to paragraph 2.62.

$$BER_{(nzeb)} \leq 0.85 \times TER$$

2.62 Where the space heating is provided by a heat pump a pro-rata reduction in the 15% betterment factor may be applied.

For example, if 50% of the annual space heating requirement is delivered solely by a heat pump, the BER should better the TER by at least 7.5%. If 100% of the space heating demand is provided solely by a heat pump then no betterment is required.

$$BER_{(hp\ nzeb)} \leq (0.85 \times TER \times (1-fQ_{sp(hp)}))+ (TER \times fQ_{sp(hp)})$$

Where;

$BER_{(hp\ nzeb)}$ = the BER for a NZEB where part of the space heating is provided by a heat pump; and

$fQ_{sp(hp)}$ = the fraction of the total space heating demand provided by a heat pump.

Where there is an option for space heating to be provided by either a heat pump or another source, the heat pump should be ignored and paragraph 2.61 applied.

2.63 The above calculations to ensure the BER betters the TER should be carried out after the NCM assessment has been completed and the resulting TER and BER values and calculations included in the submissions to the district council both before and after construction.

Fixed building service systems

System efficiencies

2.64 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 a notified 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

2.65 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

2.66 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 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 TM 46 *Energy benchmarks*.

Centralised switching of appliances

2.67 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

2.68 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.

2.69 If this criterion (given in the provisions in paragraph 2.70) 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 the CIBSE TM37 *Design for improved solar shading control* and, for education buildings, in Department for Education and Skills' BB101 *Ventilation of school buildings*.

Demonstrating compliance

2.70 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 2.70(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

2.71 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 Emission Rate (BER) no greater than the Target carbon dioxide Emission Rate (TER) and take into account the betterment required by paragraph 2.61.

As stated in paragraph 2.46, 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 in order to demonstrate that the BER for the building as constructed is no greater than its TER and takes into account the betterment required by paragraph 2.61.

Building envelope

2.72 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

2.73 Cavity walls separating buildings (hereafter referred to as party walls) may not have zero heat loss because a thermal bypass is created where there is air movement in the cavity.

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

2.75 Where edge sealing is adopted to address the party wall bypass, it is essential that the edge sealing is effective in restricting air flow into the cavity and that it is aligned with the thermal envelope. Sealing is required at the top, the bottom and vertically. Although effective edge sealing may be incorporated as 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 into the cavity. In order to use the reduced cavity wall U-values in Table 2.4 (0.2 or 0.0 $W/m^2.K$) it will be necessary to demonstrate that the design adopted is likely to be robust under normal site conditions.

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.

2.76 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.

Table 2.4 U-values to be used for party walls ($W/m^2.K$)

Type	U-value
Solid	0.00
Unfilled cavity with effective edge sealing around all exposed edges and in line with insulation layers in abutting elements	0.20
Fully filled cavity with effective edge sealing around all exposed edges and in line with insulation layers in abutting elements	0.00

2.77 It is important also to be satisfied that any solution to the party wall bypass does not contravene other parts of the regulations, in particular Part G (Resistance to the passage of sound) and Part E (Fire safety).

Thermal bridges

2.78 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.

2.79 Significant reductions in thermal performance can occur where the air barrier and the insulation layer are not in contact with one another 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.

2.80 Non-repeating thermal bridge heat losses for each element (including windows, etc.) is normally taken into account by the approved software and must be allowed for by either –

a) calculating the non-repeating thermal bridge heat losses for each element by a method that satisfies BS EN ISO 14683; or

b) adding 10% to the standard area-weighted average U-values,

in accordance with the NCM modelling guide.

2.81 Non-repeating thermal bridge heat losses for each element, Ψ (psi) values, should be applied to each junction based upon the following options –

(a) where construction of a junction follows substantiated approved design details, published by a government or a third party accredited source, (such as BRE Certified Thermal Details and Products Scheme) input Ψ values of the relevant junction from that document. Where this option is used the U-value of each thermal element should be within ± 20% of the values indicated on the detail for any given location. Reference should also be made to any other relevant supporting sections of the document, such as the relevant introductions and principles, to ensure correct application;

(b) input of Ψ values calculated by a person with suitable expertise and experience following the guidance set out in BRE Report BR 497 *Conventions for calculating linear thermal transmittance and temperature factors*. In these cases 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*. Evidence of suitable expertise and experience for calculating linear thermal transmittance would be to demonstrate that the person has been trained in the software used to carry out the calculation, has applied that model to the example calculations set out in BR 497 and has achieved results that are within the stated tolerances.

(c) Where a junction is not constructed to an accredited detail, and no specific quantification of the thermal bridge values has been suitably established, linear thermal bridge values from Table 8 of the NCM modelling guide should be used in the calculation of the BER. These values reflect an increase of 0.04 W/m.K or 50%, whichever is greater, above the values used in the comparative notional building which establishes the TER.

2.82 The approaches given in paragraph 2.81 are not mutually exclusive. For example, a person carrying out the work may use the approved design detail approach for the majority of junctions, but use a bespoke detail for a window head.

2.83 In support of the approaches given in paragraphs 2.81, 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.

Air permeability and pressure testing

2.84 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. Trickle ventilators should be temporarily sealed rather than just closed.

2.85 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 with an appropriate air tightness scheme to test the specific class of building concerned.

2.86 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) 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;

(b) 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 paragraphs 2.86(c) apply;

(c) 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 a member of an air tightness scheme, with the appropriate registration, experience of testing, inspecting and overseeing air tightness performance of very large buildings. 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

(d) 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 2.87 to 2.89 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

2.87 Compliance would be demonstrated where –

(a) the measured air permeability is not greater than 10 $m^3/(h.m^2)$ at 50 Pa; and

(b) the BER, calculated on completion using the measured air permeability, is not greater than the TER and takes into account any betterment required by paragraph 2.61.

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).

2.88 The person carrying out the work is required to give, not more than 5 days after completion of the testing, a notice in writing to the district council stating the result of the air pressure test.

2.89 Where a building fails to achieve the provisions of paragraph 2.87, remedial measures should be carried out such that the building complies with the provisions of paragraph 2.87.

If the measured air permeability is greater than the design air permeability, but not more than the limiting value of 10 $m^3/(h.m^2)$, then improvements, other than, or alongside, air tightness rectification, may be required to achieve the TER and any betterment required by paragraph 2.61.

Commissioning of fixed building services

General

2.90 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.

2.91 It would be useful to prepare a Commissioning Plan 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.

2.92 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.

2.93 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 2.94 to 2.97.

Air leakage testing of ductwork

2.94 Air leakage testing of ductwork should be carried out in accordance with the procedures given in the BESA DSP DW/143 *A Practical guide to ductwork leakage testing (6th edition) and BESA DSP DW/144 Specification for sheet metal ductwork (3rd edition)* 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.

2.95 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.

2.96 Membership of the Building & Engineering Services Association (B&ES) specialist ductwork group or the Association of Ductwork Contractors and Allied Services could be a way of demonstrating suitable qualifications for this testing work.

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)(1)
	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 $\Delta P^{0.65}$
High pressure (class D)	2000	750	40	0.001 $\Delta P^{0.65}$

Note:
(1) Where ΔP is the differential in pascals.

2.97 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

2.98 A notice in writing confirming that all fixed building services have been properly commissioned is required to be given to the building owner not more than 5 days after completion of the commissioning. 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 B&ES, 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.

2.99 The district council is required to be notified in writing that the provision in paragraph 2.98 has been met.

2.100 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.

2.101 The use of the templates in the BSRIA *Model Commissioning Plan* is a way of documenting the process in an appropriate way.

2.102 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

2.103 The person carrying out the work shall give, not more than 5 days after completion of the work, a notice in writing to the building owner giving sufficient information, including operational and maintenance requirements, to enable the building and its fixed building services to be operated and maintained in an energy efficient manner. They should include any relevant information regarding non-export connection considerations (see paragraph 2.37).

2.104 The district council is required to be notified in writing that the provision in paragraph 2.103 has been met.

2.105 A building log book 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.

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

This should include an electronic copy of the TER/BER data input file for the building to facilitate any future analysis that may be required by the owners and operators 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 where one or more of the following building works are carried out –

(a) the construction of an extension (see paragraphs 3.15 to 3.29);

(b) where there is a material change of use (see paragraphs 3.30 to 3.38);

(c) where there is a change of energy status (see paragraphs 3.30 to 3.39);

(d) the provision or extension of a controlled service (see paragraphs 3.40 to 3.56);

(e) the provision or extension of a controlled fitting (see paragraphs 3.57 to 3.64);

(f) the replacement or renovation of a thermal element (see paragraphs 3.65 to 3.76); and

(g) consequential improvements (see paragraphs 3.77 to 3.86).

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 3.16). 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 – 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 exempt from the energy efficiency requirements

3.4 Work to existing buildings and extensions to buildings other than dwellings that use energy to condition the indoor climate, must comply with the energy efficiency requirements (regulations 39, 40, 41, 43, 43A, 43B and 47) of the Building Regulations unless they are exempt from those requirements.

The following classes of existing buildings, or parts of buildings, are exempt from compliance with the energy efficiency requirements in Part F –

(a) protected buildings where compliance with the energy efficiency requirements would unacceptably alter the character or appearance of such buildings. Guidance is given in paragraphs 3.7 to 3.10;

(b) buildings used as places of worship, and for religious activities;

(c) temporary buildings with a planned time of use of 2 years or less, industrial sites, workshops and non-residential agricultural buildings with a low energy demand; and

(d) stand-alone buildings other than dwellings with a total useful floor area of less than 50 m^2.

3.5 Guidance on classes (b) and (c) is given in paragraph 2.10.

Buildings requiring Specific consideration

3.6 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 3.7 to 3.10;

(b) buildings with low energy demand – the guidance specific to such buildings is given in paragraphs 3.12 to 3.14; and

(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.

Protected buildings and buildings of historic or architectural merit

Protected buildings

3.7 Building work to an existing building is exempt from the energy efficiency requirements if the building is a protected building and where compliance with the energy efficiency requirements would unacceptably alter the character or appearance of the building. Guidance on these buildings is given in paragraphs 3.9 and 3.10.

The case for a protected building to be exempt from the energy efficiency requirements of the building regulations must be supported by evidence

e.g. by restrictions imposed by the relevant planning authority, advice from Department for Communities Historic Environment Division, or advice from a qualified conservation specialist, etc.

Protected building means –

(a) a listed building within the meaning of the Planning (Northern Ireland) Act 2011; and

(b) buildings situated in conservation areas within the meaning of that Act.

Buildings of historic or architectural merit

3.8 Special considerations may apply where the building to which the work is to be carried out is not a protected building but has historic or architectural merit and compliance with the energy efficiency requirements of Part F would unacceptably alter the character or appearance of the building.

3.9 When undertaking work to or in connection with a building of historic or architectural merit, the aim should be to follow the guidance in this Technical Booklet to the extent that it is practicable. Particular issues in relation to work to 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.

3.10 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.

Electricity generated by renewable technologies

3.11 Where a renewable generation technology is installed in an existing building, the relevant provisions of paragraph 2.34 to 2.39 should apply.

Buildings with low energy demand

3.12 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 the *Non-Domestic Building Services Compliance Guide*.

3.13 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.

3.14 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 3.77 to 3.86). 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

3.15 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 3.77 to 3.86, in addition to following the guidance in the rest of this Section.

Large extensions

3.16 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. However, in this case, regulation 43B's NZEB requirements do not apply and hence paragraph 2.61 does not apply.

The requirement for consequential improvements, if applicable, should also be met by following the guidance in paragraphs 3.77 to 3.86.

Other extensions

3.17 For other extensions there are three approaches –

(a) the Standards Based Approach (see paragraphs 3.19 to 3.21);

(b) the Calculated Trade-off Approach (see paragraph 3.22); or

(c) the Equivalent Carbon Target Approach (see paragraphs 3.23 to 3.25).

3.18 The Standards Based Approach is 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

3.19 The extension should achieve the following performance standards –

(a) area of glazing that comply with paragraph 3.20;

(b) doors, windows, roof windows, rooflights and smoke vents that meet the standards given in paragraphs 3.57 to 3.64;

(c) newly constructed thermal elements that meet the standards given in paragraphs 3.65 to 3.70; and

(d) existing opaque fabric that becomes part of the thermal envelope, where previously it was not, that meets the standards given in paragraphs 3.75 and 3.76.

Opening areas

3.20 The total area of windows and rooflights 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 Opening areas in the extension

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

Fixed building services

3.21 Where a fixed building service is provided or extended as part of constructing the extension, it should comply with the guidance in paragraphs 3.40 to 3.56.

Calculated Trade-off Approach

3.22 The fabric standards referred to in paragraph 3.19 and the glazed areas given in paragraph 3.20 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 3.19 and the glazed area standards in paragraph 3.20; and

(b) any fixed building service provided or extended as part of constructing the extension should comply with the standards given in paragraphs 3.40 to 3.56.

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

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

Equivalent Carbon Target Approach

3.23 An approved software implementation of a National Calculation Methodology should be used to demonstrate that the calculated carbon dioxide emission 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 3.19 to 3.21. 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 3.77 to 3.86).

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

3.24 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.

3.25 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 paragraph 3.23.

Highly glazed extensions

Conservatories exempt from the Building Regulations

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

3.27 Where a previously exempt conservatory becomes no longer exempt and energy is used to condition the indoor climate this is a change of energy status and the guidance in paragraph 3.39 should be followed.

Conservatories, sun-rooms and other highly glazed spaces

3.28 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 3.57 to 3.64;

(c) no limit on the area of glazing (i.e. paragraph 3.20 does not apply);

(d) new thermal elements that comply with the guidance in paragraph 3.66 to 3.70.

(e) retained thermal elements that comply with the guidance in paragraphs 3.75 and 3.76; and

(f) where the extension is heated, or cooled by a fixed building service either taken from the main system or provided solely for the extension, independent temperature and on/off controls.

3.29 Alternatively, the extension may be constructed in accordance with one of the approaches given in paragraph 3.17.

MATERIAL CHANGE OF USE OR CHANGE OF ENERGY STATUS

General

3.30 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.

3.31 Where a previously thermally unconditioned building (or part of a building) is to be conditioned this is a change of energy status.

Standards Based Approach

Common provisions

3.32 Where the work involves the provision of a new or replacement thermal element it should comply with the provisions of paragraphs 3.66 to 3.70.

3.33 Where a thermal element is to being retained, it should comply with the provisions of paragraphs 3.75 and 3.76. 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.

3.34 Where controlled fittings or services are being provided or extended, they should comply with the provisions of paragraphs 3.40 to 3.63.

3.35 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 3.57 to 3.64.

Additional provision for a material change of use

3.36 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 3.38.

3.37 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 3.77 to 3.86).

Equivalent Carbon Target Approach

3.38 An approved software implementation of a National Calculation Methodology may be used to demonstrate that the carbon dioxide emission rate from the building as it will be constructed 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

3.39 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 –

(d) controlled fittings whose performance is no worse than that given in Table 3.1;

(e) thermal elements that have U-values no greater than that given in Table 3.2; and

(f) 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 3.38.

CONTROLLED SERVICES

General

3.40 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 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.

3.41 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 Appendix C of the NCM modelling guide.

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 3.41 would be satisfied.

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

3.42 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.

3.43 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*.

3.44 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.

3.45 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 that become available in the future.

Energy meters

3.46 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 (e.g. heating, lighting, etc.).

3.47 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 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 TM 46 *Energy benchmarks*.

Commissioning of fixed building services

General

3.48 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.

3.49 It would be useful to prepare a Commissioning Plan 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.

3.50 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 3.51 to 3.53.

Air leakage testing of ductwork

3.51 Air leakage testing of ductwork should be carried out on new or refurbished ducting where practicable in accordance with the procedures given in the HVCA 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.

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

3.53 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

3.54 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.

3.55 For HVAC systems, a member of the Commissioning Specialists Association or the Commissioning Group of the B&ES, 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.

3.56 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

3.57 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.

3.58 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.

3.59 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.

3.60 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 windows can be taken as the value for –

(a) the smaller of the two standard windows defined in BS EN 14351-1;

(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.

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 3.63
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. The developed area of a rooflight is explained in NARM Technical Document NTD 2 (2010) *Assessment of thermal performance of out-of-plane rooflights*.

3.61 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.

3.62 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.

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

$$U_{limit} = 0.8 + \{(1.2 + (FOL \times 0.5)) \times GF\}$$

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 –

$$0.8 + \{(1.2 + (0.5 \times 0.5)) \times 0.6\} = 1.7 \text{ W/m}^2\text{.K}.$$

3.64 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

3.65 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

3.66 New thermal elements, or thermal elements constructed as replacements for existing elements, should have a U-value not greater than that given in Table 3.3.

Curtain walling is treated as a controlled fitting and guidance is given in paragraph 3.63.

Table 3.3 U-values for new thermal elements (W/m^2.K)

Element[1]	U-value[2]
Wall	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
Floors	0.22
Swimming pool basin (walls and floor)[3]	0.25

Notes:

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

(2) Area-weighted average value.

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

Continuity to limit thermal bridging and air leakage

3.67 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.

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

3.69 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.

3.70 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 substantiated approved design details, published by a government or third party accredited source, such as BRE Certified Thermal Details and Products Scheme. Reference should also be made to any other relevant supporting sections of the document, such as the relevant introductions and principles, to ensure correct application; or

(b) demonstrate that the specified details provide equivalent thermal performance using the guidance in BRE IP 1/06 *Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings* and BRE Report BR 497 *Conventions for calculating linear thermal transmittance and temperature factors*.

Renovated thermal elements

3.71 Major Renovation means the renovation of a building where more than 25% of the surface area of the building envelope undergoes renovation. When assessing whether the area proportion constitutes a major renovation of a building, the surface area of the whole of the external building envelope should be taken into account i.e. external walls, floor, roof, windows, doors, roof windows and rooflights.

The renovation of a thermal element is defined as “the provision of a new layer to a thermal element or the replacement of an existing layer (other than where a partial replacement layer is provided solely as a means of patch repair to a flat roof) but does not include thin decorative surface finishes”. However, the following renovation works require the thermal element to be upgraded in accordance with paragraphs 3.72 to 3.74 –

(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.

3.72 When undertaking the renovation of thermal elements, special considerations apply to protected buildings, buildings of historical or architectural merit and to buildings of traditional construction that need to "breathe" (see paragraphs 3.8 to 3.10).

3.73 Where an individual thermal element is being renovated through undertaking an activity listed in paragraph 3.71, and the renovation –

(a) constitutes a major renovation; or

(b) is greater than 50% of the surface of the individual thermal element,

the whole of that thermal element should be upgraded to the improved U-value 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 each individual thermal 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 pitched 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.

When a building undergoes a major renovation this may represent an opportunity to consider and take into account the technical, environmental and economic feasibility of installing high-efficiency alternative systems.

3.74 Where upgrading to the above standards is not technically or functionally feasible or would not achieve a simple payback of 15 years or less, the element should be upgraded to the best 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 B of Technical Booklet F1.

Retained thermal elements

3.75 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.

Table 3.4 Upgrading of renovated or retained thermal elements

Element(1)	U-value W/m².K	
	(a) Threshold	(b) Upgraded
Cavity 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 (dormer 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 for "Wall – external or internal insulation".

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

(4) 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 loadbearing capacity of the frame or 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.

3.76 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 B of Technical Booklet F1. However, this lesser standard should have a U-value not 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

3.77 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

3.78 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 3.79 to 3.86 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.

3.79 Where improvement works (other than the “trigger activities” listed in paragraph 3.77) 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 3.23 to 3.25).

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.

3.80 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.

On extending a building

3.81 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 3.82 and Table 3.5.

3.82 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.

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 circuit watt and that serve areas greater than 100 m^2 by the provision of new luminaires or improved controls
5	Installing energy metering following the guidance given in CIBSE TM 39
6	Upgrading thermal elements which have U-values greater than those given in column (a) of Table 3.4 following the guidance in paragraphs 3.75 and 3.76
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 $W/m^2.K$ following the guidance in paragraphs 3.57 to 3.64
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

Note:

1 to 7 will usually meet the economic feasibility criterion given in paragraph 3.80. 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 installing or increasing the capacity of fixed building services

3.83 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 3.85 and 3.86.

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 3.82 and Table 3.5.

The cost of any improvements made to comply with paragraph 3.83(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 3.82.

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.

3.84 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 3.81 would be required but those in the following paragraphs would not apply.

3.85 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 3.75 and 3.76; 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.K), should be replaced by fittings complying with paragraphs 3.57 to 3.63.

3.86 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 3.75 and 3.76; 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 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

3.87 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).

3.88 The regulations require the district council to be notified in writing that the provision in paragraph 3.83 has been met.

3.89 A building log book should be provided in the format given in CIBSE 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.

3.90 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 Reporting evidence of compliance

A1 To facilitate effective communication between the person carrying out the work and the district council, it would be beneficial to adopt a standardised format for presenting the evidence that demonstrates compliance with Part F (see paragraph 2.40).

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.

A2 The compliance software and the results they calculate can provide a substantial proportion of the evidence in support of the compliance demonstration and will produce this report as a standard output option. Additional calculations and checks based on these output values may also be required (see paragraph 2.1).

A3 Two versions of the standardised report should 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 constructed 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.

A4 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.

A5 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	**U-values** ($W/m^2.K$)
Wall	0.18
Roof	0.13
Floor	0.16
Window/door U-value	1.40
Design air permeability – 5.00 $m^3/(h.m^2)$ 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 B Publications referred to

British Standards (BS)

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

BS EN 410: 2011 Glass in building. Determination of luminous and solar characteristics of glazing.

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

Air Tightness Testing and Measurement Association (ATTMA)

Measuring air permeability of building envelopes (non-dwellings), Technical Standard L2, 2010.

Building Research Establishment (BRE)

BR 262 Thermal insulation: avoiding risks, 2001.

BR Report 443 Conventions for U-value calculations, 2006.

BRE Report BR 497 Conventions for Calculating Linear Thermal Transmittance and Temperature Factors, 2007 incorporating 2010 amendment and corrections.

Information Paper IP1/06 Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings, 2006.

Simplified Building Energy Model (SBEM) User manual and software.

Building Services Research and Information Association (BSRIA)

BSRIA BG 8/2009 Model Commissioning Plan.

Chartered Institution of Building Services Engineers (CIBSE)

CIBSE Commissioning Code M Commissioning Management, 2003.

CIBSE Design Guide A.

TM 31 Building Log Book Toolkit, CIBSE, 2006.

TM 37 Design for improved solar shading control, 2006.

TM 39 Building energy metering, 2009.

TM 46 Energy benchmarks, 2008.

Department for Communities and Local Government (CLG)

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

Non-Domestic Building Services Compliance Guide, HM Government 2013.

Department for Education and Skills (DfES)

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

Department for Energy and Climate Change (DECC)

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

Department for Infrastructure (DFI)

The Planning (Northern Ireland) Act 2011.

Building and Engineering Services Association (B&ES)

DW/143 A practical guide to ductwork leakage testing, 2013.

DW/144 Specification for sheet metal ductwork, 2013.

National Association of Rooflight Manufacturers (NARM)

Technical Document NTD 2 (2010) Assessment of thermal performance of out-of-plane rooflights.

Northern Ireland Environment Agency: Built Heritage (NIEA)

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

Other publications

Building Regulations Information Note: October 2019 –
Nearly zero-energy buildings (NZEB) requirements for new public buildings.

Building Regulations Information Note: December 2020 –
Nearly zero-energy buildings (NZEB) requirements for new buildings.

Technical Booklet B: 2013 – Materials and workmanship (amended in 2022)

Technical Booklet F1: 2022 – Conservation of fuel and power in buildings other than dwellings

Technical Booklets

The following list comprises the series of Technical Booklets prepared by the Department for the purpose of providing practical guidance with respect to the technical requirements of the Building Regulations (Northern Ireland) 2012 as amended.

Technical Booklet B	Materials and workmanship
Technical Booklet C	Site preparation and resistance to contaminants and moisture
Technical Booklet D	Structure
Technical Booklet E	Fire safety
Technical Booklet F1	Conservation of fuel and power in dwellings
Technical Booklet F2	Conservation of fuel and power in buildings other than dwellings
Technical Booklet G	Resistance to the passage of sound
Technical Booklet H	Stairs, ramps, guarding and protection from impact
Technical Booklet J	Solid waste in buildings
Technical Booklet K	Ventilation
Technical Booklet L	Combustion appliances and fuel storage systems
Technical Booklet M	Physical infrastructure for high-speed communications networks
Technical Booklet N	Drainage
Technical Booklet P	Sanitary appliances, unvented hot water storage systems and reducing the risk of scalding
Technical Booklet R	Access to and use of buildings
Technical Booklet V	Glazing

Any person who intends to demonstrate compliance with the Building Regulations by following the guidance given in a Technical Booklet is advised to ensure that the guidance is current on the date when the plans are deposited or notice given to the district council. Additional amendment booklets may be applicable in some circumstances.

Appendix C Main changes in this Technical Booklet

C1 This Technical Booklet comes into effect on 30th June 2022. The following provides a summary of the main changes from the previous guidance in place, (i.e. Technical Booklet F2 2012 edition with 2014 and 2016 amendments).

C2 New guidance is provided to further support regulation 43B (Nearly zero-energy requirements for new buildings) ('NZEB') requiring NZEB buildings to better the previous Target carbon dioxide Emissions Rate (TER) by up to 15% in the case of new non-domestic buildings. The level of improvement is eased where space heating is provided by heat pumps.

C3 The guidance sets improved U-value limits for elements of new buildings. A whole building area-weighted U-value assessment provides an alternative approach, provided the overall U-values deliver the same overall performance.

C4 The previous option on air permeability assessment, for a default value of 15 $m^3/(h.m^2)$ at 50 Pa to be submitted on non-domestic buildings smaller than 500 m^2, has been removed.

C5 New guidance also deals with circumstances where an export connection is not provided from on-site renewables that generate electricity (e.g. photovoltaic panels).

C6 The references to the *Non-Domestic Building Services Compliance Guide* (NDBSCG) have been updated to the 2013 edition, rather than retaining the previous 2010 edition.

C7 Other minor amendments clarify or rectify previous guidance to reflect current working and enforcement practices. The changes include re-wording to clarify provisions in relation to thermal bridge assessments.