Development & Planning Authority

Guernsey Technical Standard

Conservation of fuel and power - Dwellings

The Building (Guernsey) Regulations, 2012

L1

L1 Dwellings

2012 edition
With May 2016 amendments

MAIN CHANGES MADE BY THE MAY 2016 AMENDMENTS

1. Text changes made to reflect the new structure of government post May 1st 2016. All references to Departments have been removed.

MAIN CHANGES MADE BY THE FEB 2013 AMENDMENTS

2. The general guidance on materials and workmanship and the Construction Products Directive has been edited to reflect the new EU Construction Products Regulation.

MAIN CHANGES IN THE 2012 EDITION

3. This Guernsey Technical Standard which takes effect on 1st July 2012, is issued under the Building (Guernsey) Regulations, 2012. From this date all previous editions of documents approved under the Building Regulations, 1992 i.e. (the UK Approved Document L1 2002 edition, as amended) will no longer be valid except in relation to building work carried out in accordance with full plans deposited with the States of Guernsey Building Control before that date.

How this Guernsey Technical Standard L1 differs from the UK Approved Document L1

4. In addition to the different legislative references reflecting Guernsey legislation, the main differences a non resident based applicant should note include the following.

5 This document is based on the standards of the UK's 2002 edition of Approved Document Part L1.

6 Section 2 of that document is amended to take account of the addition of section 3.

7 Section 3 of this document relates to provisions in relation to Regulation 22 - Thermal Elements.

8 2009 revision including provisions for condensing boilers has been integrated into this document.

9. The UK Building (Approved Inspectors, etc.) Regulations 2010 are not in force in Guernsey. Therefore approved inspectors are not recognised on the Island and all references have been removed.

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Introduction

What is a Guernsey Technical Standard?

This document has been approved and issued Development and Planning Authority to provide practical guidance on ways of complying with requirement L1 and regulation 11 of the Building (Guernsey) Regulations, 2012 (GSI, 2012 No.11) . The Building (Guernsey) Regulations, 2012 are referred to throughout the remainder of this document as 'the Building Regulations'.

The intention of issuing Guernsey Technical Standards is to provide guidance about compliance with specific aspects of the Building Regulations in some of the more common building situations. They include examples of what, in ordinary circumstances, may be reasonable provision for compliance with the relevant requirement(s) of the Building Regulations to which they refer.

If guidance in a Guernsey Technical Standard is followed this may be relied upon as tending to show compliance with the requirement(s) covered by the guidance. Similarly a contravention of the standard may be relied upon as tending to establish a breach of the requirements. However, this is not conclusive, so simply following guidance does not guarantee compliance in an individual case or a failure to follow it meaning that there is necessarily a breach. It is also important to note that there may well be other ways of achieving compliance with the requirements. There is therefore no obligation to adopt any particular solution contained in this Guernsey Technical Standard if you would prefer to meet the relevant requirement in some other way. However, persons intending to carry out building work should always check with the Building Control, that their proposals comply with Building Regulations.

The guidance contained in this Guernsey Technical Standard relates only to the particular requirements of the Building Regulations that the document addresses, (see 'Requirements' below). However, building work may be subject to more than one requirement of the Building Regulations and there may be an obligation to carry out work on a material change of use. In such cases the works will also have to comply with any other applicable requirements of the Building Regulations and work may need to be carried out which applies where a material change of use occurs.

This document is one of a series that has been approved and issued for the purpose of providing practical guidance with respect to the requirements of the Building Regulations in particular of regulations 6, 8 and 11 and Schedule 1.

At the back of this document is a list of all the documents that have been approved and issued for this purpose.

How to use this Guernsey Technical Standard

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

a. Texts shown against a yellow background are extracts from the Building Regulations, and set out the legal requirements that relate to compliance with the conservation of fuel and power requirements of the Building Regulations. It should be remembered however that, as noted above, building works must comply with all the other applicable provisions of the Building Regulations.

b. Key terms are defined in annex G at the rear of this document.

c. Details of technical publications referred to in the text of this document will be presented in ***italics*** and repeated in standards referred to as an annex at the rear of this document. A reference to a publication is likely to be made for one of two main reasons. The publication may contain additional or more comprehensive technical detail, which it would be impractical to include in full in this Document but which is needed to fully explain ways of meeting the requirements; or it is a source of more general information. The reason for the reference will be indicated in each case. The reference will be to a specified edition of the document. The Guernsey Technical Standard may be amended from time to time to include new references or to refer to revised editions where this aids compliance.

Where you can get further help

If you require clarification on any of the technical guidance or other information set out in this Guernsey Technical Standard and the additional detailed technical references to which it directs you, there are a number of routes through which you can seek further assistance:

– The States of Guernsey website: **www.gov.gg/planning**

– If you are the person undertaking the building work you can seek advice from Building Control Surveyors to help ensure that, when carried out, your work will meet the requirements of the Building Regulations.

– Businesses registered with a competent person self-certification scheme may be able to get technical advice from their scheme operator. A full list of competent persons schemes are included as Schedule 3 of the Building Regulations.

– If your query is of a highly technical nature you may wish to seek the advice of a specialist, or industry technical body, in the area of concern.

Responsibility for compliance

It is important to remember that if you are the person (e.g. designer, builder, installer) carrying out building work to which any requirement of Building Regulations applies you have a responsibility to ensure that the work complies with any such requirement. The building owner or occupier will also have a responsibility for ensuring compliance with Building Regulation requirements and could be served with a compliance notice in cases of non-compliance or with a challenge notice in cases of suspected non-compliance.

Types of work covered by this Guernsey Technical Standard

Building work

Building work, as defined in regulation 5 of the Building (Guernsey) Regulations, 2012, includes the erection or extension of a building, the provision or extension of a controlled service or fitting, and the material alteration of a building or a controlled service or fitting. In addition, the Building Regulations may apply in cases where the purposes for which, or the manner or circumstances in which, a building or part of a building is used change in a way that constitutes a material change of use.

Under regulation 6 of the Building Regulations 2012, building work must be carried out in such a way that, on completion of work,

i. the work complies with the applicable Parts of Schedule 1 of the Building Regulations,

ii. in the case of an extension or material alteration of a building, or the provision, extension or material alteration of a controlled service or fitting, it complies with the applicable Parts of Schedule 1 to the Building Regulations and also does so as satisfactorily as it did before the work was carried out.

Work described in Part L1 concerns the conservation of fuel and power in dwellings. Work associated with conservation of fuel and power in dwellings covered in these sections may be subject to other relevant Parts of the Building Regulations.

Material change of use

A material change of use occurs in specified circumstances in which a building, or part of a building that was previously used for one purpose will be used in future for another, or is converted to a building of another kind. Where there is a material change of use, the Building Regulations set requirements that must be met before the building can be used for its new purpose.

Regulation 7 of the Building (Guernsey) Regulations, 2012 specifies the following circumstances as material changes of use:

- a building is used as a dwelling where previously it was not,
- a building contains a flat where previously it did not,
- a building is used as an institution where previously it was not,
- a building is used as a public building where previously it was not,
- a building is not described in Classes I to V or VI of Schedule 2, where previously it was,
- a building contains a room for residential purposes where previously it did not,
- a building contains an office where previously it did not,
- a building is used as an hotel or guest house, where previously it was not,
- a building is an industrial building, where previously it was not,
- a building contains a shop, where previously it did not,
- a building is used for the sale of food or drink, to the public in the course of a business and for consumption in that building and where there is a maximum capacity of 15 or more persons seated or standing, where previously it was not so used,
- the building, which contains at least one room for residential purposes, contains a greater or lesser number of such rooms than it did previously,

General Guidance

– the building, which contains at least one dwelling, contains a greater or lesser number of dwellings than it did previously.

Part L1 will apply to all the material changes of use mentioned above. This means that whenever such changes occur the building must be brought up to the standards required by Part L1.

Protected Buildings and Monuments

The types of building works covered by this Guernsey Technical Standard may include work on historic buildings. Historic buildings include:

a. a building appearing on the protected buildings listing

b. a building or other structure appearing on the protected monument listing

When exercising its functions under The Land Planning and Development Law, the States has duties under s30(1), 34, 35 and 38(1) of that Law, to secure so far as possible that monuments are protected and preserved, that the special characteristics of protected buildings are preserved and to pay special attention to the desirability of preserving and enhancing the character and appearance of a conservation area. Building Control will need to comply with these duties when considering any decisions in relation to such buildings or buildings in such areas.

Special considerations may apply if the building on which the work is to be carried out has special historic, architectural, traditional or other interest, and compliance with the **conservation of fuel and power** requirements would unacceptably alter the fabric, character or appearance of the building or parts of it.

When undertaking work on or in connection with buildings with special historic, architectural, traditional or other interest, the aim should be to improve the **conservation of fuel and power** where and to the extent that it is possible provided that the work does not prejudice the fabric, character or appearance of the host building or increase the long-term deterioration to the building's fabric or fittings.

In arriving at a balance between historic building conservation and the **conservation of fuel and power** requirements advice should be sought from the historic building adviser.

Note: Any building which is a protected monument listed under Section 29 of The Land Planning and Development (Guernsey) Law 2005 is exempt from most Building Regulations requirements including those in Part L, (See regulation 13 and class V of Schedule 2 to the Building Regulations) unless the proposed works constitute a material change of use.

Notification of work

In almost all cases of new building work it will be necessary to notify Building Control in advance of any work starting. The exception to this: where work is carried out under a self-certification scheme listed in Schedule 3 or where works consist of emergency repairs.

Competent person self-certification schemes under Schedule 3

Under regulations 14(4), 17(4) and 19 of the Building Regulations it is not necessary to deposit plans or notify Building Control in advance of work which is covered by this Guernsey Technical Standard if that work is of a type set out in column 1 of Schedule 3 to the Regulations and is carried out by a person registered with a relevant self-certification (competent persons) scheme as set out in column 2 of that Schedule. In order to join such a scheme a person must demonstrate competence to carry out the type of work the scheme covers, and also the ability to comply with all relevant requirements in the Building Regulations. These schemes may change from time to time, or schemes may change name, or new schemes may be authorised under Schedule 3; the current list on the States website should always be consulted. Full details of the schemes can be found on the individual scheme websites.

Where work is carried out by a person registered with a competent person scheme, regulation 19 of the Building Regulations requires that the occupier of the building be given, within 30 days of the completion of the work, a certificate confirming that the work complies with all applicable Building Regulation requirements. There is also a requirement that Building Control be given a notice that this has been done, or the certificate, again within 30 days of the completion of the work.

These certificates and notices are usually made available through the scheme operator.

Building Control is authorised to accept these certificates as evidence of compliance with the requirements of the Building Regulations. However, inspection and enforcement powers remain unaffected, although they are normally used only in response to a complaint that work does not comply.

Exemptions

Schedule 2 to the Building Regulations sets out a number of classes of buildings which are exempt from majority of Building Regulations requirements including Part L1

Materials and workmanship

Any building work within the meaning of the Building Regulations should, in accordance with regulation 11, be carried out with proper materials and in a workmanlike manner.

You may show that you have complied with regulation 11 in a number of ways. These include the appropriate use of a product bearing CE marking in accordance with the Construction Products Regulation (305/2011/EU-CPR) as or a product complying with an appropriate technical specification (as defined in those Regulations), a British Standard or an alternative national technical specification of any state which is a contracting party to the European Economic Area which in use is equivalent, or a product covered by a national or European certificate issued by a European Technical Approval issuing body, and the conditions of use are in accordance with the terms of the certificate.

You will find further guidance in the Guernsey Technical Standard on materials and workmanship that provides practical guidance on regulation 11 on materials and workmanship.

Supplementary guidance

Building Control occasionally issues additional material to aid interpretation of the guidance in Guernsey Technical Standards. This material may be conveyed in official letters to relevant agents and/or posted on the States website accessed through: **www.gov.gg/planning**

Technical specifications

When a Guernsey Technical Standard makes reference to specific standards or documents, the relevant version of the standard is the one listed at the end of the publication. However, if this version of the standard has been revised 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.

Where it is proposed to work to an updated version of the standard instead of the version listed at the end of the publication, this should be discussed with Building Control in advance of any work starting on site.

The appropriate use of any product, which complies with a European Technical Approval as defined in the Construction Products Regulation, (305/2011/EU-CPR) as amended, repealed or replaced will meet the relevant requirements.

Independent schemes of certification and accreditation

Much of the guidance throughout this document is given in terms of performance.

Since the performance of a system, product, component or structure is dependent upon satisfactory site installation, testing and maintenance, independent schemes of certification and accreditation of installers and maintenance firms will provide confidence in the appropriate standard of workmanship being provided.

Confidence that the required level of performance can be achieved will be demonstrated by the use of a system, material, product or structure which is provided under the arrangements of a product conformity certification scheme and an accreditation of installer scheme.

Third party accredited product conformity certification schemes not only provide a means of identifying materials and designs of systems, products and structures which have demonstrated that they reach the requisite performance, but additionally provide confidence that the systems, materials, products and structures are actually provided to the same specification or design as that tested or assessed.

Third party accreditation of installers of systems, materials, products and structures provides a means of ensuring that installations have been conducted by knowledgeable contractors to appropriate standards, thereby increasing the reliability of the anticipated performance.

Many certification bodies that approve such schemes are accredited by the **United Kingdom Accreditation Service**.

Certification of products, components, materials or structures under such schemes may be accepted as evidence of compliance with the relevant standard. Similarly the certification of installation or maintenance of products, components, materials and structures under such schemes as evidence of compliance with the relevant standard may be acceptable. Nonetheless Building Control will wish to establish in advance of the work, that any such scheme is adequate for the purpose of the Building Regulations.

Interaction with other legislation

This Guernsey Technical Standard makes reference to other legislation, including that listed below, the requirements of which may be applicable when carrying out building work. All references are to legislation as amended or repealed and replaced.

Note: All Laws, Ordinances and Statutory instruments can be accessed at;

www.guernseylegalresources.gg/

The Health and Safety at Work (General) (Guernsey) Ordinance, 1987 made under the Health and Safety at Work etc. (Guernsey) Law, 1979 and the Health, Safety and Welfare of Employees Law, 1950 applies to any workplace or part of a workplace. It applies 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.

Mixed use development

In mixed use developments part of a building may be used as a dwelling while another part has a non-domestic use. In such cases, if the requirements of this Part of the Regulations for dwellings and non-domestic use differ, the requirements for non-domestic use should apply in any shared parts of the building.

Routes to compliance for dwellings

STEP	TEST		ACTION
START	**Choose method of compliance**		
	Elemental method		Go to 1
	Target U-value method		Go to 5
	Carbon Index method		Go to 11
Compliance by Elemental method			
1	Is the heating by gas or oil boiler, heat pump, community heating with CHP, biogas or biomass fuel?	No	Elemental Method not applicable - go to START and choose another method
		Yes	Continue
2	For gas or oil boilers, is the SEDBUK of proposed heating system ≥ SEDBUK from Table 2 in 1.7? [Note: for heat pump, CHP, biogas or biomass fuel, efficiency is not an issue, so continue]	No	Change heating system and go to 1
		Yes	Continue
3	Are all U-values of proposed dwelling ≤ the corresponding values from Table 1 in 1.3?	No	**FAIL** by Elemental Method - revise U-values and repeat 3 or go to START
		Yes	Continue
4	Is the area of windows, doors and roof windows ≤ 25% of total floor area?	No	**FAIL** by Elemental Method - reduce area of openings and repeat 4 or go to START
		Yes	**PASS** by Elemental Method and go to Additional checks
Compliance by Target U-value method			
5			Calculate the target U-value (U_T) from equation (1) in 1.18
6	Is the heating by a system other than gas or oil boiler, heat pump, CHP, biogas or biomass fuel, or is it undecided?	Yes	Divide the target U-value (U_T) by 1.15 and go to 8
		No	Continue

Summary guide to the use of this Guernsey Technical Standard

7	For gas or oil boilers, is the proposed SEDBUK for the heating system equal to the corresponding SEDBUK from from Table 2 in 1.7	Yes	Multiply the target U-value (U_T) by $\frac{\text{proposed SEDBUK}}{\text{SEDBUCK from table 2}}$
	[**Note:** for heat pump, CHP, Biogas or fuel, efficiency is not an issue, so continue]	No	Continue
8	Is there a greater area of glazing facing South than is facing North?	Yes	Add: 0.04 x $\frac{A_S - A_N}{A_T}$ to the Target U-value (U_T)
		No	Continue
9			Calculate the average U-value from $\bar{U} = \frac{\sum A_U}{\sum A}$
10	Is $\bar{U} \leq U_T$ and is the U-value of each element ≤ corresponding value from Table 3 in 1.29?	No	FAIL by Target U-value Method - revise and go to 5 or go to **START**
		Yes	**PASS** by Target U-value method and go to Additional checks
Compliance by Carbon Index method			
11			Calculate the Carbon Index (CI) as defined in SAP 2001
12	Is the Carbon Index (CI) ≥ 8.0 and is the U-value of each element ≤ corresponding value from Table 3 in 1.29?	No	**FAIL** by Carbon Index Method - revise and go to 11 or go to START
		Yes	**PASS** by Carbon Index method and go to Additional checks

Additional checks by builders

Limiting thermal bridging at junctions and around openings (see clauses 1.30 to 1.32)

Check that details comply with clauses 1.30 or that calculations show equivalence

Limiting air leakage (see clauses 1.33 to 1.35)

Check that air leakage is limited according to clauses 1.34 or 1.35

Space heating controls and HWS (see clauses 1.36 to 1.45)

Zone controls:	Check that zone controls comply with clauses 1.38 and 1.39
Timing controls:	Check that timing controls comply with clause 1.40
Boiler control interlocks:	Check that boiler control interlocks comply with clause 1.41
Hot Water Storage:	Check that hot water storage complies with clauses 1.42 to 1.45

Alternative approach for space heating and HWS systems (see clause 1.46)

Check that the space heating and hot water systems comply by adopting the relevant recommendations in Good Practice Guide 302 and that provision has been made to include zoning, timing and interlock features similar to those given in clauses 1.36 to 1.45

Commisioning of heating and HWS systems (see clauses 1.47 to 1.49)

Inspect, commission and test systems OR check that the installation sub-contractor has certified, following commissioning, that the systems comply.

Operating and Maintenance instructions for heating and hot water systems (see clause 1.50)

Check that the building owner and/or occupier has been given information on the operation and maintenance of the heating and hot water systems.

Insulation of pipes and ducts (see clauses 1.51 and 1.52)

Check that reasonable provision has been made to insulate pipes and ducts, and that in unheated areas the central heating and hot water pipework has been insulated sufficiently to protect against freezing.

Internal Lighting (see clauses 1.53 to 1.55)

Check that reasonable provision has been made for occupiers to obtain the benefits of efficient lighting.

External lighting fixed to the building (see clause 1.56)	
	Check that reasonable provision has been made to enable effective control and/or use of efficient lamps.
Conservatories (see clauses 1.57 to 1.61)	
When part of a new dwelling:	a) Check, where the conservatory is not separated from the rest of the dwelling, that the conservatory has been treated as an integral part of the dwelling. b) Check, where the conservatory is separated from the rest of the dwelling and has a fixed heating installation, that the heating in the conservatory has its own separate temperature and on/off controls.
When attached to an existing dwelling:	Check, that where an opening is created or enlarged, provision has been made to limit heat loss from the dwelling such that it is no worse than before the work was undertaken.
In addition:	Check, that with regard to the glazing, the safety requirements of Part N of the Building Regulations have been met.

The Requirement L1

This Guernsey Technical Standard deals with the following requirements from Part L of Schedule 1 of the Building Regulations.

Requirement	*Limits on application*
Dwellings **L1.** Reasonable provision must be made for the conservation of fuel and power in dwellings by - (a) limiting the heat loss: (i) through thermal elements and other parts of the fabric of the building, (ii) from hot water pipes and hot air ducts used for space heating, and (iii) from hot water vessels, (b) providing space heating and hot water systems which are energy-efficient,	
(c) providing lighting systems with appropriate lamps and sufficient controls so that energy can be used efficiently, and	The requirement for sufficient controls in requirement L1(c) applies only to external lighting systems fixed to the building.
(d) providing sufficient information with the heating and hot water services so that building occupiers can operate and maintain the services in such a manner as to use no more energy than is reasonable in the circumstances.	

Guidance

Performance

L1.1 The requirement L1 (a) will be met by the provision of energy efficiency measures which:

a) limit the heat loss through the roof, wall, floor, windows and doors etc by suitable means of insulation, and where appropriate permit the benefits of solar heat gains and more efficient heating systems to be taken into account; and

b) limit unnecessary ventilation heat loss by providing building fabric which is reasonably airtight; and

c) limit the heat loss from hot water pipes and hot air ducts used for space heating and from hot water vessels and their primary and secondary hot water connections by applying suitable thicknesses of insulation where such heat does not make an efficient contribution to the space heating.

L1.2 The requirement L1 (b) will be met by the provision of space heating and hot water systems with reasonably efficient equipment such as heating appliances and hot water vessels where relevant, and suitable timing and temperature controls that have been appropriately commissioned such that the heating and hot water systems can be operated effectively as regards the conservation of fuel and power.

L1.3 The requirement L1 (c) will be met by the provision of lighting systems that utilise energy-efficient lamps where this is appropriate; and that have manual switching controls or, in the case of external lighting fixed to the building, automatic switching, or both manual and automatic switching controls as appropriate, such that the lighting systems can be operated effectively as regards the conservation of fuel and power.

L1.4 The requirement L1 (d) will be met by providing information, in a suitably concise and understandable form, and including the results of performance tests carried out during the works, that shows building occupiers how the heating and hot water services can be operated and maintained so that they use no more energy than is reasonable in the circumstances.

Introduction to Provisions

Technical risk

L1.5 Guidance on avoiding technical risks (such as rain penetration, condensation etc) which might arise from the application of energy conservation measures is given in *BRE Report No 262: "Thermal Insulation: avoiding risks",* 2002 Edition. As well as giving guidance on ventilation for health, Guernsey Technical Standard F contains guidance on the provision of ventilation to reduce the risk of condensation in roof spaces. Guernsey Technical Standard J gives guidance on the safe accommodation of combustion systems including the ventilation requirements for combustion and the proper working of flues. Guernsey Technical Standard E gives guidance on achieving satisfactory resistance to the passage of sound. Guidance on some satisfactory design details is given in the report on *Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings, TSO, 2001.*

Thermal conductivity and transmittance

L1.6 In the absence of test information, thermal conductivities and thermal transmittances (U-values) may be taken from the tables in this Guernsey Technical Standard or alternatively in the case of U-values they may be calculated. However, if test results for particular materials and makes of products obtained in accordance with a harmonised European standard are available they should be used in preference. Measurements of thermal conductivity should be made according to *BS EN 12664:2001 Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Dry and moist products of low and medium thermal resistance, BS EN12667: 2000 Thermal performance of building materials and products –*

Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Products of high and medium thermal resistance, or BS EN 12939: 2001 Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Thick products of high and medium thermal resistance.
Measurements of thermal transmittance should be made according to *BS EN ISO 8990: 1996 Thermal insulation –Determination of steady-state thermal transmission properties – Calibrated hot box* or, in the case of windows and doors, *BS EN ISO 12567-1 : 2000 Thermal performance of windows and doors – Determination of thermal transmittance by hot box method – Part 1: Complete windows and doors*. The size and configuration of windows for testing or calculation should be representative of those to be installed in the building, or conform to published guidelines on the conventions for calculating U-values, BRE.

U-value reference tables

L1.7 Annex A contains tables of U-values and examples of their use, which provide a simple way to establish the amount of insulation needed to achieve a given U-value for some typical forms of construction. They yield cautious results that, in practice, are equal or better than the stated U values. However specific calculations where proprietary insulation products are proposed may indicate that somewhat less insulation could be reasonable. The values in the tables have been derived taking account of typical thermal bridging where appropriate. Annex A also contains tables of indicative U-values for windows, doors and rooflights.

Calculation of U-values

L1.8 U-values should calculated using the methods given in:

- for walls and roofs: *BS EN ISO 6946: 1997 Building components and building elements – Thermal resistance and thermal transmittance – Calculation method*

- for ground floors: *BS EN ISO 13370: 1998 Thermal performance of buildings – Heat transfer via the ground – Calculation methods*
- for windows and doors: *BS EN ISO 10077-1: 2000 Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 1: Simplified methods,* or

prEN ISO 10077-2 Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 2: Numerical method for frames.

- for basements: *BS EN ISO 13370*

For building elements not covered by these documents the following may be appropriate alternatives:

BRE Digest 465 U-values for light steel frame walls , or

Finite element analysis in accordance with *BS EN ISO 10211-1: 1996 Thermal bridges in building construction – Calculation of heat flows and surface temperatures – Part 1: General methods* or *BS EN ISO 10211-2: 2001 Thermal bridges in building construction – Calculation of heat flows and surface temperatures – Part 2: Linear thermal bridges*.

BRE Report 443 conventions for establishing U-values can be followed.

Some examples of U-value calculations are given in Annex B and Annex C gives data for ground floors and basements.

L1.9 Thermal conductivity values for common building materials can be obtained from *BS EN 12524: 2000 Building materials and products – Hygrothermal properties – Tabulated design values* or the *CIBSE Guide A: Environmental design, Section A3: Thermal properties of building structures, CIBSE, 1999*, but for ease of reference a table of common materials is given in Annex A. For specific insulation products, data should be obtained from the manufacturers.

L1.10 When calculating U-values the thermal bridging effects of, for instance, timber joists, structural and other framing, normal mortar bedding and window frames should generally be taken into account using the procedure given in *BS EN ISO 6946* (some examples are given in Annex B). Thermal bridging can be disregarded however where the difference in thermal resistance between the bridging material and the bridged material is less than 0.1m^{2}K/W. For example normal mortar joints need not be taken into account in calculations for brickwork. Where, for example, walls contain in-built meter cupboards, and ceilings contain loft hatches, recessed light fittings, etc, area-weighted average U-values should be calculated.

Basis for calculating areas

L1.11 The dimensions for the areas of walls, roofs and floors should be measured between finished internal faces of the external elements of the building including any projecting bays. In the case of roofs they should be measured in the plane of the insulation. Floor areas should include non-useable space such as builders' ducts and stairwells.

Standard assessment procedure (SAP)

L1.12 The SAP provides the methodology for the calculation of the Carbon Index which can be used to demonstrate that dwellings comply with Part L of the Building Regulations (see paragraph 1.27).

Note: It is encouraged to obtain a full SAP rating for new build properties. This is normally based on the builders plan and construction drawings and construction materials in association with the latest building regulations currently in force. Using this method a SAP rating can be calculated before the building is constructed. More information is available for new build homes SAP Assessment. In addition new build "on-construction" assessors SAP Assessment provides information required from you to enable energy ratings to be calculated

Section 1 - Design and Construction

Alternative methods of showing compliance

1.1 Three methods are shown for demonstrating reasonable provision for limiting heat loss through the building fabric:

a) An Elemental method;
b) A Target U-value method;
c) A Carbon Index method.

1.2 The Elemental Method can be used only when the heating system will be based on an efficient gas or oil boiler, on a heat pump, on community heating with CHP or on biogas or biomass fuel, or electric heating or other systems. The Target U-value Method and the Carbon Index Method can be used with any heating system.

Table 1 **Elemental Method: U-values for construction elements**

Exposed Element	U-value
Pitched roof with insulation between rafters [1, 2]	0.2
Pitched roof with integral insulation	0.25
Pitched roof with insulation between joists	0.16
Flat roof [3]	0.25
Walls, including basement walls	0.35
Floors, including ground floors and basement floors	0.25
Windows, doors and rooflights [4] (area-weighted average), glazing in metal frames [5]	2.2
Windows, doors and rooflights [4] (area-weighted average), glazing in wood or PVC frames [5]	2.0

Notes to Table 1:
1 Any part of a roof having a pitch of 70° or more can be considered as a wall.
2 For the sloping parts of a room-in-the-roof constructed as a material alteration, a U-value of 0.3 W/m2K would be reasonable.
3 Roof of pitch not exceeding 10°
4 Rooflights include roof windows
5 The higher U-value for metal-framed windows allows for additional solar gain due to the greater glazed proportion.

Elemental method
U-values for construction elements

1.3 The Elemental Method is suitable for alterations and extension work, and for newbuild work when it is desired to minimise calculations. When using the Elemental Method, the requirement will be met for new dwellings by selecting construction elements that provide the U-value thermal performances given in Table 1.

1.4 One way of achieving the U-values in Table 1 is by providing insulation of an appropriate thickness estimated from the tables in Annex A. An alternative for walls and roofs is to use the combined method of calculation outlined in Annex B and set out in more detail in the *CIBSE Guide Section A3 1999 Edition*. An alternative for floors is to use the data given in Annex C.

1.5 Door designs can include various panel arrangements but the indicative U-values given in Annex A, Table A1 will generally be acceptable. Single-glazed panels can be acceptable in external doors provided that the heat loss through all the windows, doors and rooflights does not exceed that of the standard provision given in paragraphs 1.8 to 1.10 below.

1.6 Care should be taken in the selection and installation of appropriate sealed double-glazed windows in order to avoid the risk of condensation forming between the panes. Guidance on avoiding this problem is given in *BRE Report No 262 “Thermal insulation: avoiding risks”, 2002 edition.*

1.7 Table 2 sets out the minimum boiler SEDBUK values that enable the adaption of the U-values in Table 1 when using the Elemental Method, and the reference boiler SEDBUK values to be used in the Target U-value Method for establishing the fabric insulation specifications. See paragraph 1.36 for the boiler performance standards that should actually be achieved.

Table 2 Minimum boiler SEDBUK to enable adoption of the U-values in Table 1, and reference boiler SEDBUK for use in the Target U-value Method

Central heating system fuel	SEDBUK (1) %
Mains natural gas	78
LPG	80
Oil	85 (2)

Notes to Table 2:
1 For boilers for which the SEDBUK is not available, the appropriate seasonal efficiency value from Table 4b of the SAP may be used instead (see paragraph L1.12).
2 For oil-fired combination boilers a SEDBUK of 82%, as calculated by the SAP 2001 method, would be acceptable

Areas for windows, doors and rooflights

Standard Area Provision

1.8 The requirement would be met if the average U-value of windows, doors and rooflights matches the relevant figure in Table 1 and the area of the windows, doors and rooflights together does not exceed 25% of the total floor area.

1.9 The average U-value is an area-weighted average for the whole dwelling, and depends on the individual U-values of the glazed components and door components proposed and their proportions of the total area of openings. Examples of how the average U-value is calculated are given in Annex D.

Adapting the Standard Area Provision for particular cases

1.10 Areas of windows, doors and rooflights larger than that given in paragraph 1.8 may be adopted in particular cases by using the Target U-value Method to demonstrate compliance. Another option would be to reduce the area of windows, doors and rooflights to compensate for a higher average U-value (ie lower performance glazing). However reducing glazing area could lead to inadequate daylighting.

Extensions to dwellings

1.11 The fabric U-values given in Table 1 in the Elemental Method can be applied when proposing extensions to dwellings. The Target U-value and Carbon Index Methods can be used only if applied to the whole enlarged dwelling.

1.12 Only when applied to extension works, the U-values in Table 1 may be varied provided that the total rate of heat loss from the extension is no higher than it would be if all elements had the U-values given in Table 1. The total rate of heat loss is the sum of (area x U-value) for all exposed elements. As an example, where the floor area and the roof area are equal, it would be acceptable for the roof to have a U-value of 0.18 W/m^{2}K if the floor U-value is 0.23 W/m^{2}K.

1.13 For small extensions to dwellings (for example, ground-floor extension to single rooms such as kitchen extensions in terraced houses, porches where the new heated space created has a floor area of not more than about 6 m^2), reasonable provision would be to use construction details that are no worse in energy performance terms than those in the existing building.

1.14 The area-weighted average U-value of windows, doors and rooflights (“openings”) in extensions to existing dwellings should not exceed the relevant values in Table 1. An appropriate area provision for openings for extensions could be established where:

a) the area of openings in the extension does not exceed 25% of the floor area of the extension plus the area of any windows or doors in the existing dwelling which, as a result of the extension works, no longer exist or are no longer exposed; or

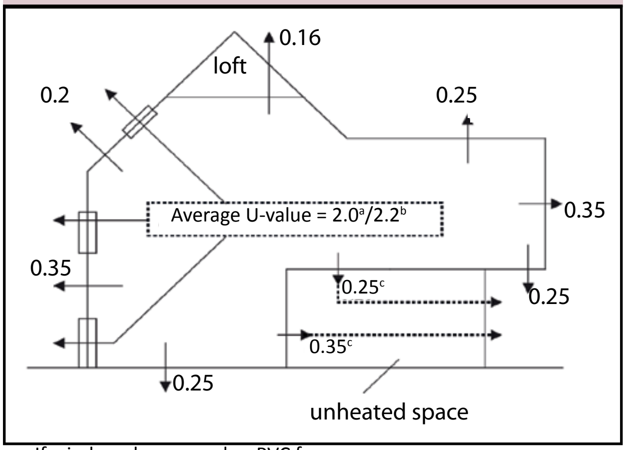
b) the area of openings in the enlarged dwelling does not exceed the area of openings in the existing dwelling; or

c) the area of openings in the enlarged dwelling does not exceed 25% of the total floor area of the enlarged dwelling.

Summary of provisions in the elemental method

1.15 Diagram 1 summarises the fabric insulation standards and allowances for windows, doors and rooflights given in the Elemental method. Examples of the procedures used in this method are given in Annexes A to C. For the calculation of U-values of elements adjacent to an unheated space, see key terms 'Exposed Element' (Annex G).

Diagram 1 **Summary of Elemental Method**



a. If windows have wood or PVC frames
b. If windows have metal frames
c. includes the effect of the unheated space

Target U-value method for new dwellings

1.16 Within certain limits, this method allows greater flexibility than the Elemental Method in selecting the areas of windows, doors and rooflights, and the insulation levels of individual elements in the building envelope, taking into account the efficiency of the heating system and enabling solar gain to be addressed. It can be used for any heating system. In adjusting the areas of windows, doors and rooflights, however, consideration should be given to providing satisfactory daylighting. *BS 8206: Part 2 'Lighting for buildings: Code of practice for daylighting', BSI, London, 1992.* gives advice but in general total opening areas of less than 17% of the total floor area might be inadequate. The Target U-value equation given below and the associated guidance is applicable only to complete dwellings.

1.17 The requirement would be met if the calculated average U-value of the dwelling does not exceed the Target U-value, corrected for the proposed method of heating, as determined from the following paragraphs.

1.18 The Target U-value is determined from the following equation:

$$U_T = [0.35 - 0.19(A_R/A_T) - 0.10(A_{GF}/A_T) + 0.413(A_F/A_T)]$$

where:

- U_T is the target U-value prior to any adjustment for heating system performance or solar gain (see paragraphs 1.20 to 1.24);
- A_R is the exposed roof area;
- A_{GF} is the ground floor area;
- A_F is the total floor area (all storeys); and
- A_T is the total area of exposed elements of the dwelling (including the ground floor).

1.19 The total area of exposed elements should be calculated in accordance with paragraph **L1.11**.

1.20 Where the reference boiler SEDBUK value as indicated in Table 2 is used no adjustment to the Target U-value is necessary. Where the proposed boiler SEDBUK value used is better or worse than the tabulated value, the Target U-value can be eased or should be tightened as appropriate by multiplying the Target U-value by the factor f_e where:

$$f_e = \frac{\text{Proposed boiler SEDBUK (\%)}}{\text{Reference boiler SEDBUK (\%)}}$$

and for boilers for which the SEDBUK is not available, the appropriate seasonal efficiency value from Table 4b of the SAP may be used instead (see paragraph **L1.12**).

1.21 For dwellings that are to be heated by a system other than those specified in paragraph 1.2, or if the heating system is undecided, the Target U-value is made more demanding (i.e. improved) by dividing by a factor of 1.15 to compensate for the higher carbon emission rate.

1.22 A solid fuel boiler should have an efficiency not less than that recommended for its type in the HETAS certification scheme.

Optional allowance for solar gains

1.23 For dwellings whose windows have metal frames (including thermally broken frames) the Target U-value can be increased by multiplying by a factor of 1.03, to take account of the additional solar gain due to the greater glazed proportion.

1.24 The Target U-value equation assumes equal distribution of glazed openings on North and South elevations. Where the area of glazed openings on the South elevations exceeds that on the North, the benefit of solar heat gains can be taken into account to ease the target U-value by adding ΔS to the target U-value, where:-

$\Delta S = 0.04 \times [(A_S - A_N) / A_{TG}]$

A_S = Area of glazed openings facing south;

A_N = Area of glazed openings facing north;

A_{TG} = Total area of all glazed openings in the building;

and

South-facing is defined as facing South $\pm 30^0$;

North-facing is defined as facing North $\pm 30^0$; and

the area of glazed openings includes the area of the frames.

1.25 If adjustments to the Target U-value are being made for heating system or window type as well as for solar gain, the adjustment for solar gain should be applied last.

1.26 Example calculations for determining Target U-values and average U-values are given in Annex E.

Carbon Index method

1.27 The aim in this method is to provide more flexibility in the design of new dwellings whilst achieving similar overall performance to that obtained by following the Elemental Method. The Carbon Index adopted in this method is defined in the SAP, and the requirement would be met if the Carbon Index for the dwelling (or each dwelling in a block of flats or converted building) is not less than 8.0.

1.28 The edition of SAP used for the calculation of the Carbon Index should be the edition having the UK's Secretary of State's approval at the relevant time in the particular case (see paragraph **L1.12**).

Constraints when using the calculation procedures

Poorest acceptable U-values

1.29 When using the calculation procedures in the Target U-value and Carbon Index methods it may be possible to achieve satisfactory solutions where the U-values of some parts of elements (such as one of the walls, a part of a floor, ingle-nooks, meter boxes or fireplace recesses) are worse than those set out in Table 1. This is provided that the poorer performance is compensated for by better performance of the other elements. However such local reductions in performance should be limited having regard for the avoidance of condensation risks on inner surfaces and within the fabric as well as the overall aim of the conservation of fuel and power. A way of achieving this would be to adopt local U-values no higher than those in Table 3.

Table 3 **Poorest U-values for parts of elements acceptable as a general rule when using the Target U-value and Carbon Index Methods**

Element	Poorest acceptable U-value
Parts 1 of roof	0.35
Parts 1 of exposed wall or floor	0.7

Note
1 Whilst parts of these elements may (within the limits given in this table) have poorer U-values than those given in Table 1, it will not normally be practical to make sufficient allowances elsewhere in the design for the whole element to be built to these standards.

Limiting thermal bridging at junctions and around openings

1.30 The building fabric should be constructed so that there are no significant thermal bridges or gaps in the insulation layer(s) within the various elements of the fabric, at the joints between elements, and at the edges of elements such as those around window and door openings.

1.31 A way of meeting the requirements would be to adopt the recommendations in *Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings,TSO, 2001*., which gives examples of design details and constructional practices that can deliver the required performances.

1.32 An alternative way of meeting the requirements would be to demonstrate by calculation that the performance of the building is at least as a good as it would be by following paragraph 1.31.

BRE information paper 17/01 Assessing the effects of thermal bridging at junctions and around openings in the external elements of buildings, illustrates how this can be done.

Limiting air leakage

1.33 Reasonable provision should be made to reduce unwanted air leakage. Without prejudice to the need for compliance with all the requirements in Schedule 1, however, the need to provide for adequate ventilation for health (Part F) and adequate air for combustion appliances (Part J) should particularly be taken into account.

1.34 Guidance on some ways of reducing infiltration is given in the report on robust construction details. The main principle is to provide a continuous barrier to air movement around the habitable space (including separating walls and the edges of intermediate floors) that is in contact with the inside of the thermal insulation layer.

1.35 An alternative and more quantifiable method of showing satisfactory levels of air infiltration is by pressure-testing the building following the method given in *TM 23:2000: Testing of buildings for air leakage, CIBSE* that the dwelling Air Permeability does not exceed 10 cubic metres per hour per square metre of external surface area at an applied pressure difference of 50 pascals.

Boiler Efficiency

1.36 Notwithstanding the boiler SEDBUK value used in establishing compliant fabric specifications (as set out in paragraphs 1.7 and 1.20), reasonable provision for boiler efficiency in actual installations in new dwellings would be:

a) in the case of boilers fulled with gas or LPG, a boiler with SEDBUK not less than 86%; and

b) in the case of boilers fulled with oil, a boiler with SEDBUK not less than 85%.

Space heating system controls

1.37 The following guidance covers provisions which are appropriate for the more common varieties of heating system excluding space heating provided by individual solid fuel, gas and electric fires or room heaters. For electric storage heaters appropriate provision would be achieved by automatic charge control that detects the internal temperature and adjusts the charging of the heater accordingly.

1.38 The requirement would be met by the appropriate provision of:

a) zone controls; and
b) timing controls; and
c) boiler control interlocks.

Zone controls

1.39 A way of demonstrating compliance would be (for hot water central heating systems, fan controlled electric storage heaters and electric panel heaters) to control the temperatures independently in areas (such as separate sleeping and living areas) that have different heating needs. Temperature control could be effected by room thermostats and/or thermostatic radiator valves or any other suitable temperature sensing devices, together with appropriate control devices.

1.40 In most dwellings one timing zone divided into two temperature control sub-zones would be appropriate. However in single-storey open-plan flats and bed-sitters, for example, sub-zoning of temperature control could be inappropriate. Reasonable provision in the case of large dwellings of more than 150m^2 floor area, would be for no zone to have an area exceeding 150m^2 and the operation of the heating to be separately timed in each zone.

Timing controls

1.41 Timing devices should be provided to control the periods when the heating systems operate. This provision should be made for gas fired and oil fired systems and for systems with solid fuel fired boilers where forced-draught fans operate when heat is required. Timing systems would be inappropriate for systems with solid fuel boilers which operate only by natural draught. Separate timing control should be provided for space heating and water heating, except for combination boilers or solid fuel appliances.

Boiler control interlocks

1.42 Gas and oil fired hot water central heating system controls should switch the boiler off when no heat is required whether control is by room thermostats or by thermostatic radiator valves:

a) The boiler in systems controlled by thermostats should operate only when a space heating or vessel thermostat is calling for heat.

b) Where it is proposed to effect control by thermostatic radiator valves, a room thermostat (or other device such as a flow switch) should also be provided to switch off the boiler when there is no demand for heating or hot water.

Hot Water Systems

1.43 There are several acceptable ways of providing hot water systems in dwellings. The guidance in this document is for systems incorporating hot water storage.

1.44 For systems incorporating integral or separate hot water storage vessels, ways of meeting the requirement include:

a) arranging for hot water storage systems to meet the insulation requirements of *BS 1566, BS 699, BS 3198, or BS 7206* (as appropriate); or

b) in ordinary cases, insulating vessels with a 35mm thick, factory-applied coating of PU-foam having a minimum density of 30kg/m^3. (For unvented hot water systems additional insulation should be provided to control the heat losses through the safety fittings and pipework but without impeding safe operation and visibility of warning discharges. (See Guernsey Technical Standard G.)

1.45 Provisions should enable efficient operation without excessive boiler firing and primary circuit losses. A way of demonstrating compliance for indirectly heated hot water storage systems would be for the size of the heat exchanger to be at least that recommended in *BS 1566, BS 3198, or BS 7206* (as appropriate) and for them to be served by a pumped primary system.

1.46 A way of demonstrating compliance for primary storage systems would be to meet the requirements of the *1999 WMA performance specifications for thermal stores.*

Alternative approach for space heating and HWS system controls

1.47 The requirement would be met by adopting the relevant recommendations in *BS 5864: 1989 Specification for installation in domestic premises of gas-fired ducted air heaters of rated output not exceeding 60 kW* or *Good Practice Guide 302 (2001): Controls for Domestic Central Heating and Hot Water, BRECSU.*

provided that they include zoning, timing and interlock features similar to the above.

Commissioning of heating and HWS systems

1.48 Heating and HWS systems should be inspected at completion of installation so as to establish that the specified and approved provisions for efficient operation have been put in place. Without prejudice to the need to comply with health and safety requirements, these systems should be commissioned to make reasonably certain they can operate efficiently for the purposes of the conservation of fuel and power.

1.49 Commissioning means the advancement of these systems from the state of static completion to working order to the specifications relevant to achieving compliance with Part L, without prejudice to the need to comply with health and safety requirements. For each system it includes setting-to-work, regulation (that is testing and adjusting repetitively) to achieve the specified performance, the calibration, setting up and testing of the associated automatic control systems, and recording of the system settings and the performance test results that have been accepted as satisfactory.

1.50 Responsibility for achieving compliance with the requirements of Part L rests with the person carrying out the work. That "person" may be, e.g., a developer or main contractor who has directly carried out the work subject to Part L, or engaged a subcontractor to carry it out; or a specialist firm directly engaged by a private client. The person responsible for achieving compliance should either themselves provide a certificate, or obtain a certificate from the sub-contractor, that commissioning has been successfully carried out. The certificate should be made available to the client and Building Control. Where the person giving the certificate has a recognised qualification, the certificate may be accepted by Building Control as evidence that the relevant requirements in Part L1 b) and d) have been complied with. If there is no relevant qualification, or if a suitably qualified certifier is not available, the person responsible for carrying out the work should nevertheless provide or obtain a written declaration of successful commissioning and make it available to the client and Building Control.

1.51 A suitable commissioning certificate would be the one published as part of the *Benchmark Code of Practice for the Installation, Commissioning and Servicing of Central Heating Systems* available from the **Central Heating Information Council Tel. 01926 430486***,* a blank copy of which may be included with the boiler manufacturer's installation instructions.

Operating and Maintenance instructions for heating and hot water systems

1.52 The building owner and/or occupier should be given information on the operation and maintenance of the heating and hot water systems. A way of complying would be to provide a suitable set of operating and maintenance instructions in an accessible format in each new dwelling, and whenever the systems in an existing dwelling are substantially altered. The instructions should be directly related to the system(s) in the dwelling. Without prejudice to the need to comply with health and safety requirements, the instructions should explain to householders how to operate the systems so that they can perform efficiently, and what routine maintenance is advisable for the purposes of the conservation of fuel and power.

Insulation of pipes and ducts

1.53 Reasonable provision should be made for insulating pipes and ducts to conserve heat and hence maintain the temperature of the water or air heating service, and in the case of HWS systems to avoid excessive losses between useful draw-offs. Some ways of meeting the requirement comprise:-

a) wrapping space heating pipe work located outside the building fabric insulation layer(s) with insulation material having a thermal conductivity at 40°C not exceeding 0.035 W/m·K and a thickness equal to the outside diameter of the pipe up to a maximum of 40mm; or

b) for pipes and in the case of warm air ducts providing insulation in accordance with the recommendations of *BS 5422:2001, Methods for specifying thermal insulation materials on pipes, ductwork and equipment in the temperature range –40ºC to +700ºC*; and

c) insulating the hot pipes connected to hot water storage vessels, including the vent pipe, and the primary flow and return to the heat exchanger, where fitted, to the standard in b) above for at least 1 metre from their points of connection (or they should be insulated up to the point where they become concealed).

1.54 It should be noted that central heating and hot water pipe work in unheated areas may need increased insulation thicknesses for the purpose of protection against freezing. Guidance on suitable protection measures is given in *BRE Report No 262 Thermal insulation: avoiding risks, 2002 Edition.*

Internal Lighting

1.55 Reasonable provision should be made for dwelling occupiers to obtain the benefits of efficient lighting. A way of showing compliance with the requirement would be to provide at a reasonable number of locations, where lighting can be expected to have most use, fixed lighting (comprising either basic lighting outlets or complete luminaires) that only take lamps having a luminous efficacy greater than 40 lumens per circuit-watt. Circuit-watts means the power consumed in lighting circuits by lamps and their associated control gear and power factor correction equipment. Examples of lamps that achieve this efficacy include fluorescent tubes and compact fluorescent lamps (not GLS tungsten lamps with bayonet cap or Edison screw bases).

1.56 Guidance on identifying suitable locations for efficient lighting is given in *General Information Leaflet 'Low Energy Domestic Lighting' GIL 20, BRESCU*. A way of establishing how many locations to equip for efficient lighting would be to follow the recommendations in Table 4.

Table 4 **Method for determining the number of locations to be equipped as a reasonable provision for efficient lighting**

Number of rooms created (1)	Recommended minimum number of locations (2)
1-3	1
4-6	2
7-9	3
10-12	4

Notes
1 Hall, stairs and landing(s) count as one room (but may contain more than one fitting)
2 Excludes garages, lofts and outhouses

1.57 When considering reasonable provision for lighting, for a new dwelling with an integral conservatory, the conservatory should be counted as a room. In other cases, the conservatory can be excluded from the method in Table 4.

External lighting fixed to the building

1.58 External lighting includes lighting in porches, but not lighting in garages and carports. When providing external lighting, reasonable provision should be made to enable effective control and/or the use of efficient lamps. A way of showing compliance when providing external lighting would be to install systems that:

a) automatically extinguish when there is enough daylight, and when not required at night; or

b) have sockets that can only be used with lamps having an efficacy greater than 40 lumens per circuit Watt (such as fluorescent or compact fluorescent lamp types, and not GLS tungsten lamps with bayonet cap or Edison screw bases).

Conservatories

1.59 For the purposes of the guidance in Part L, a conservatory has not less than threequarters of the area of its roof and not less than one half of the area of its external walls made of translucent material.

1.60 When a conservatory is attached to and built as part of a new dwelling:

a) Where there is no separation between the conservatory and the dwelling, the conservatory should be treated as an integral part of the dwelling;

b) Where there is separation between the conservatory and the dwelling, energy savings can be achieved if the conservatory is not heated. If fixed heating installations are proposed, however, they should have their own separate temperature and on/off controls.

1.61 When a conservatory is attached to an existing dwelling and an opening is enlarged or newly created as a material alteration, reasonable provision should be made to enable the heat loss from the dwelling to be limited. Ways of meeting the requirement would be:

a) to retain the existing separation where the opening is not to be enlarged; or

b) to provide separation as or equivalent to windows and doors having the average U-value given in Table 1 where the opening is to be newly created or enlarged.

1.62 For the purposes of satisfying the requirements for the conservation of fuel and power, separation between a dwelling and a conservatory means:

a) Separating walls and floors insulated to at least the same degree as the exposed walls and floors;

b) Separating windows and doors with the same U-value and draught-stripping provisions as the exposed windows and doors elsewhere in the dwelling.

1.63 Attention is drawn to the safety requirements of Part N of the Building Regulations regarding conservatory glazing.

Sunlounges/Substantially glazed extension

1.64 If a substantially glazed extension fails to qualify as a conservatory because it has less than the minimum qualifying amounts of translucent material, but otherwise satisfies paragraphs 1.59 and 1.60, reasonable provision would be to demonstrate that the performance is no worse than a conservatory of the same size and shape. A way of doing so would be to show the area weighted U-value of the elements in the proposed extension is no grater than that of a conservatory that complies with the standards set out in paragraphs 1.60 to 1.62.

Section 2 - Work on existing dwellings - Building Work

Replacement of controlled services or fittings

2.1 "Controlled Service or fitting" is defined in Regulation 2 of the Building Regulations as "a service or fitting in relation to which Paragraph C1, F1, G1 to G5, G7, Part H or J or paragraph L1, L2, M3, M4 or P2 of Schedule 1 imposes a requirement;".

2.2 The definition of building work in regulation 5 includes the provision or extension of a controlled service or fitting in or in connection with a building.

2.3 Reasonable provision where undertaking replacement work on controlled services or fittings (whether replacing with new but identical equipment or with different equipment and whether the work is solely in connection with controlled services or includes work on them) depends on the circumstances in the particular case and would also need to take account of historic value (see paragraph 2.7 et seq). Possible ways of satisfying the requirements include the following:-

a) **Windows, doors and rooflights.** Where these elements are to be replaced, providing new draught-proofed ones either with an average U-value not exceeding the appropriate entry in Table 1, or with a centre-pane U-value not exceeding 1.2 W/m^{2}K (the requirement does not apply to repair work on parts of these elements, such as replacing broken glass or sealed double-glazing units or replacing rotten framing members). The replacement work should comply with the requirements of Parts L and N. In addition the building should not have a worse level of compliance, after the work, with other applicable Parts of Schedule 1. These may include Parts B, F and J.

b) **Heating boilers.** Where hot water central heating boilers are to be installed or replaced, providing a new boiler as follows:-

(1) In the case of gas and oil-fired boilers, in normal circumstances, providing a condensing boiler with a SEDBUK not less than 86%, together with appropriate controls following the guidance starting at paragraph 1.37

(2) in the case of back boilers providing a boiler having a SEDBUK of not less than three percentage points lower than the appropriate entry in Table 2;

(3) in the case of solid fuel boilers, providing a boiler having an efficiency not less than that recommended for its type in the HETAS certification scheme.

c) **Hot water vessels.** When replacing hot water vessels, reasonable provision would be to provide new equipment as if for a new dwelling following the guidance beginning at paragraph 1.44.

d) **Boiler and hot water storage controls.** So that replacement boilers (other than solid fuel boilers) and hot water vessels can achieve reasonable seasonal efficiency, the work may also need to include replacement of the time switch or programmer, room thermostat, and hot water vessel thermostat, and provision of a boiler interlock and fully pumped circulation. Section 3 of *GPG 302 2001: Controls for domestic central heating and hot water, BRECSU*. gives more advice on how this can be done.

e) As an alternative to a) to d), following the guidance in, for example, *GPG 155 2001: Energy efficient refurbishment of existing housing, BRECSU*. may be acceptable provided that an equivalent improvement in the dwelling's Carbon Index is achieved.

f) **Commissioning and providing operating and maintenance instructions**. Where heating and hot water systems are to be altered as in paragraphs (a) to (e), reasonable provision would also include appropriate commissioning and the provision of operating and maintenance instructions following the guidance in paragraphs 1.48 to 1.52.

Material alterations

2.4 With reference to this document a material alteration that involves building work on any thermal element of a building, as defined under regulation 22 is subject to the requirements of that regulation. For guidance on meeting the requirements of regulation 22 please refer to Section 3 of this document.

Material changes of use

2.5 In addition to the guidance given under this heading on page 8 of this document, reasonable provision where undertaking a material change of use depends on the circumstances in each particular case and would need to take account of historic value (see paragraph 2.7). Without prejudice to the need for compliance with all the requirements in Schedule 1, the need to comply with the requirements of Parts F and J should particularly be taken into account.

2.6 Work to form the material change of use that involves building work on any thermal element of a building, as defined under regulation 22 is subject to the requirements of that regulation. For guidance on meeting the requirements of regulation 22 please refer to Section 3 of this document.

Protected Buildings

2.7 Further to the general advice given under this heading on page 8 The need to conserve the special characteristics of such historic buildings needs to be recognised. In such work, the aim should be to improve energy efficiency where and to the extent that it is practically possible, always provided that the work does not prejudice the character of the historic building, or increase the risk of long-term deterioration to the building fabric or fittings. In arriving at an appropriate balance between historic building conservation and energy conservation, it would be appropriate to take into account the advice of the historic buildings advisor.

2.8 Particular issues relating to work in historic buildings that warrant sympathetic treatment and where advice from others could therefore be beneficial include –

a) restoring the historic character of a building that had been subject to previous inappropriate alteration, eg replacement windows, doors and rooflights;

b) rebuilding a former historic building (e.g. following a fire or filling in a gap site in a terrace;

c) making provisions enabling the fabric of historic buildings to “breathe” to control moisture and potential long term decay problems.

Section 3 - Guidance on thermal elements

3.1 New thermal elements must comply with Part L1 of Schedule 1 to the Building Regulations. Work on existing thermal elements must comply with regulation 22 of the Building Regulations which states:

Requirements relating to thermal elements.

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

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

(3) For the purposes of these Regulations, a "thermal element" means a wall, floor or roof which separates a thermally conditioned part of the building ("the conditioned space") from -

(a) the external environment including the ground, or

(b) in the case of a wall or floor, another part of the building which is -

(i) not thermally conditioned,

(ii) an extension of a building falling within Class VI of Schedule 2, or

(iii) where the building falls within paragraph (4), conditioned to a different temperature,

and, for the avoidance of doubt, includes all parts of such a wall, floor or roof between the surface bounding the conditioned space and the external environment or other part of the building, as the case may be.

(4) A building falls within this paragraph if -

(a) the building is not a dwelling, and

(b) the other part of the building is used for a purpose which is not identical or similar to that for which the conditioned space is used.

The Provision of Thermal Elements

U-values

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

3.3 Reasonable provision for newly constructed thermal elements such as those constructed as part of an extension would be to meet the standards set out in Table 5.

3.4 Reasonable provision for those thermal elements constructed as replacements for existing elements would be to meet the standards set out in Table 5.

Table 5 **Standards for new thermal elements**

Element[1]	Standard (W/m².K)
Wall	0.35
Pitched roof – insulation at ceiling level	0.16
Pitched roof – insulation at rafter level	0.2
Flat roof or roof with integral insulation	0.25
Floors[3]	0.25

Notes:

1. 'Roof' includes the roof parts of dormer windows, and 'wall' includes the wall parts (cheeks) of dormer windows.
2. Area-weighted average values.
3. A lesser provision may be appropriate where meeting such a standard would result in a reduction of more than 5% in the internal floor area of the room bounded by the wall.
4. A lesser provision may be appropriate where meeting such a standard would create significant problems in relation to adjoining floor levels. The U-value of the floor of an extension can be calculated using the exposed perimeter and floor area of the whole enlarged dwelling.

Continuity of insulation and airtightness

3.5 The building fabric should be constructed so that there are no reasonably avoidable thermal bridges in the insulation layers caused by gaps within the various elements, at the joints between elements, and at the edges of elements such as those around window and door openings. Reasonable provision should also be made to reduce unwanted air leakage through the new envelope parts. The work should comply with all the requirements of Schedule 1, but particular attention should be paid to Parts F and J.

Renovation of Thermal Elements

3.6 For the purposes of this Guernsey Technical Standard, **renovation** of a **thermal element** through:

a. the provision of a new layer means either of the following activities:

   i. Cladding or rendering the external surface of the **thermal element**; or

   ii. Dry-lining the internal surface of a **thermal element**.

b. the replacement of an existing layer means either of the following activities:

   i. Stripping down the element to expose the basic structural components (brick/ blockwork, timber/metal frame, joists, rafters, etc.) and then rebuilding to achieve all the necessary performance requirements. As discussed in paragraphs 2.7 - 2.8, particular considerations apply to renovating elements of traditional construction; or

   ii. Replacing the water proof membrane on a flat roof.

3.7 Where a thermal element is subject to a renovation through undertaking an activity listed in paragraph 3.6a or 3.6b, the performance of the whole element should be improved to achieve or better the relevant U-value set out in column (b) of Table 6, provided the area to be renovated is greater than 50 per cent of the surface of the individual element or 25 per cent of the total building envelope. When assessing this area proportion, the area of the element should be taken as that of the individual element, not all the elements of that type in the building. The area of the element should also be interpreted in the context of whether the element is being renovated from inside or outside, e.g. if removing all the plaster finish from the inside of a solid brick wall, the area of the element is the area of external wall in the room. If removing external render, it is the area of the elevation in which that wall sits.

This means that if all the roofing on the flat roof of an extension is being stripped down, the area of the element is the roof area of the extension, not the total roof area of the dwelling. Similarly, if the rear wall of a single-storey extension was being re-rendered, it should be upgraded to the standards of Table 6 column (b), even if it was less than 50 per cent 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.

3.8 If achievement of the relevant U-value set out in column (b) of Table 6 is not technically or functionally feasible or would not achieve a **simple payback** of 15 years or less, the element should be upgraded to the best standard that is technically and functionally feasible and which can be achieved within a **simple payback** of no greater than 15 years. Guidance on this approach is given in Annex F.

3.9 When renovating **thermal elements**, the work should comply with all the requirements in Schedule 1 of the Building Regulations, but particular attention should be paid to Parts F and J.

Retained Thermal Elements

3.10 Part L of Schedule 1 to the Building Regulations applies to retained thermal elements in the following circumstances:

a. where an existing thermal element is part of a building subject to a material change of use;

b. where an existing element is to become part of the thermal envelope where previously it was not, e.g. as part of a loft or garage conversion where the space is now to be heated.

3.11 Reasonable provision would be to upgrade those **thermal elements** whose U-value is worse than the threshold value in column (a) of Table 6 to achieve the U-values given in column (b) of Table 6 provided this is technically, functionally and economically feasible. A reasonable test of economic feasibility is to achieve a **simple payback** of 15 years or less. Where the standard given in column (b) is not technically, functionally or economically feasible, then the **thermal element** should be upgraded to the best standard that is technically and functionally feasible and delivers a **simple payback** period of 15 years or less. Generally, this lesser standard should not be worse than 0.7 W/m^2.K.

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

3.12 When upgrading retained **thermal elements**, the work should comply with all the requirements in Schedule 1, but particular attention should be paid to Parts F and J.

Table 6 **Upgrading retained thermal elements**

Element[1]	**(a) Threshold U-value W/m²·K**	**(b) Improved U-value W/m²·K**
Wall – cavity insulation[2]	0.70	0.55
Wall – external or internal insulation[3]	0.70	0.35
Floor[4,5]	0.70	0.25
Pitched roof – insulation at ceiling level	0.35	0.16
Pitched roof – insulation between rafters[6]	0.35	0.2
Flat roof or roof with integral insulation[7]	0.35	0.25

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

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

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

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

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

6 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.

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

Annex A - Tables of U-Values

Windows, doors and rooflights

The following tables provide indicative U-values for windows, doors and rooflights. Table 7 applies to windows and rooflights with wood or PVC-U frames. Table 8 applies to windows with metal frames, to which (if applicable) the adjustments for thermal breaks and rooflights in Table 9 should be applied. The tables do not apply to curtain walling or to other structural glazing not fitted in a frame. For the purposes of this Guernsey Technical Standard a roof window may be considered as a rooflight. The U-value of a window or rooflight containing low-E glazing is influenced by the emissivity, εn, of the low-E coating. Low-E coatings are of two principal types, known as 'hard' and 'soft'. Hard coatings generally have emissivities in the range 0.15 to 0.2, and the data for εn = 0.2 should be used for hard coatings, or if the glazing is stated to be low-E but the type of coating is not specified. Soft coatings generally have emissivities in the range 0.05 to 0.1. The data for εn = 0.1 should be used for a soft coating if the emissivity is not specified. When available, manufacturers' certified U-values should be used in preference to the data given in these tables

Table 7 **Indicative U-values (W/m²·K) for windows and rooflights with wood or PVC-U frames, and doors**

	gap between panes			
	6mm	12mm	16mm +	Roof light adjustment[3]
Single glazing	4.8			+0.3
Double glazing (air filled)	3.1	2.8	2.7	+0.2
Double glazing (low-E, εn = 0.2)[1]	2.7	2.3	2.1	
Double glazing (low-E, εn = 0.15)	2.7	2.2	2.0	
Double glazing (low-E, εn = 0.1)	2.6	2.1	1.9	
Double glazing (low-E, εn = 0.05)	2.6	2.0	1.8	
Double glazing (argon filled) [2]	2.9	2.7	2.6	
Double glazing (low-E, εn = 0.2,argon filled)	2.5	2.1	2.0	
Double glazing (low-E, εn = 0.1, argon filled)	2.3	1.9	1.8	
Double glazing (low-E, εn = 0.05, argon filled)	2.3	1.8	1.7	
Triple glazing	2.4	2.1	2.0	
Triple glazing (low-E, εn = 0.2)	2.1	1.7	1.6	
Triple glazing (low-E, εn = 0.1)	2.0	1.6	1.5	
Triple glazing (low-E, εn = 0.05)	1.9	1.6	1.5	
Triple glazing (argon-filled)	2.2	2.0	1.9	
Triple glazing (low-E, εn = 0.2, argon filled)	1.9	1.6	1.5	
Triple glazing (low-E, εn = 0.1, argon filled)	1.8	1.4	1.3	
Triple glazing (low-E, εn = 0.05, argon filled)	1.7	1.4	1.3	
Solid wooden door[4]	3.0			

Notes

[1] The emissivities quoted are normal emissivities. (Corrected emissivity is used in the calculation of glazing U-values.) Uncoated glass is assumed to have a normal emissivity of 0.89.

[2] The gas mixture is assumed to consist of 90% argon and 10% air.

[3] No correction need be applied to rooflights in buildings other than dwellings.

[4] For doors which are half-glazed the U-value of the door is the average of the appropriate window U-value and that of the non-glazed part of the door (e.g. 3.0 W/m²K for a wooden door).

Table 8 **Indicative U-values (W/m²·K) for windows with metal frames (4mm thermal break)**

	gap between panes		
	6mm	**12mm**	**16mm +**
Single glazing	5.7		
Double glazing (low-E, εn = 0.2)	3.7	3.4	3.3
Double glazing (low-E, εn = 0.1)	3.2	2.6	2.5
Double glazing (low-E, εn = 0.05)	3.1	2.5	2.3
Double glazing (argon filled)	3.5	3.3	3.2
Double glazing (low-E, εn = 0.2,argon filled)	3.1	2.6	2.5
Double glazing (low-E, εn = 0.1, argon filled)	2.9	2.4	2.3
Double glazing (low-E, εn = 0.05, argon filled)	2.8	2.3	2.1
Triple glazing	2.9	2.6	2.5
Triple glazing (low-E, εn = 0.2)	2.6	2.2	2.0
Triple glazing (low-E, εn = 0.1)	2.5	2.0	1.9
Triple glazing (low-E, εn = 0.05)	2.4	1.9	1.8
Triple glazing (argon-filled)	2.8	2.5	2.4
Triple glazing (low-E, εn = 0.2, argon filled)	2.4	2.0	1.9
Triple glazing (low-E, εn = 0.1, argon filled)	2.2	1.9	1.8
Triple glazing (low-E, εn = 0.05, argon filled)	2.2	1.8	1.7

Note
For windows and rooflights with metal frames incorporating a thermal break other than 4mm, the following adjustments should be made to the U-values given in Table 8.

Table 9 **Adjustments to U-values in Table 8 for frames with thermal breaks**

Thermal break (mm)	**Adjustment to U-value (W/m²K)**	
	Window or rooflight in building other than a dwelling	**Rooflight in dwellings**
0	+0.3	+0.7
4	+0.0	+0.3
8	-0.1	+0.2
12	-0.2	+0.1
16	-0.2	+0.1

Note Where applicable adjustments for both thermal break and rooflight should be made. For intermediate thicknesses of thermal breaks, linear interpolation may be used.

Corrections to U-values of roofs, walls and floors

Annex D of BS EN ISO 6946 provides corrections to U-values to allow for the effects of:

- air gaps in insulation
- mechanical fasteners penetrating the insulation layer
- precipitation on inverted roofs.

The corrected U-value (U_C) is obtained by adding a correction term ΔU:

$$U_C = U + \Delta U$$

Table 10 gives the values of ΔU for some typical constructions.

If the total ΔU is less than 3% of U then the corrections need not be applied and ΔU can be taken to be zero. However, where corrections are to be applied, before using the following tables the following steps should be carried out:-

1) subtract ΔU from the desired U-value.

2) use this adjusted U-value in the tables

when calculating the required thickness of insulation. This thickness of insulation then meets the original desired U-value, having allowed for the ΔU correction(s).

Table 10 **Corrections to U-values**

	Adjustment to U-value (W/m^2K)
Roofs	**(W/m^2K)**
Insulation fixed with nails or screws	0.02
Insulation between joists or rafters	0.01
Insulation between and over joists or rafters	0.00
Walls	
Timber frame where the insulation partly fills the space between the studs	0.04
Timber frame where the insulation fully fills the space between the studs	0.01
Internal insulation fixed with nails or screws which penetrate the insulation	0.02
External insulation with metal fixings that penetrate the insulation	0.02
Insulated cavity wall with cavity greater than 75mm and tied with steel vertical-twist ties	0.02
Insulated cavity wall with a cavity less than or equal to 75mm tied with ties other than steel vertical-twist ties	0.00
Floors	
Suspended timber floor with insulation between joists	0.04
Floor insulation fixed with nails or screws	0.02

Roofs

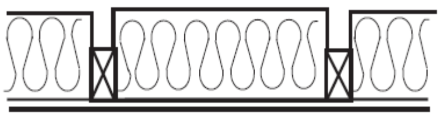


Table 11 **Base thickness of insulation between ceiling joists or rafters**

		Thermal conductivity of insulants (W/m.K)						
		0.020	**0.025**	**0.030**	**0.035**	**0.040**	**0.045**	**0.050**
	Design U-value (W/m^2K)	**Base thickness of insulating material (mm)**						
	A	B	C	D	E	F	G	H
1	0.15	371	464	557	649	742	835	928
2	0.20	180	224	269	314	359	404	449
3	0.25	118	148	178	207	237	266	296
4	0.30	92	110	132	154	176	198	220
5	0.35	77	91	105	122	140	157	175
6	0.40	67	78	90	101	116	130	145

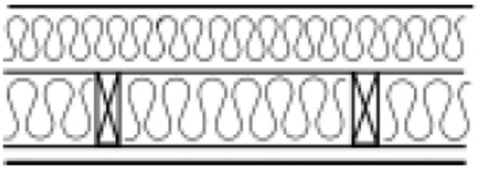


Table 12 Base thickness of insulation between and over joists or rafters

	Design U-value (W/m²K)	Base thickness of insulating material (mm)						
		Thermal conductivity of insulants (W/m.K)						
		0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
1	0.15	161	188	217	247	277	307	338
2	0.20	128	147	167	188	210	232	255
3	0.25	108	122	137	153	170	187	205
4	0.30	92	105	117	130	143	157	172
5	0.35	77	91	103	113	124	136	148
6	0.40	67	78	90	101	110	120	130

Note
Tables 11 and 12 are derived for roofs with the proportion of timber at 8%, corresponding to 48mm wide timbers at 600mm centres, excluding noggings. For other proportions of timber the U-value can be calculated using the procedure in Annex B.

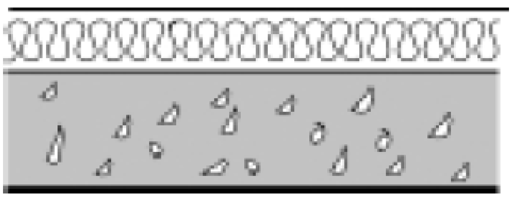


Table 13 Base thickness for continuous insulation

	Design U-value (W/m²K)	Base thickness of insulating material (mm)						
		Thermal conductivity of insulants (W/m.K)						
		0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
1	0.15	131	163	196	228	261	294	326
2	0.20	97	122	146	170	194	219	243
3	0.25	77	97	116	135	154	174	193
4	0.30	64	80	96	112	128	144	160
5	0.35	54	68	82	95	109	122	136
6	0.40	47	59	71	83	94	106	118

Table 14 Allowable reduction in base thickness for common roof components

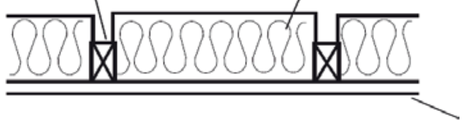
	Concrete slab density (kg/m³)	Reduction in base thickness of insulation for each 100mm of concrete slab						
		Thermal conductivity of insulants (W/m.K)						
		0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
1	600	10	13	15	18	20	23	25
2	800	7	9	11	13	14	16	18
3	1100	5	6	8	9	10	11	13
4	1300	4	5	6	7	8	9	10
5	1700	2	2	3	3	4	4	5
6	2100	1	2	2	2	3	3	3

	Other materials and components	Reduction in base thickness of insulating material (mm)						
	A	B	C	D	E	F	G	H
7	10mm plasterboard	1	2	2	2	3	3	3
8	13mm plasterboard	2	2	2	3	3	4	4
9	13mm sarking board	2	2	3	3	4	4	5
10	12mm calcium silicate liner board	1	2	2	2	3	3	4
11	Roof space (pitched)	4	5	6	7	8	9	10
12	Roof space (flat)	3	4	5	6	6	7	8
13	19mm roof tiles	0	1	1	1	1	1	1
14	19mm asphalt (or 3 layers of felt)	1	1	1	1	2	2	2
15	50mm screed	2	3	4	4	5	5	6

Example 1: Pitched roof with insulation between ceiling joists or between rafters

Determine the thickness of the insulation layer required to achieve a U-value of 0.21 W/m²K if insulation is between the joists, and 0.26 W/m²K if insulation is between the rafters. From Table 10 there is a ΔU correction of 0.01 W/m²K which applies to both the following cases. To allow for this, the 'look-up' U-value is reduced by 0.01 W/m²K to 0.20 and 0.25 W/m²K respectively.

For insulation placed between ceiling joists (look-up U-value 0.20 W/m²K)



Using Table 11:
From **column D, row 2** of the table, the base thickness of insulation required is 269mm. The base thickness may be reduced by taking account of the other materials as follows:

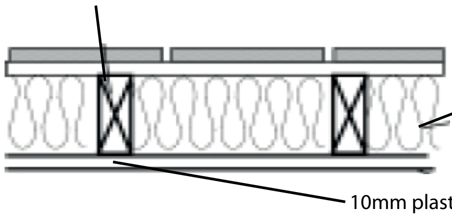
From Table 14:

19mm roof tiles	**column D, row 13**	=	1mm
Roofspace (pitched)	**column D, row 11**	=	6mm
10mm plasterboard	**column D, row 7**	=	2mm
Total reduction		=	9mm

The minimum thickness of the insulation layer between the ceiling joists required to achieve a U-value of 0.21 W/m²K (including the ΔU correction) is therefore:

Base thickness less total reduction
i.e. 269 – 9 = 260mm.

For insulation placed between rafters (lookup U-value 0.25 W/m²K)



Using Table 11 :
From **column D, row 4** in the table, the base thickness of insulation required is 178mm. The reductions in the base thickness are obtained as follows:

From Table 14:

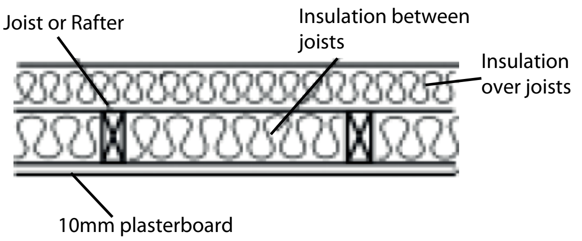
19mm roof tiles	**column D, row 13**	= 1mm
10mm plasterboard	**column D, row 7**	= 2mm
Total reduction		= 3mm

The minimum thickness of the insulation layer between the rafters required to achieve a U-value of 0.25 W/m²K (including the ΔU correction) is therefore:

Base thickness less total reduction
ie 178 - 3 = 175mm.

Example 2: Pitched roof with insulation between and over ceiling joists

Determine the thickness of the insulation layer above the joists required to achieve a U-value of 0.20 W/m²K for the roof construction shown below:



It is proposed to use mineral wool insulation between and over the joists with a thermal conductivity of 0.04 W/m·K.

Using Table 12:
From **column F, row 2** of the table, the base thickness of insulation layer = 210mm.
The base thickness may be reduced by taking account of the other materials as follows:

From Table 14:

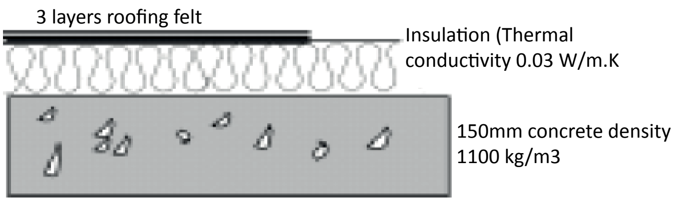
19mm roof tiles	**column F, row 13**	= 1mm
Roofspace (pitched)	**column F, row 11**	= 8mm
10mm plasterboard	**column F, row 7**	= 3mm
Total reduction		= 12mm

The minimum thickness of the insulation layer over the joists, required in addition to the 100mm insulation between the joists, to achieve a U-value of 0.20 W/m²K is therefore:

Base thickness less total reduction
ie 210 – l00 - 12 = 98mm.

Example 3: Concrete deck roof

Determine the thickness of the insulation layer required to achieve a U-value of 0.25 W/m²K for the roof construction shown below.



Using Table 13:
From **column D, row 3** of the table, the base thickness of the insulation layer is 116mm.
The base thickness may be reduced by taking account of the other materials as follows:

From Table 14:

3 layers of felt	**column D, row 14**	= 1mm
150mm concrete deck	**column D, row 3**	
adjusted for 150mm thickness (1.5 x 8)		= 12mm
Total reduction		= 13mm

The minimum thickness of the insulation layer required to achieve a U-value of 0.25 W/m²K is therefore:
Base thickness less total reduction
i.e. 116 - 13 = 103mm.

Walls

Table 15 Base thickness of insulation layer

	Design U-value (W/m^2K)	Thermal conductivity of insulants (W/m.K) – Base thickness of insulating material (mm) 0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
1	0.20	97	121	145	169	193	217	242
2	0.25	77	96	115	134	153	172	192
3	0.30	63	79	95	111	127	142	158
4	0.35	54	67	81	94	107	121	134
5	0.40	47	58	70	82	93	105	117
6	0.45	41	51	62	72	82	92	103

Table 16 Allowable reductions in base thickness for common components

	Component	Thermal conductivity of insulants (W/m.K) – Reduction in base thickness of insulating material (mm) 0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
1	Cavity (25mm or more)	4	5	5	6	7	8	9
2	Outer leaf brickwork	3	3	4	5	5	6	6
3	13mm plaster	1	1	1	1	1	1	1
4	13mm lightweight plaster	2	2	2	3	3	4	4
5	9.5mm plasterboard	1	2	2	2	3	3	3
6	12.5mm plasterboard	2	2	2	3	3	4	4
7	Airspace behind plasterboard drylining	2	3	4	4	5	5	6
8	9mm sheathing ply	1	2	2	2	3	3	3
9	20mm cement render	1	1	1	1	2	2	2
10	13mm tile hanging	0	0	0	1	1	1	1

Table 17 Allowable reductions in base thickness for concrete components

	Density (kg/m^3)	Thermal conductivity of insulants (W/m.K) – Reduction in base thickness of insulating material (mm) for each 100mm of concrete 0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
	Concrete blockwork inner leaf							
1	600	9	11	13	15	17	20	22
2	800	7	9	10	12	14	16	17
3	1000	5	6	8	9	10	11	13
4	1200	4	5	6	7	8	9	10
5	1400	3	4	5	6	7	8	8
6	1600	3	3	4	5	6	6	7
7	1800	2	2	3	3	4	4	4
8	2000	2	2	2	3	3	3	4
9	2400	1	1	2	2	2	2	3
	Concrete blockwork outer leaf or single leaf wall							
10	600	8	11	13	15	17	19	21
11	800	7	9	10	12	14	15	17
12	1000	5	6	7	8	10	11	12
13	1200	4	5	6	7	8	9	10
14	1400	3	4	5	6	6	7	8
15	1600	3	3	4	5	5	6	7
16	1800	2	2	3	3	3	4	4
17	2000	1	2	2	3	3	3	4
18	2400	1	1	2	2	2	2	3

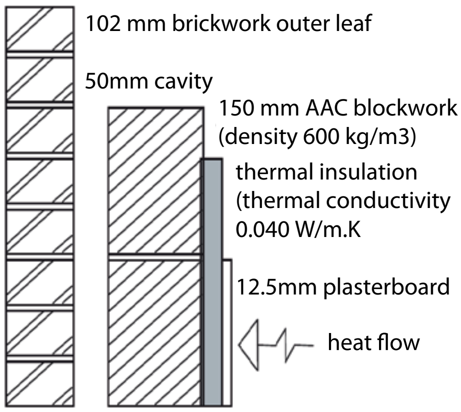
Table 18 Base thickness for continuous insulation

	Thermal conductivity of insulation within frame (W/m·K)	Thermal conductivity of insulants (W/m.K) – Reduction in base thickness of insulation material (mm) for each 100mm of frame (mm) 0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
1	0.035	39	49	59	69	79	89	99
2	0.040	36	45	55	64	73	82	91

Note
The table is derived for walls for which the proportion of timber is 15%, which corresponds to 38mm wide studs at 600mm centres and includes horizontal noggings etc. and the effects of additional timbers at junctions and around openings. For other proportions of timber the U-value can be calculated using the procedure in Annex B.

Example 4: Masonry cavity wall with internal insulation

Determine the thickness of the insulation layer required to achieve a U-value of 0.35 W/m²K for the wall construction shown below.



Using Table 15:
From **column F, row 4** of the table, the base thickness of the insulation layer is 107mm. The base thickness may be reduced by taking account of the other materials as follows:

From Table 16:

Brickwork outer leaf	**column F, row 2** = 5mm
Cavity	**column F, row 1** = 7mm
Plasterboard	**column F, row 6** = 3mm

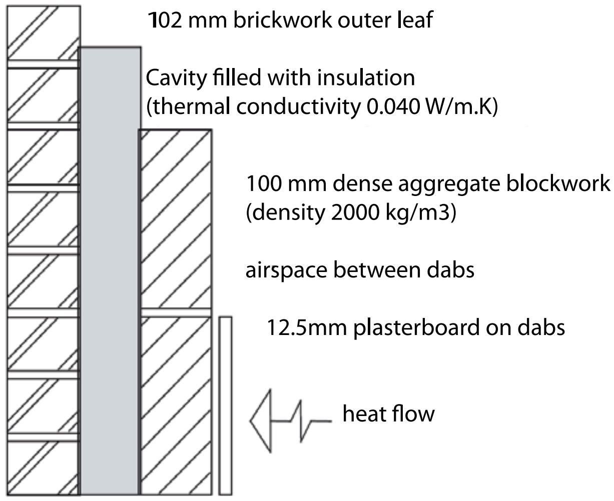
And from table 17
Concrete blockwork **column F, row 1** adjusted for 150mm block thickness (1.5 x 17) = 26mm
Total reduction = 41mm

The minimum thickness of the insulation layer required to achieve a U-value of 0.35 W/m²K is therefore:

Base thickness less total reduction
i.e. 107 – 41 = 66mm.

Example 5: Masonry cavity wall (tied with vertical-twist stainlesssteel ties) filled with insulation with plaster-board on dabs

Determine the thickness of the insulation layer required to achieve a U-value of 0.37 W/m²K for the wall construction shown below. From Table 10 there is a ΔU correction for the wall ties of 0.02 W/m²K which applies. To allow for this, the 'look-up' U-value is reduced by 0.02 W/m²K to 0.35 W/m²K.



Using Table 15:
From **column F, row 4** of the table, the base thickness of the insulation layer is 107mm. The base thickness may be reduced by taking account of the other materials as follows:

From Table 16:

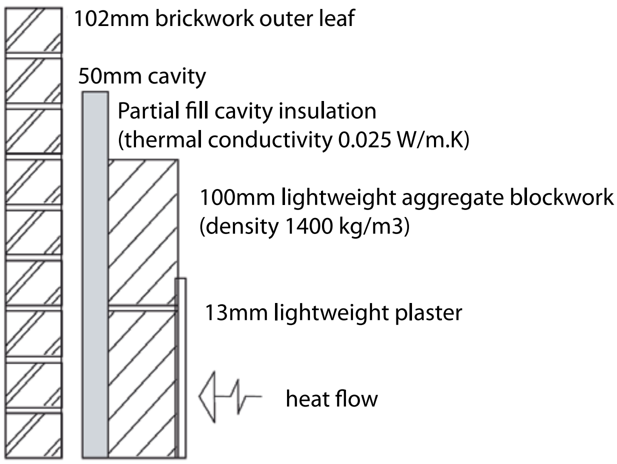
Brickwork outer leaf	**column F, row 2** = 5mm
Plasterboard	**column F, row 6** = 3mm
Airspace behind plasterboard	**column F, row 7** = 5mm

And from Table 17:
Concrete blockwork **column F, row 1** = 3mm
Total reduction = 16mm
The minimum thickness of the insulation layer required to achieve a U-value of 0.37 W/m²K (including ΔU for the wall ties) is therefore:

Base thickness less total reduction
i.e. 107 – 16 = 91mm.

Example 6: Masonry wall (tied with vertical-twist stainless-steel ties) with partial cavity-fill

Determine the thickness of the insulation layer required to achieve a U-value of 0.32 W/m²K for the wall construction shown below. From Table 10 there is a ΔU correction for the wall ties of 0.02 W/m²K which applies. To allow for this, the 'look-up' U-value is reduced by 0.02 W/m²K to 0.30 W/m²K.



Using Table 15:
From **column C, row 3** of the table, the base thickness of the insulation layer is 79mm. The base thickness may be reduced by taking account of the other materials as follows:

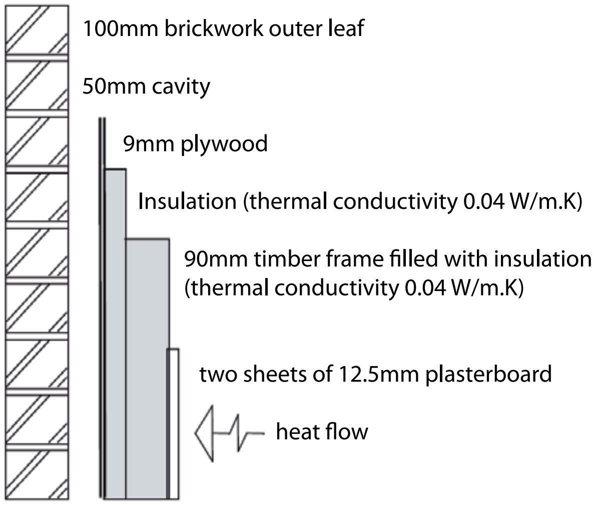
From Table 16:	
Brickwork outer leaf	**column C, row 2** = 3mm
Cavity	**column C, row 1** = 5mm
Lightweight plaster	**column C, row 4** = 2mm
And from Table 17:	
Concrete blockwork	**column C, row 5** = 4mm
Total reduction	= 14mm

The minimum thickness of the insulation layer required to achieve a U-value of 0.3 W/m²K (including ΔU for the wall ties) is therefore:

Base thickness less total reduction i.e. 79 – 14 = 65mm.

Example 7: Timber-framed wall

Determine the thickness of the insulation layer required to achieve a U-value of 0.35 W/m²K for the wall construction shown below.



Using Table 15:
From **column F, row 4** of the table, the base thickness of the insulation layer is 107mm. The base thickness may be reduced by taking account of the other materials as follows:

From Table 16:	
Brickwork outer leaf	**column F, row 2** = 5mm
Cavity	**column F, row 1** = 7mm
Sheathing ply	**column F, row 8** = 3mm
Plasterboard	**column F, row 6** = 3mm
Plasterboard	**column F, row 6** = 3mm
And from Table 18:	
Timber frame	**column F, row 2**
adjusted for stud thickness	
(73mm x 90/100)	= 66mm
Total reduction	= 87mm

The minimum thickness of the insulation layer required to achieve a U-value of 0.35 W/m²K is therefore:

Base thickness less total reduction i.e. 107 - 87 = 20mm.

Ground floors

Note: in using the tables for floors it is first necessary to calculate the ratio P/A, where P is the floor perimeter length in metres and A is the floor area in square metres.

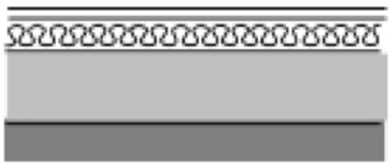


Table 19 **Insulation thickness for solid floors in contact with the ground**

	P/A	Insulation thickness (mm) for U-value of 0.20 W/m²K – Thermal conductivity of insulant (W/m.K) 0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
1	1.00	81	101	121	142	162	182	202
2	0.90	80	100	120	140	160	180	200
3	0.80	78	98	118	137	157	177	196
4	0.70	77	96	115	134	153	173	192
5	0.60	74	93	112	130	149	167	186
6	0.50	71	89	107	125	143	160	178
7	0.40	67	84	100	117	134	150	167
8	0.30	60	74	89	104	119	134	149
9	0.20	46	57	69	80	92	103	115
		U-value of 0.25 W/m²K						
10	1.00	61	76	91	107	122	137	152
11	0.90	60	75	90	105	120	135	150
12	0.80	58	73	88	102	117	132	146
13	0.70	57	71	85	99	113	128	142
14	0.60	54	68	82	95	109	122	136
15	0.50	51	64	77	90	103	115	128
16	0.40	47	59	70	82	94	105	117
17	0.30	40	49	59	69	79	89	99
18	0.20	26	32	39	45	52	58	65
		U-value of 0.30 W/m²K						
19	1.00	48	60	71	83	95	107	119
20	0.90	47	58	70	81	93	105	116
21	0.80	45	56	68	79	90	102	113
22	0.70	43	54	65	76	87	98	108
23	0.60	41	51	62	72	82	92	103
24	0.50	38	47	57	66	76	85	95
25	0.40	33	42	50	59	67	75	84
26	0.30	26	33	39	46	53	59	66
27	0.20	13	16	19	22	25	28	32

Note
P/A is the ratio of floor perimeter (m) to floor area (m²).

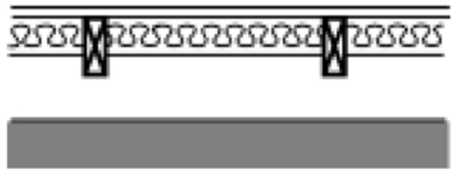


Table 20 **Insulation thickness for suspended timber ground floors**

	P/A	Insulation thickness (mm) for U-value of 0.20 W/m²K – Thermal conductivity of insulant (W/m.K) 0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
1	1.00	127	145	164	182	200	218	236
2	0.90	125	144	162	180	198	216	234
3	0.80	123	142	160	178	195	213	230
4	0.70	121	139	157	175	192	209	226
5	0.60	118	136	153	171	188	204	221
6	0.50	114	131	148	165	181	198	214
7	0.40	109	125	141	157	173	188	204
8	0.30	99	115	129	144	159	173	187
9	0.20	82	95	107	120	132	144	156
		U-value of 0.25 W/m²K						
10	1.00	93	107	121	135	149	162	176
11	0.90	92	106	119	133	146	160	173
12	0.80	90	104	117	131	144	157	170
13	0.70	88	101	114	127	140	153	166
14	0.60	85	98	111	123	136	148	161
15	0.50	81	93	106	118	130	142	154
16	0.40	75	87	99	110	121	132	143
17	0.30	66	77	87	97	107	117	127
18	0.20	49	57	65	73	81	88	96
		U-value of 0.30 W/m²K						
19	1.00	71	82	93	104	114	125	135
20	0.90	70	80	91	102	112	122	133
21	0.80	68	78	89	99	109	119	129
22	0.70	66	76	86	96	106	116	126
23	0.60	63	73	82	92	102	111	120
24	0.50	59	68	78	87	96	104	113
25	0.40	53	62	70	79	87	95	103
26	0.30	45	52	59	66	73	80	87
27	0.20	28	33	38	42	47	51	56

Notes
P/A is the ratio of floor perimeter (m) to floor area (m²).
The table is derived for suspended timber floors for which the proportion of timber is 12%, which corresponds to 48mm wide timbers at 400mm centres.

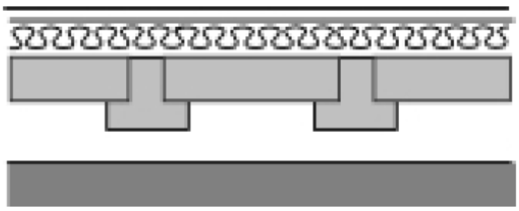


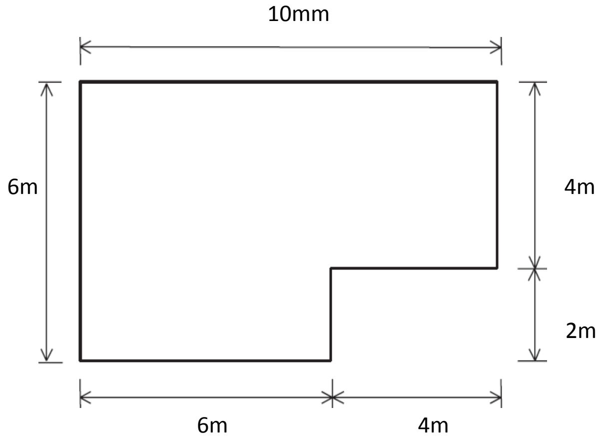
Table 21 **Insulation thickness for suspended concrete beam and block ground floors**

		Insulation thickness (mm) for U-value of 0.20 W/m²K						
		Thermal conductivity of insulant (W/m.K)						
	P/A	0.020	0.025	0.030	0.035	0.040	0.045	0.050
	A	B	C	D	E	F	G	H
1	1.00	82	103	123	144	164	185	205
2	0.90	81	101	122	142	162	183	203
3	0.80	80	100	120	140	160	180	200
4	0.70	79	99	118	138	158	177	197
5	0.60	77	96	116	135	154	173	193
6	0.50	75	93	112	131	150	168	187
7	0.40	71	89	107	125	143	161	178
8	0.30	66	82	99	115	132	148	165
9	0.20	56	69	83	97	111	125	139
		U-value of 0.25 W/m²K						
10	1.00	62	78	93	109	124	140	155
11	0.90	61	76	92	107	122	138	153
12	0.80	60	75	90	105	120	135	150
13	0.70	59	74	88	103	118	132	147
14	0.60	57	71	86	100	114	128	143
15	0.50	55	68	82	96	110	123	137
16	0.40	51	64	77	90	103	116	128
17	0.30	46	57	69	80	92	103	115
18	0.20	36	45	54	62	71	80	89
		U-value of 0.30 W/m²K						
19	1.00	49	61	73	85	97	110	122
20	0.90	48	60	72	84	96	108	12
21	0.80	47	59	70	82	94	105	117
22	0.70	45	57	68	80	91	102	114
23	0.60	44	55	66	77	88	98	109
24	0.50	41	52	62	72	83	93	104
25	0.40	38	48	57	67	76	86	95
26	0.30	33	41	49	57	65	73	81
27	0.20	22	28	33	39	44	50	56

Note
P/A is the ratio of floor perimeter (m) to floor area (m²).

Example 8: Solid floor in contact with the ground

Determine the thickness of the insulation layer required to achieve a U-value of 0.3 W/m²K for the ground floor slab shown below.



It is proposed to use insulation with a thermal conductivity of 0.025 W/m·K.

The overall perimeter length of the slab is (10 + 4 + 4 + 2 + 6 + 6) = 32m.

The floor area of the slab is (6 x 6) + (4 x 4) = 52 m².

The ratio: $\frac{\text{perimeter length}}{\text{floor area}} = \frac{32}{52} = 0.6$

Using Table 19, **column C, row 23** indicates that 51mm of insulation is required.

Example 9: Suspended timber floor

If the floor shown above was of suspended timber construction, the perimeter length and floor area would be the same, yielding the same ratio of:

$$\frac{\text{perimeter length}}{\text{floor area}} = \frac{32}{52} = 0.6$$

To achieve a U-value of 0.30 W/m²·K, using insulation with a thermal conductivity of 0.04 W/mK, Table 20 **column F, row 23** indicates that the insulation thickness between the joists should be not less than 102mm.

Upper Floors

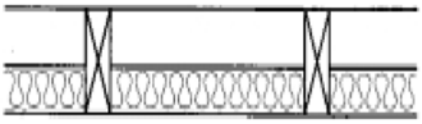


Table 22 **Upper floors in timber construction**

	Design U-value (W/m²K)	Thermal conductivity of insulants (W/m.K)						
		0.020	0.025	0.030	0.035	0.040	0.045	0.050
		Base thickness of insulation between joints to achieve design U-values						
	A	B	C	D	E	F	G	H
1	0.20	167	211	256	298	341	383	426
2	0.25	109	136	163	193	225	253	281
3	0.30	80	100	120	140	160	184	208

Note
Table 22 is derived for floors with the proportion of timber at 12% which corresponds to 48mm wide timbers at 400mm centres. For other proportions of timber the U-value can be calculated using the procedure in Annex B

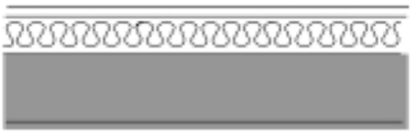


Table 23 **Upper floors of concrete construction**

	Design U-value (W/m²K)	Thermal conductivity of insulants (W/m.K)						
		0.020	0.025	0.030	0.035	0.040	0.045	0.050
		Base thickness of insulation to achieve design U-values						
	A	B	C	D	E	F	G	H
1	0.20	95	119	142	166	190	214	237
2	0.25	75	94	112	131	150	169	187
3	0.30	62	77	92	108	123	139	154

Table 24 **Upper floors: allowable reductions in base thickness for common components**

	Component	Thermal conductivity of insulants (W/m.K)						
		0.020	0.025	0.030	0.035	0.040	0.045	0.050
		Reduction in base thickness of insulating material (mm)						
	A	B	C	D	E	F	G	H
1	10mm plasterboard	1	2	2	2	3	3	3
2	19mm timber flooring	3	3	4	5	5	6	7
3	50mm screed	2	3	4	4	5	5	6

Table 25 **Thermal conductivity of some common building materials**

	Density (kg/m^2)	Conductivity (W/m.K)
Walls		
Brickwork (outer leaf)	1700	0.77
Brickwork (inner leaf)	1700	0.56
Lightweight aggregate concrete block	1400	0.57
Autoclaved aerated concrete block	600	0.18
Concrete (medium density) (inner leaf)	1800	1.13
	2000	1.33
	2200	1.59
Concrete (high density)	2400	1.93
Reinforced concrete (1% steel)	2300	2.3
Reinforced concrete (2% steel)	2400	2.5
Mortar (protected)	1750	0.88
Mortar (exposed)	1750	0.94
Gypsum	600	0.18
	900	0.3
	1200	0.43
Gypsum plasterboard	900	0.25
Sandstone	2600	2.3
Limestone (soft)	1800	1.1
Limestone (hard)	2200	1.7
Fibreboard	400	0.1
Plasterboard	900	0.25
Tiles (ceramic)	2300	1.3
Timber (softwood, plywood, chipboard)	500	0.13
Timber (hardwood)	700	0.18
Wall ties (stainless steel)	7900	17.0
Surface finishes		
External rendering	1300	0.57
Plaster (dense)	1300	0.57
Plaster (lightweight)	600	0.18
Roofs		
Aerated concrete slab	500	0.16
Asphalt	2100	0.7
Felt/bitumen layers	1100	0.23
Screed	1200	0.41
Stone chippings	2000	2.0
Tiles (clay)	2000	1.0
Tiles (concrete)	2100	1.5
Wood wool slab	500	0.1
Floors		
Cast concrete	2000	1.35
Metal tray (steel)	7800	50.0
Screed	1200	0.41
Timber (softwood), plywood, chipboard	500	0.13
Timber (hardwood)	700	0.18
Insulation		
Expanded polystyrene (EPS) board	15	0.04
Mineral wool quilt	12	0.042
Mineral wool batt	25	0.038
Phenolic foam board	30	0.025
Polyurethane board	30	0.025

Note
If available, certified test values should be used in preference to those in the table.

Annex B - Calculating U-values

Introduction

B1 For building elements which contain repeating thermal bridges, such as timber joists between insulation in a roof or mortar joints around lightweight blockwork in a wall, the effect of thermal bridges should be taken into account when calculating the U-value. Other factors, such as metal wall ties and air gaps around insulation should also be included. The calculation method, known as the Combined Method, is set out in BS EN ISO 6946 and the following examples illustrate the use of the method for typical wall, roof and floor designs.

B2 In cases where the joists in roof, wall or floor constructions project beyond the surface of the insulation, the depths of the joists should be taken to be the same as the thickness of insulation for the purposes of the U-value calculation (as specified in BS EN ISO 6946).

B3 Thermal conductivity values for common building materials can be obtained from the CIBSE Guide Section A3 or from EN ISO 12524. For specific insulation products, however, data should be obtained from manufacturers.

B4 The procedure in this Annex does not apply to elements containing metal connecting paths, for which the reader is directed to BRE IP 5/98 for metal cladding and to BS EN ISO 10211-1 and -2 for other cases, and it does not deal with ground floors and basements (which are dealt with in Annex C).

B5 The examples are offered as indicating ways of meeting the requirements of Part L but designers also have to ensure that their designs comply with all the other parts of Schedule 1 to the Building Regulations.

The procedure

B6 The U-value is calculated by applying the following steps:

a) Calculate the upper resistance limit (R_{upper}) by combining in parallel the total resistances of all possible heat-flow paths (i.e. sections) through the plane building element.

b) Calculate the lower resistance limit (R_{lower}) by combining in parallel the resistances of the heat flow paths of each layer separately and then summing the resistances of all layers of the plane building element.

c) Calculate the U-value of the element from U = $1/R_T$,

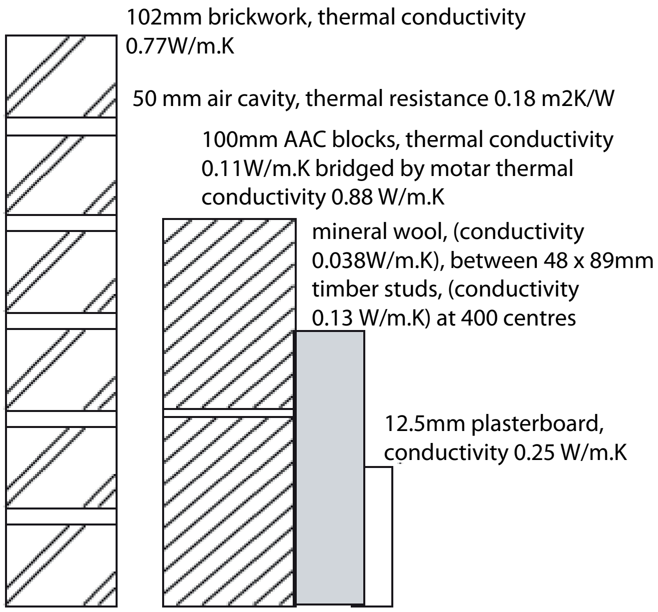
$$\text{where } R_1 = \frac{R_{upper} + R_{lower}}{2}$$

d) Adjust the U-value as appropriate to take account of metal fasteners and air gaps.

Example 1: Cavity wall with lightweight masonry leaf and insulated dry-lining

In this example there are two bridged layers - insulation bridged by timber and lightweight blockwork bridged by mortar (for a single bridged layer see the next example).

Diagram B1: Wall construction with two bridged layers



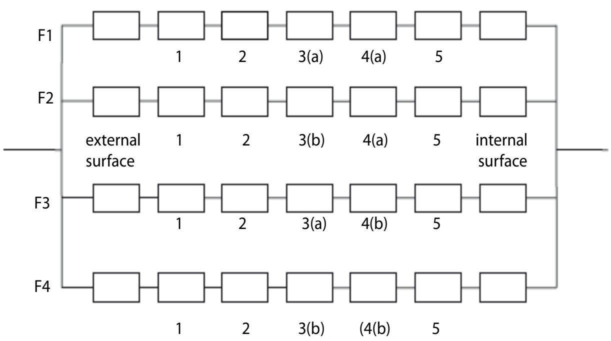
(Total thickness 353.5mm, U = 0.32W/m²K)

Layer	Material	Thickness (mm)	Thermal conductivity (W/m·K)	Thermal resistance (m^2K/W)
	external surface	-	-	0.040
1	outer leaf brickwork	102	0.77	0.132
2	air cavity (unvented)	50	-	0.180
3(a)	AAC blocks (93%)	100	0.11	0.909
3(b)	mortar (7%)	(100)	0.88	0.114
4(a)	mineral wool (88%)	89	0.038	2.342
4(b)	timber battens (12%)	(89)	0.13	0.685
5	plasterboard	12.5	0.25	0.050
	internal surface	-	-	0.130

Upper resistance limit

There are four possible sections (or paths) through which heat can pass. The upper limit of resistance is therefore given by $R_{upper} = 1/(F_1/R_1 + ... + F_4/R_4)$ where F_m is the fractional area of section m and R_m is the total thermal resistance of section m. A conceptual illustration of the upper limit of resistance is shown in Diagram B2.

Diagram B2: Conceptual illustration of the upper limit of resistance



Resistance through section containing AAC blocks and mineral wool

External surface resistance	= 0.040
Resistance of brickwork	= 0.132
Resistance of air cavity	= 0.180
Resistance of AAC blocks	= 0.909
Resistance of mineral wool	= 2.342
Resistance of plasterboard	= 0.050
Internal surface resistance	= 0.130
Total thermal resistance R1	= 3.783 m^2K/W

Fractional area F_1= 93% x 88% = 0.818

Resistance through section containing mortar and mineral wool

External surface resistance	= 0.040
Resistance of brickwork	= 0.132
Resistance of air cavity	= 0.180
Resistance of mortar	= 0.114
Resistance of mineral wool	= 2.342
Resistance of plasterboard	= 0.050
Internal surface resistance	= 0.130
Total thermal resistance R2	= 2.988 m^2K/W

Fractional area F_2= 7% x 88% = 0.062

Resistance through section containing AAC blocks and timber

External surface resistance	= 0.040
Resistance of brickwork	= 0.132
Resistance of air cavity	= 0.180
Resistance of AAC blocks	= 0.909
Resistance of timber	= 0.685
Resistance of plasterboard	= 0.050
Internal surface resistance	= 0.130
Total thermal resistance R3	= 2.126 m^2K/W

Fractional area F_3= 93% x 12% = 0.112

Resistance through section containing mortar and timber

External surface resistance	= 0.040
Resistance of brickwork	= 0.132
Resistance of air cavity	= 0.180
Resistance of mortar	= 0.114
Resistance of timber	= 0.685
Resistance of plasterboard	= 0.050
Internal surface resistance	= 0.130
Total thermal resistance R4	= 1.331 m^2K/W

Fractional area F_4= 7% x 12% = 0.008

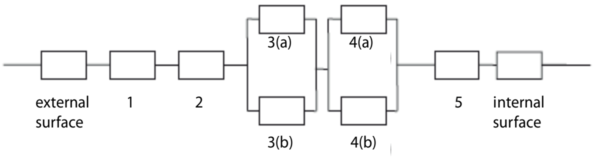
Combining these resistances we obtain:

$$R_{upper} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2} + \frac{F_3}{R_3} + \frac{F_4}{R_4}} = \frac{1}{\frac{0.818}{3.783} + \frac{0.062}{2.988} + \frac{0.112}{2.126} + \frac{0.008}{1.331}}$$

$= 3.382\ m^2K/W$

Lower resistance limit

Diagram B3: Conceptual illustration of the lower limit of resistance



The resistances of the layers are added together to give the lower limit of resistance. The resistance of the bridged layer consisting of AAC blocks and mortar is calculated using:

$$R = \frac{1}{\frac{F_{blocks}}{R_{blocks}} + \frac{F_{mortar}}{R_{mortar}}}$$

and the resistance of the bridged layer consisting of insulation and timber is calculated using:

$$R = \frac{1}{\frac{F_{insul}}{R_{insul}} + \frac{F_{timber}}{R_{timber}}}$$

The lower limit of resistance is then obtained by adding together the resistances of the layers:

External surface resistance	= 0.040
Resistance of brickwork	= 0.132
Resistance of air cavity	= 0.180

Resistance of first bridged layer (blocks and mortar)

$$= \frac{1}{\frac{0.93}{0.909} + \frac{0.707}{0.114}} = 0.611$$

Resistance of second bridged layer (insulation and timber)

$$= \frac{1}{\frac{0.88}{2.342} + \frac{0.12}{0.685}} = 1.815$$

Resistance of plasterboard	= 0.050
Internal surface resistance	= 0.130
Total (Rlower)	= 2.958 m^2K/W

Total resistance of wall

The total resistance of the wall is the average of the upper and lower limits of resistance:

$$R_T = \frac{R_{upper} + R_{lower}}{2} = \frac{3.382 + 2.958}{2}$$

$$= 3.170 \ m^2K/W.$$

Correction for air gaps

If there are small air gaps penetrating the insulating layer a correction should be applied to the U-value. The correction for air gaps is ΔU_g, where

$$\Delta U_g = \Delta U'' \times (R_I / R_T)^2$$

and where R_I is the thermal resistance of the layer containing gaps, R_T is the total resistance of the element and $\Delta U''$ is a factor which depends upon the way in which the insulation is fitted. In this example R_I is 1.815 m^2K/W, R_T is 3.170 m^2K/W and $\Delta U''$ is 0.01 (ie correction level 1). The value of ΔU_g is then

ΔU_g = 0.01 x (1.815/3.170) 2 = 0.003 W/m^2K.

***Correction level 1** applies for "Insulation installed in such a way that no air circulation is possible on the warm side of the insulation; air gaps may penetrate the insulation layer"*

U-value of the wall

The effect of air gaps or mechanical fixings should be included in the U-value unless they lead to an adjustment in the U-value of less than 3%.

$U = 1/R_T + \Delta U_g$ (if ΔU_g is not less than 3% of $1/R_T$)

$U = 1/R_T$ (if ΔU_g is less than 3% of $1/R_T$)

In this case ΔU_g = 0.003 W/m^{2}K and $1/R_T$ = 0.315 W/m2K, i.e. ΔU_g is less than 3% of ($1/R_T$).

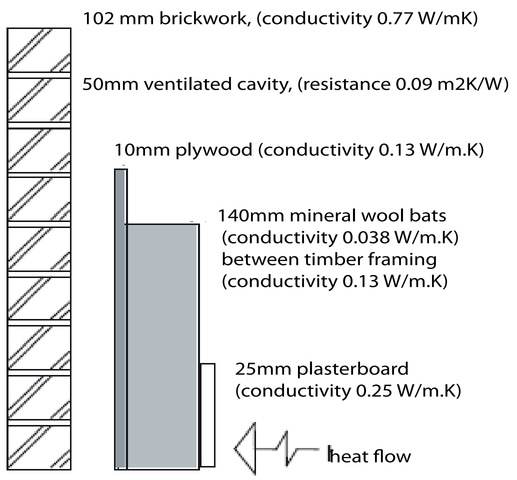
Therefore U = $1/R_T$ = 1/3.170 = 0.32 W/m^{2}K (expressed to two decimal places).

Example 2: Timber framed wall

In this example there is a single bridged layer in the wall, involving insulation bridged by timber studs. The construction consists of outer leaf brickwork, a clear ventilated cavity, 10mm plywood, 38 x 140mm timber framing with 140mm of mineral wool quilt insulation between the timber studs and 2 sheets of plasterboard, each 12.5mm thick, incorporating a vapour check.

The timber fraction in this particular example is 15%. This corresponds to 38mm wide studs at 600mm centres and includes horizontal noggings etc. and the effects of additional timbers at junctions and around openings.

Diagram B4: Timber framed wall construction



(Total thickness 327mm, U = 0.30 W/m^{2}K)

The thicknesses of each layer, together with the thermal conductivities of the materials in each layer, are shown below. The internal and external surface resistances are those appropriate for wall constructions. Layer 4 is thermally bridged and two thermal conductivities are given for this layer, one for the main part and one for the bridging part of the layer. For each homogeneous layer and for each section through a bridged layer, the thermal resistance is calculated by dividing the thickness (in metres) by the thermal conductivity.

Layer	Material	Thickness (mm)	Thermal conductivity (W/m.K)	Thermal resistance (m²K/W)
	external surface	-	-	0.040
1	outer leaf brick	102	0.77	0.123
2	ventilated air cavity	50	-	0.090
3	plywood	10	0.13	0.077
4(a)	mineral wool quilt between timber framing (85%)	140	0.038	3.684
4(b)	timber framing (15%)	(140)	0.13	1.077
5	plasterboard	25	0.25	0.100
	internal surface	-	-	0.130

Both the upper and the lower limits of thermal resistance are calculated by combining the alternative resistances of the bridged layer in proportion to their respective areas, as illustrated below. The method of combining differs in the two cases.

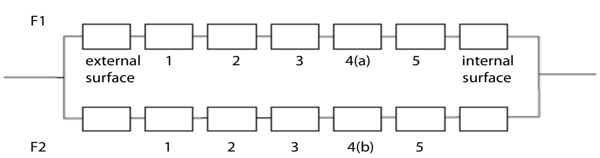
Upper resistance limit

When calculating the upper limit of thermal resistance, the building element is considered to consist of two thermal paths (or sections). The upper limit of resistance is calculated from:

$$R_{upper} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2}}$$

where F_1 and F_2 are the fractional areas of the two sections (paths) and R_1 and R_2 are the total resistances of the two sections. The method of calculating the upper resistance limit is illustrated conceptually in Diagram B5.

Diagram B5: Conceptual illustration of how to calculate the upper limit of thermal resistance



Resistance through the section containing insulation

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.090
Resistance of plywood	= 0.077
Resistance of mineral wool (85%)	= 3.684
Resistance of plasterboard	= 0.100
Internal surface resistance	= 0.130
Total (R_1)	= 4.253

Fractional area F_1 = 0.85 (85%)
The resistance through this section is therefore 4.253 m^2K/W.

Resistance through section containing timber stud

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.090
Resistance of plywood	= 0.077
Resistance of timber studs (15%)	= 1.077
Resistance of plasterboard	= 0.100
Internal surface resistance	= 0.130
Total (R_2)	= 1.646

Fractional area F_2 = 0.15 (15%)
The resistance through this section is therefore 1.646 m^2K/W.

The upper limit of resistance is then:

$$R_{upper} = \frac{1}{\frac{F_1}{R_1} + \frac{F_2}{R_2}} = \frac{1}{\frac{0.85}{4.253} + \frac{0.15}{1.646}}$$

$$= 3.437 m^2K/W$$

Lower resistance limit

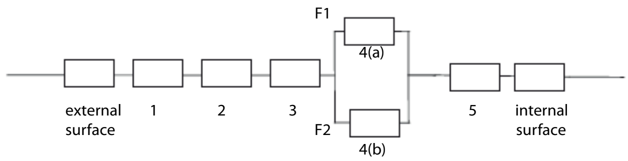
When calculating the lower limit of thermal resistance, the resistance of a bridged layer is determined by combining in parallel the resistances of the unbridged part and the bridged part of the layer. The resistances of all the layers in the element are then added together to give the lower limit of resistance.

The resistance of the bridged layer is calculated using:

$$R = \frac{1}{\frac{F_{insul}}{R_{insul}} + \frac{F_{timber}}{R_{timber}}}$$

The method of calculating the lower limit of resistance is illustrated conceptually in Diagram B6.

Diagram B6: Conceptual illustration of how to calculate the lower limit of thermal resistance



The lower limit of resistance is then obtained by adding up the resistances of all the layers:

External surface resistance	= 0.040
Resistance of bricks	= 0.132
Resistance of air cavity	= 0.090
Resistance of plywood	= 0.077

$$\text{Resistance of bridged layer} = \frac{1}{\frac{0.85}{3.684} + \frac{0.15}{1.077}} = 2.703$$

Resistance of plasterboard	= 0.100
Internal surface resistance	= 0.130
Total (R_{lower})	= 3.272

The lower limit of resistance is then 3.272 m^2K/W.

Total resistance of wall (not allowing for air gaps around the insulation)

The total resistance of the wall is the average of the upper and lower resistance limits:

$$R_T = \frac{R_{upper} + R_{lower}}{2} = \frac{3.437 + 3.272}{2}$$

$$= 3.354 m^2K/W.$$

Correction for air gaps

If there are small air gaps penetrating the insulating layer a correction should be applied to the U-value to account for this. The correction for air gaps is ΔU_g, where

$\Delta U_g = \Delta U'' \times (R_I/R_T)^2$

and where R_I is the thermal resistance of the layer containing gaps, R_T is the total resistance of the element and $\Delta U''$ is a factor which depends upon the way in which the insulation is fitted. In this example R_I is 2.703 m^2K/W, R_T is 3.354 m^2K/W and $\Delta U''$ is 0.01 (ie correction level 1). The value of ΔU_g is then

$\Delta U_g = 0.01 \times (2.703/3.354)^2 = 0.006$ W/m^2K.

U-value of the wall

The effect of air gaps or mechanical fixings should be included in the U-value unless they lead to an adjustment in the U-value of less than 3%.

$U = 1/R_T + \Delta U_g$ (if ΔU_g is not less than 3% of $1/R_T$)

$U = 1/R_T$ (if ΔU_g is less than 3% of $1/R_T$)

In this case $\Delta U_g = 0.006$ W/m^2K and 1/RT = 0.298 W/m^2K. Since ΔU_g is less than 3% of $(1/R_T)$,

$U = 1/R_T = 1 / 3.354 = 0.30$ W/m^2K.

Annex C - U- values of ground floors

C1 The guidance in this Guernsey Technical Standard states that a ground floor should not have a U-value exceeding 0.25 W/m^{2}K if the Elemental Method of compliance is to be used. This can normally be achieved without the need for insulation if the perimeter to area ratio is less than 0.12 m/m^2 for solid ground floors or less than 0.09 m/m^2 for suspended floors. For most buildings, however, some ground floor insulation will be necessary to achieve this U-value or better performance. For exposed floors and for floors over unheated spaces the reader is referred to *BS EN ISO 6946 or the CIBSE Guide Section A3.*

C2 This Annex provides a simple method for determining U-values which will suffice for most common constructions and ground conditions in the UK. More rigorous procedures are given in *BS EN ISO 13370 and in CIBSE Guide Section A3 (1999 edition).*

C3 For ground floors the U-value depends upon the type of soil beneath the building. Where the soil type is unknown, silt should be assumed as this is the most typical soil type in Guernsey. The tables which follow are based on this soil type. Where the soil is not clay or silt, the U-value should be calculated using the procedure in *BS EN ISO 13370.*

C4 Floor dimensions should be measured between finished internal faces of the external elements of the building including any projecting bays. In the case of semi-detached or terraced premises, blocks of flats and similar, the floor dimensions can either be taken as those of the premises themselves, or of the whole building. When considering extensions to existing buildings the floor dimensions may be taken as those of the complete building including the extension.

C5 Floor designs should prevent excessive thermal bridging at the floor edge so that the risk of condensation and mould are reasonably controlled. See *BRE Report BR 262 Thermal insulation: avoiding risks.*

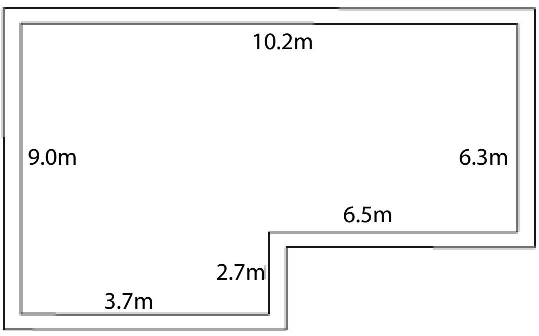
C6 Unheated spaces outside the insulated fabric, such as attached garages or porches, should be excluded when determining the perimeter and area but the length of the wall between the heated building and the unheated space should be included when determining the perimeter.

Example of how to obtain U-values from the tables

The following example illustrates the use of the tables by interpolating between appropriate rows or columns.

A proposed building has a perimeter of 38.4 m and a ground floor area of 74.25m^2. The floor construction consists of a 150mm concrete slab, 95mm of rigid insulation (thermal conductivity 0.04 W/m·K) and a 65mm screed. Only the insulation layer is included in the calculation of the thermal resistance.

Diagram C1



The perimeter to area ratio is equal to (38.4 ⁄ 74.25 = 0.517) m/m^2. Table 26 provides values for perimeter/area ratios of 0.50 and 0.55 but not for any values between 0.50 and 0.55. In this case, the U-value corresponding to a perimeter to area ratio of 0.50 should be used since 0.517 is closer to 0.50 than to 0.55. The thermal resistance of the insulation is obtained by dividing the thickness (in metres) by the conductivity. The resistance is then 0.095 ⁄ 0.04 = 2.375 m^{2}K/W.

The relevant part of Table 26 is shown below:

Thermal resistance of all-over insulation (m²K/W)

perimeter/area	2.0	2.5
0.50	0.28	0.24

The U-value corresponding to a thermal resistance of 2.375 m²K/W is obtained by linear interpolation as below:

$$U = 0.28 \times \frac{2.5 - 2.375}{2.5 - 2.0} + 0.24 \times \frac{2.375 - 2.0}{2.5 - 2.0}$$

$$= 0.28 \times 0.25 + 0.24 \times 0.75$$
$$= 0.25 \text{ W/m}^2\text{K}$$

The U-value of this ground floor is therefore **0.25 W/m²K.**

Note
In the example for Table 26 the appropriate row was chosen and interpolation was carried out between the appropriate columns. For all of the other tables, however, the appropriate column in the table should be selected and interpolation should be carried out between the appropriate rows.

Solid ground floors

Listed in Table 26 are U-values for solid ground floors. U-values are given in the following table for various perimeter-to-area ratios for a range of insulation levels. Where the floor is uninsulated the column corresponding to a thermal resistance of 0 should be used.

Table 26 **U-values (W/m²K) for solid ground floors**

perimeter/ area (m/m²)	Thermal resistance of all-over insulation (m²K/W) 0	0.5	1	1.5	2	2.5
0.05	0.13	0.11	0.10	0.09	0.08	0.08
0.10	0.22	0.18	0.16	0.14	0.13	0.12
0.15	0.30	0.24	0.21	0.18	0.17	0.15
0.20	0.37	0.29	0.25	0.22	0.19	0.18
0.25	0.44	0.34	0.28	0.24	0.22	0.19
0.30	0.49	0.38	0.31	0.27	0.23	0.21
0.35	0.55	0.41	0.34	0.29	0.25	0.22
0.40	0.60	0.44	0.36	0.30	0.26	0.23
0.45	0.65	0.47	0.38	0.32	0.27	0.23
0.50	0.70	0.50	0.40	0.33	0.28	0.24
0.55	0.74	0.52	0.41	0.34	0.28	0.25
0.60	0.78	0.55	0.43	0.35	0.29	0.25
0.65	0.82	0.57	0.44	0.35	0.30	0.26
0.70	0.86	0.59	0.45	0.36	0.30	0.26
0.75	0.89	0.61	0.46	0.37	0.31	0.27
0.80	0.93	0.62	0.47	0.37	0.32	0.27
0.85	0.96	0.64	0.47	0.38	0.32	0.28
0.90	0.99	0.65	0.48	0.39	0.32	0.28
0.95	1.02	0.66	0.49	0.39	0.33	0.28
1.00	1.05	0.68	0.50	0.40	0.33	0.28

Ground floors with edge insulation

Where horizontal or vertical edge insulation is used instead of all-over floor insulation, (P/A) x Ψ is added to the U-value to account for the effects of edge insulation, where P/A is the perimeter (m) to area (m²) ratio and Ψ is the edge insulation factor obtained from one of the following two tables. Since the term (P/A) x Ψ is negative it reduces the U-value of the ground floor. The tables apply only to floors without overall insulation.

Table 27 **Edge insulation factor Ψ (W/m·K) for horizontal edge insulation**

insulation width (m)	Thermal resistance of all-over insulation (m²K/W) 0.5	1.0	1.5	2.0
0.5	-0.13	-0.18	-0.21	-0.22
1.0	-0.20	-0.27	-0.32	-0.34
1.5	-0.23	-0.33	-0.39	-0.42

Table 28 **Edge insulation factor Ψ (W/m·K) for vertical edge insulation**

insulation width (m)	Thermal resistance of all-over insulation (m^2K/W) 0.5	1.0	1.5	2.0
0.25	-0.13	-0.18	-0.21	-0.22
0.50	-0.20	-0.27	-0.32	-0.34
0.75	-0.23	-0.33	-0.39	-0.42
1.00	-0.26	-0.37	-0.43	-0.48

For floors with both all-over insulation and edge insulation the calculation method in *BS EN ISO 13370* can be used.

Uninsulated suspended ground floors

Table 29 gives U-values of uninsulated suspended floors for various perimeter to area ratios and for two levels of ventilation (expressed in m^2/m) below the floor deck. The data apply for the floor deck at a height not more than 0.5 m above the external ground level where the wall surrounding the underfloor space is uninsulated.

Insulated suspended floors

The U-value of an insulated suspended floor should be calculated using

$$U = 1/[(1/U_0) - 0.2 + R_f]$$

where U_0 is the U-value of an uninsulated suspended floor obtained using Table 29 or another approved method. R_f, the thermal resistance of the floor deck, is determined from U_f, the U-value of the floor deck, where

$$R_f = \frac{1}{U_f} - 0.17 - 0.17$$

and where Uf takes account of any thermal bridging in the floor deck and is calculated as recommended in *BS EN ISO 6946* or by numerical modelling. The two values “0.17” are the two surface resistances.

Table 29 **U-values (W/m^2K) of uninsulated suspended floors**

perimeter to area ratio (m/m^2)	Ventilation opening area per unit perimeter of underfloor space 0.0015 m^2/m	0.0030 m^2/m
0.05	0.15	0.15
0.10	0.25	0.26
0.15	0.33	0.35
0.20	0.40	0.42
0.25	0.46	0.48
0.30	0.51	0.53
0.35	0.55	0.58
0.40	0.59	0.62
0.45	0.63	0.66
0.50	0.66	0.70
0.55	0.69	0.73
0.60	0.72	0.76
0.65	0.75	0.79
0.70	0.77	0.81
0.75	0.80	0.84
0.80	0.82	0.86
0.85	0.84	0.88
0.90	0.86	0.90
0.95	0.88	0.92
1.00	0.89	0.93

Annex D - Determining U-values for glazing

D1 Within the Elemental Method of compliance it is permissible to have windows, doors or rooflights with U-values that exceed the standard U-values provided that the average U-value of all of the windows (including rooflights) and doors taken together does not exceed the standard U-value in Table 1 in Section 1. The following examples illustrate how this can be done.

Example 1

D2 A semi-detached house is to have a total window area of 16.9m^2, a rooflight of area 0.9m^2 and a total door area of 3.8m^2. The windows have wood frames. It is proposed to use solid wooden doors with a U-value of 3.0 W/m^{2}K. In order to use the Elemental Method, the additional heat loss due to the use of solid timber doors must be compensated by lower U-values the windows so that the average U-value of all openings does not exceed the appropriate standard U-value, which in this case is 2.0 W/m^{2}K.

D3 Using windows with a U-value of 1.7 W/m^{2}K is sufficient to satisfy this requirement as shown in the following table and the subsequent calculation.

Element	**Area (m^2)**	**U-value (W/m^{2}K)**	**Rate of heat loss per degree (W/K)**
Windows	16.9	1.7	28.73
Doors	3.8	3.0	11.4
Rooflights	0.9	1.9	1.71
Total	21.6		41.84

D4 This gives an average U-value of 41.84/21.6, or 1.94 W/m^{2}K, which is less than 2.0 W/m^{2}K. The windows, doors and rooflights therefore satisfy the requirements of the Elemental Method.

Example 2

D5 If, for the same dwelling as example 1, windows with a U-value of 2.1 W/m^{2}K are proposed, the requirement can be satisfied by using insulated doors with a U-value of 1.0 W/m^{2}K, as shown below.

Element	Area (m^2)	U-value (W/m^{2}K)	Rate of heat loss per degree (W/K)
Windows	16.9	2.1	35.49
Doors	3.8	1.0	3.8
Rooflights	0.9	2.3	2.07
Total	21.6		41.36

D6 This gives an average U-value of 41.36/21.6, or 1.91 W/m^{2}K, which is less than the standard U-value of 2.0 W/m^{2}K when wood-framed windows are being used. Taken together, the windows, doors and rooflights therefore satisfy the requirements of the Elemental Method.

Annex E - Assessing the case for a non-condensing boiler

1. This Annex sets out the approved assessment procedure for determining, for the purposes of the requirement in Part L1 of the Building Regulations, where practical considerations mean that it would be reasonable to install a non-condensing boiler. The assessment is applicable where boilers are to be installed in dwellings whose designs were approved before 5th October 2009.

2. The chart summarises the steps in the assessment procedure. In determining the position within a dwelling where a condensing boiler could be installed at lowest cost obstacles such as furniture or fittings should be ignored. If the assessment shows that this cost is too high then, in accordance with paragraph 2.3b) of this Guernsey Technical Standard, it would be reasonable to install a noncondensing boiler.

3. Paragraphs 2.9 to 2.11 in the Guernsey Technical Standard give guidance on how to deal with protected buildings.

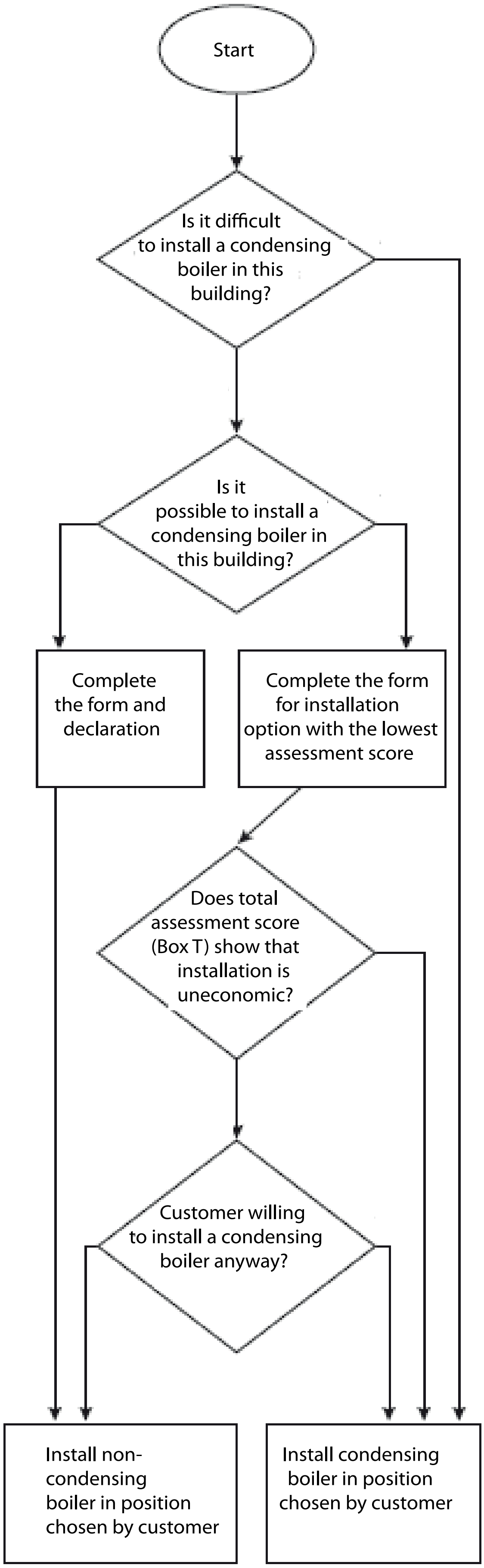
The assessment procedure

4. The assessment should be carried out following the detailed guidance given in the Guide to the *Condensing Boiler Installation Assessment Procedure for Dwellings (the Guide).* It should consider all feasible condensing boiler installation options (subject to the restrictions given later) for whichever fuel has been chosen by the householder (natural gas, LPG, or oil). For the purposes of the assessment, boiler positions preferred by the householder are not relevant. The lowest cost position should be found, and recorded on the form.

5. An assessment score exceeding 1000 points indicates that exceptional circumstances exist. In these circumstances the installation of a condensing boiler is not considered necessary to meet the requirements of the Building Regulations.

6. The assessment result is restricted to the chosen fuel for the new boiler, and is not valid for a different fuel.

7. Whether a condensing or non-condensing boiler is chosen, it need not be installed in the position shown on the assessment form.



Completion of the assessment form

1 First, complete section 1 of the form.

2 If a defective boiler is being replaced within 3 years of the date of original installation under the original manufacturer's or installer's guarantee, tick box X and sign the declaration in section 14 of the form, omitting sections 2 to 13. Otherwise, continue below.

3 Complete sections 2 and 3 of the form.

4 Decide what fuel is to be used for the new boiler (gas, LPG, or oil), and complete section 4 of the form.

5 If an oil-fired boiler is to be installed before 5th October 2009, then proceed to section 14 of the form, omitting sections 5 to 13. Otherwise, continue below.

6 Complete sections 5 and 6 of the form.

7 Consider ALL feasible condensing boiler positions and extended flue options, taking no account of householder's preferences. In some positions special condensate disposal arrangements may be necessary. Some installation options are NOT regarded as feasible for the purpose of this assessment procedure, and should NOT be considered. They are listed in Tables 30 and 31. (They do not necessarily contravene standards or regulations, and in some cases they may be acceptable to the householder but they are not acceptable for the purposes of the assessment. Further advice on the bases of Tables 30 and 31 is given in the Guide).

8 If there are no feasible condensing boiler installation options proceed to section 14, omitting sections 7 to 13. Such cases are unusual and a clear explanation should be inserted in section 14 following the advice in the Guide. Otherwise, continue below.

9 Complete section 9, inserting points from Table 32. Where a change of boiler fuel is proposed, the assessment should reflect this decision.

10 Complete sections 7, 8, and 10 to 13 for the installation option that gives the lowest assessment score in section 13. Evidence may be required that all feasible options have been considered and that this is the lowest scoring option, so forms used to assess other options should be attached when the final, signed, form is made available.

11 Complete and sign the declaration in section 14, ticking one box only. Supply the completed form to the householder for use when the house is sold and retain a copy for building control compliance purposes.

Table 30 **Flue and terminal installation options that are NOT to be considered**
Flue and terminal positions that do not comply with Guernsey Technical Standard J of the Building Regulations.
A shared flue, unless specially designed to be shared by condensing boilers.
A flue passing through a wall or floor that must not be pierced for structural reasons.
An internal flue extension exceeding 4m (ignoring the part that passes through a loft/attic space).
A flue that passes through another dwelling, or another building in different ownership, or another fire compartment.
A vertical flue pipe visible on the outside of the building facing the main approach direction (usually the front). This refers only to the flue pipe, not the flue terminal (a terminal may be positioned on any side of the building).
Wall terminals that discharge under the roof of a car port.
Wall terminals with horizontal discharge less than 2.5m from any wall, fence, building or property boundary facing the terminal.
Wall terminals with horizontal discharge less than 2.5m from a car parking space and less than 2.1m above the ground.
Wall terminals less than 2.1m above the ground with horizontal discharge of the flue products across a public footway, route, or a patio (hard surface area).

Table 31 Boiler positions not to be considered

1 Gas boilers: Where the boiler or extended internal flue is in a:
- lounge
- lounge/dining room
- principal living room that does not include a kitchen area.

2 LPG boilers: Where the boiler or extended internal flue is in a:
- lounge
- lounge/dining room
- principal living room that does not include a kitchen area
- cellar or basement.

3 Oil boilers: The only positions that ARE to be considered are:
- a kitchen, or
- a litchen/dining room, or
- a utility room
- purpose -made boiler room.

And only where they are on the ground floor or in a basement.
All other positions are NOT to be considered.

Table 32 Points for property type and fuel

Building type	Natural gas	LPG	Oil
Flat	710	660	830
Mid-terrace	640	580	790
Others (end-terrace, semi-detached, or detached)	590	520	760

CALCULATION AND DECLARATION FORM

This form may be used to show that a non-condensing boiler is reasonable for the purposes of complying with Part L or the Building Regulations

1 Full address of property assessed ______________________

____

____

Post code ______________________

2 Dwelling type (tick one only)

3 Existing boiler fuel (tick one only)

4 New boiler fuel (tick one only)

5 Existing boiler type (tick one only

6 Existing boiler position (tick one only)

7 In the lowest cost option is the boiler positioned in a different room from the existing boiler position?

8 If YES to section 7, state new boiler position

9 Determine points for property type and new boiler fuel from Table 32 and insert in box A — Box A

10 New boiler position in a different room from the existing boiler? (see 7) If YES insert 350 in box B — Box B

11 Extended flue (longer than 2m) necessary? If YES insert 200 for gas boilers or 350 for oil boilers, in box C — Box C

12 Condensate pump or soakaway necessary? If YES insert 100 in box D — Box D

13 ASSESSMENT SCORE **TOTAL of points in boxes A + B + C + D** — Box T

14 Declaration (tick one box only)

Box X I declare that the boiler is being replaced under the original manufacturer's or installer's guarantee, within 3 years of the original installation date, OR

Box Y I declare that there are no feasible condensing boiler installation options (as defined by the assessment procedure) because:

____

____

____

Box Z I declare that I have considered all feasible boiler installation options in the property above, and the option defined in boxes A to D produces the lowest total T.

Signed ______________________ Date ______________________

Name (in capitals) ______________________ Status (agent or installer) ______________________

Competent person scheme ______________________ Competent person registration number ______________________

Notice to householder

1 Where Box X is ticked, a like for like replacement boiler is reasonable

2 Where Box Y has been ticked or Box Z has been ticked and the assessment score in section 13 exceeds 1000, this document may be used as evidence that installation of a condensing boiler has been assessed as impractical or uneconomic. **Nevertheless you may choose to exceed the Building Regulations requirement** if a suitable installation option can be found. Condensing boilers are more efficient and therefore save on fuel costs and cause less harm to the environment.

3 You should retain this form. It may be required when you sell your home

Points for property type and fuel

Building type	**Natural gas**	**LPG**	**Oil**
Flat	710	660	830
Mid-terrace	640	580	790
Others (end-terrace, semi-detached, or detached)	590	520	760

Annex F - Work to thermal elements

1 Where work involves the renovation of a thermal element, an opportunity exists for cost-effective insulation improvements to be undertaken at marginal additional cost. This annex provides guidance on the cost- effectiveness of insulation measures when undertaking various types of work on a thermal element.

2 Table 33 sets out the circumstances and the level of performance that would be considered reasonable provision in ordinary circumstances. When dealing with existing dwellings some flexibility in the application of standards is necessary to ensure that the context of each scheme can be taken into account while securing, as far as possible, the reasonable improvement. The final column in Table 33 provides guidance on a number of specific issues that may need to be considered in determining an appropriate course of action. As part of this flexible approach, it will be necessary to take into account technical risk and practicality in relation to the dwelling under consideration and the possible impacts on any adjoining building. In general the proposed works should take account of:

a. the requirements of any other relevant parts of Schedule 1 to the Building Regulations;

b. the general guidance on technical risk relating to insulation improvements contained in *BR 262*;

c. for buildings falling within the categories set out in paragraphs 2.7 and 2.8 and in the general guidance on page 9, the guidance produced by English Heritage.

Where it is not reasonable in the context of the works project to achieve the performance set out in Table 33 the level of performance achieved should be as close to this as practically possible.

3 Table 33 incorporates, in outline form, examples of construction that would achieve the proposed performance, but designers are free to use any appropriate construction that satisfies the energy performance standard, so long as they do not compromise performance with respect to any other part of the Building Regulations.

4 General guidance is available from such sources as the *Energy Saving Trust and relevant British Standards*.

Table 33 **Cost-effective U-value targets when undertaking renovation works to thermal elements**

Proposed works	Target U-value (W/m².K)	Typical construction	Comments (reasonableness, practicability and cost- effectiveness)
Pitched roof constructions[16]			
Renewal of roof covering – No living accommodation in the roof void – existing insulation (if any) at ceiling level. No existing insulation, existing insulation less than 50 mm, in poor condition, and/ or likely to be significantly disturbed or removed as part of the planned work	0.16	Provide loft insulation – 250 mm mineral fibre or cellulose fibre as quilt laid between and across ceiling joists or loose fill or equivalent	Assess condensation risk in roof space and make appropriate provision in accordance with the requirements of Part C relating to the control of condensation. Additional provision may be required to provide access to and insulation of services in the roof void
Renewal of roof covering – Existing insulation in good condition and will not be significantly disturbed by proposed works. Existing insulation thickness 50 mm or more but less than 100 mm	0.16	Top up loft insulation to at least 250 mm mineral fibre or cellulose fibre as quilt laid between and across ceiling joists or loose fill or equivalent. This may be boarded out	Assess condensation risk in roof space and make appropriate provision in line with the requirements of Part C relating to the control of condensation. Additional provision may be required to provide insulation and access to services in the roof void Where the loft is already boarded out and the boarding is not to be removed as part of the work, the practicality of insulation works would need to be considered
Renewal of the ceiling to cold loft space. Existing insulation at ceiling level removed as part of the works	0.16	Provide loft insulation – 250 mm mineral fibre or cellulose fibre as quilt laid between and across ceiling joists or loose fill or equivalent. This may be boarded out	Assess condensation risk in roof space and make appropriate provision in accordance with the requirements of Part C relating to the control of condensation. Additional provision may be required to provide insulation and access to services in the roof void Where the loft is already boarded out and the boarding is not to be removed as part of the work, insulation can be installed from the underside but the target U-value may not be achievable
Renewal of roof covering – Living accommodation in roof space (room- in- the-roof type arrangement), with or without dormer windows	0.2	Cold structure – Insulation (thickness dependent on material) placed between and below rafters Warm structure – Insulation placed between and above rafters	Assess condensation risk (particularly interstitial condensation), and make appropriate provision in accordance with the requirements of Part C relating to the control of condensation (Clause 8.4 of BS 5250:2002 and BS EN ISO 13788:2002 Practical considerations with respect to an increase in structural thickness (particularly in terraced dwellings) may necessitate a lower performance target
Dormer window constructions			
Renewal of cladding to side walls	0.35	Insulation (thickness dependent on material) placed between and/or fixed to outside of wall studs. Or fully external to existing structure depending on construction	Assess condensation risk and make appropriate provision in accordance with the requirements of Part C
Renewal of roof covering	–	Follow guidance on improvement to pitched or flat roofs as appropriate	Assess condensation risk and make appropriate provision in accordance with the requirements of Part C
Flat roof constructions			
Renewal of roof covering – Existing insulation, if any, less than 100 mm, mineral fibre (or equivalent resistance) or in poor condition and likely to be significantly disturbed or removed as part of the planned work	0.25	Insulation placed between and over joists as required to achieve the target U-value – Warm structure	Assess condensation risk and make appropriate provision in accordance with the requirements of Part C. Also see BS 6229:2003 for design guidance

Table 33 **Cost-effective U-value targets when undertaking renovation works to thermal elements**

Proposed works	Target U-value ($W/m^2.K$)	Typical construction	Comments (reasonableness, practicability and cost- effectiveness)
Renewal of the ceiling to flat roof area. Existing insulation removed as part of the works	0.25	Insulation placed between and to underside of joists to achieve target U-value	Assess condensation risk and make appropriate provision in accordance with the requirements of Part C. Also see BS 6229:2003 for design guidance. Where ceiling height would be adversely affected, a lower performance target may be appropriate
Solid wall constructions			
Renewal of internal finish to external wall or applying a finish for the first time	0.35	Dry-lining to inner face of wall – insulation between studs fixed to wall to achieve target U-value – thickness dependent on insulation and stud material used Insulated wall board fixed to internal wall surface to achieve the required U-value – thickness dependent on material used	Assess the impact on internal floor area. In general it would be reasonable to accept a reduction of no more than 5% in the area of a room. However, the use of the room and the space requirements for movement and arrangements of fixtures, fittings and furniture should be assessed In situations where acoustic attenuation issues are particularly important (e.g. where insulation is returned at party walls) a less demanding U-value may be more appropriate. In such cases, the U-value target may have to be increased to 0.35 or above depending on the circumstances Assess condensation and other moisture risks and make appropriate provision in accordance with the requirements of Part C. This will usually require the provision of a vapour control and damp protection to components. Guidance on the risks involved is provided in BR 262 and, on the technical options, in Energy Saving Trust publications
Renewal of finish or cladding to external wall area or elevation (render or other cladding) or applying a finish or cladding for the first time	0.35	External insulation system with rendered finish or cladding to give required U-value	Assess technical risk and impact of increased wall thickness on adjoining buildings
Ground floor constructions			
Renovation of a solid or suspended floor involving the replacement of screed or a timber floor deck	See comment	Solid floor – replace screed with an insulated floor deck to maintain existing floor level Suspended timber floor – fit insulation between floor joists prior to replacement of floor deck	The cost-effectiveness of floor insulation is complicated by the impact of the size and shape of the floor (perimeter/area ratio). In many cases existing un-insulated floor U-values are already relatively low when compared with wall and roof U-values. Where the existing floor U-value is greater than 0.70 $W/m^2.K$, then the addition of insulation is likely to be cost-effective. Analysis shows that the cost–benefit curve for the thickness of added insulation is very flat, and so a target U-value of 0.25 $W/m^2.K$ is appropriate subject to other technical constraints (adjoining floor levels, etc.)

Annex G - Key terms

Air permeability is the physical property used to measure airtightness of building fabric. It measures the resistance of the building envelope to inward or outward air permeation. It is defined as the average volume of air (in cubic metres per hour) that passes through unit area of the structure of the building envelope (in square metres) when subject to an internal to external pressure difference of 50 Pa. It is expressed in units of cubic metres per hour, per square metre of envelope area, at a pressure difference of 50 Pa. The envelope area of the building is defined as the total area of the floor, walls and roof separating the interior volume from the outside environment, i.e. the conditioned space.

A Roof window is a window in the plane of a pitched roof and may be considered as a rooflight for the purposes of this Guernsey Technical Standard.

Exposed element means an element exposed to the outside air (including a suspended floor over a ventilated or unventilated void, and elements so exposed indirectly via an unheated space), or an element in the floor or basement in contact with the ground. In the case of an element exposed to the outside air via an unheated space (previously known as a "semi-exposed element") the U-value should be determined using the method given in the SAP 1998 (to be replaced by SAP 2001 later in 2001). Party walls, separating two dwellings or other premises that can reasonably be assumed to be heated to the same temperature, are assumed not to need thermal insulation.

SAP means the Government's Standard Assessment Procedure for Energy Rating of Dwellings. The SAP is explained and defined, along with appropriate reference data and a calculation worksheet, in "The Government's Standard Assessment Procedure for Energy Rating of Dwellings". SAP 1998 means the 1998 Edition of the publication, and SAP 2001 means the 2001 Edition of the publication.

SEDBUK is the Seasonal Efficiency of a Domestic Boiler in the UK, defined in The UK Government's Standard Assessment Procedure for the Energy Rating of Dwellings

Thermal conductivity (i.e. the lambdavalue) of a material is a measure of the rate at which that material will pass heat and is expressed in units of Watts per metre per degree of temperature difference (W/mK).

Thermal transmittance (i.e. the U-value) is a measure of how much heat will pass through one square metre of a structure when the air temperatures on either side differ by one degree. U-values are expressed in units of Watts per square metre per degree of temperature difference (W/m^2K).

Annex H - Standards referred to and other documents

BS 699:1984 Specification for copper direct cylinders for domestic purposes

BS 1566-1:1984 Copper indirect cylinders for domestic purposes. Specification for double feed indirect cylinders

BS 3198:1981 Specification for copper hot water storage combination units for domestic purposes

BS 5422:2001 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range –40°C to +700°C

BS 5864:1989 Specification for installation in domestic premises of gas-fired ducted air heaters of rated output not exceeding 60 kW

BS EN ISO 6946:1997 Building components and building elements – Thermal resistance and thermal transmittance – Calculation method

BS 7206:1990 Specification for unvented hot water storage units and packages

BS 7913:1998 The principles of the conservation of historic buildings

BS 8206:1992: Part 2: Lighting for buildings: Code of practice for daylighting

BS EN ISO 8990:1996 Thermal insulation – Determination of steady-state thermal transmission properties - Calibrated and guarded hot box

BS EN ISO 10077-1:2000 Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 1: Simplified methods

EN ISO 10077-2 Thermal performance of windows, doors and shutters – Calculation of thermal transmittance - Part 2: Numerical method for frames

BS EN ISO 10211-1:1996 Thermal bridges in building construction – Calculation of heat flows and surface temperatures – Part 1: General methods

BS EN ISO 10211-2:2001 Thermal bridges in building construction – Calculation of heat flows and surface temperatures – Part 2: Linear thermal bridges

BS EN 12524:2000 Building materials and products – Hygrothermal properties – Tabulated design values

BS EN ISO 12567-1:2000 Thermal performance of windows and doors – Determination of thermal transmittance by hot box method – Part 1: Complete windows and doors

BS EN 12664:2001 Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Dry and moist products of low and medium thermal resistance

BS EN 12667:2000 Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Products of high and medium thermal resistance

BS EN 12939:2001 Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Thick products of high and medium thermal resistance

BS EN ISO 13370:1998 Thermal performance of buildings – Heat transfer via the ground – Calculation methods

The Stationery Office

Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings, 2001

Building Research Establishment (BRE) (published by CRC Ltd)

Conventions for the calculation of U-values: expected publication date early 2002

U-value calculation procedure for light steel frame walls: expected publication date early 2002

IP 17/01 Assessing the effects of thermal bridging at junctions and around openings Building Research Energy Conservation Support Unit (BRECSU)

SAP: The Government's Standard Assessment Procedure for Energy Rating of Dwellings

GPG 302, 2001: Controls for domestic central heating and hot water systems

GIL 20, 1995: Low energy domestic lighting
33 GIL 59, 2000: Central heating specifications (CHeSS)

GPG 155: Energy efficient refurbishment of existing housing

Chartered Institution of Building Services Engineers (CIBSE)

Guide A: Environmental design, Section A3: Thermal properties of building structures, 1999

TM 23:2000 Testing of building for air leakage

Waterheater Manufacturers Association (WMA)

Performance specification for thermal stores, 1999

Society for the Protection of Ancient Buildings (SPAB)

Information Sheet 4: The need for old buildings to breathe, 1986.

GUERNSEY TECHNICAL STANDARDS

The following documents have been approved and issued Development and Planning Authority for the purpose of providing practical guidance with respect to the requirements of the Building Regulations

Guernsey Technical Standard A: Structure, 2012 edition with May 2016 amendments.

Guernsey Technical Standard B: Fire Safety - Volume 1 - Dwellinghouses, 2012 edition with May 2016 amendments.

Guernsey Technical Standard B: Fire Safety - Volume 2 - Buildings other than dwellinghouses, 2012 edition with May 2016 amendments.

Guernsey Technical Standard C: Site preparation and resistance to contaminants and moisture 2012 edition with May 2016 amendments.

Guernsey Technical Standard D: Toxic substances 2012 edition with May 2016 amendments.

Guernsey Technical Standard E: Resistance to the passage of sound, 2012 edition with May 2016 amendments.

Guernsey Technical Standard F: Ventilation, 2012 edition with May 2016 amendments.

Guernsey Technical Standard G: Health, hygiene and water efficiency, 2012 edition with May 2016 amendments.

Guernsey Technical Standard H: Drainage and waste disposal, 2012 edition with May 2016 amendments.

Guernsey Technical Standard J: Heat producing appliances and fuel storage systems, 2012 edition with May 2016 amendments.

Guernsey Technical Standard K: Safe means of access and egress, 2012 edition with May 2016 amendments.

Guernsey Technical Standard L1: Conservation of fuel and power – Dwellings, 2012 edition with May 2016 amendments.

Guernsey Technical Standard L2: Conservation of fuel and power – Buildings other than dwellings, 2012 edition with May 2016 amendments.

Guernsey Technical Standard M: Access to and use of buildings, 2012 edition with May 2016 amendments.

Guernsey Technical Standard N: Glazing - Materials and protection, 2012 edition with May 2016 amendments.

Guernsey Technical Standard P: Roads - Layout design and construction, 2012 edition with May 2016 amendments.

Guernsey Technical Standard Regulation 11: Materials and Workmanship, 2012 edition with May 2016 amendments.

This Document is available in PDF format for downloading on the States of Guernsey website www.gov.gg

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