Contents

6.0 Introduction

Introduction

6.0

6.0.1 Background

Over the years changes have been made to the Scottish building regulation requirements for energy conservation. A brief history of the drivers for these changes is as follows:

- in the 1960s health was the main focus and minimising the occurrence of damp and mould in *housing* and other *residential buildings*;
- in the 1970s tackling the fuel crises was the main issue and the scope of the regulations was extended to cover all heated *buildings*;
- in the 1980s to early 1990s cost effectiveness identified a need for heating controls and these were introduced for non-domestic *buildings*;
- from the late 1990s to the present, ‘greenhouse gas emissions' in particular carbon dioxide and ‘global warming’ have been the drivers for regular changes;
- in this century the European Union has influenced the way that energy standards of the Member States are set through the Directive on the energy performance of *buildings* (EPBD).

The *construction* industry has a major role to play in the conservation of fuel and power and the consequential reduction of carbon emissions. Carbon dioxide emissions from the burning of fossil fuels are contributing to climate change and energy use in *buildings* is a significant source of emissions. Rising temperatures, an increased risk of flooding and sea level rise are some of the expected impacts of climate change on Scotland and the UK, but some of the worst impacts of climate change can be avoided if action is taken to reduce reliance on fossil fuels. Increased energy efficiency and promotion of renewable energy are an important element of Scotland’s strategy to tackle the threat of climate change.

6.0.2 Aims

The intention of section 6 is to ensure that effective measures for the conservation of fuel and power are incorporated in *dwellings* and *buildings* consisting of *dwellings*. In addition to energy conservation provisions for the *building* fabric and the *building* services it contains, a carbon dioxide emissions standard obliges a designer of new *dwellings* to consider *buildings* in an holistic way. In view of this, localised or building-integrated low and zero carbon technologies (LZCT) (e.g. photovoltaics, active solar water heating, combined heat and power and heat pumps) can be used as a contribution towards meeting this standard. Although the focus is primarily on lowering carbon dioxide emissions from *dwellings* in use, the measures within this section will also address fuel poverty issues to a certain degree.

The standards and guidance given in this section are intended to achieve an improvement of around 18-25% fewer emissions than the previous standards, however nothing here prevents a *domestic building* from being designed and *constructed* to be even more energy efficient and make greater use of LZCT. Where this occurs, both the monetary and environmental savings will be improved.

This section should be read in conjunction with all the guidance to the Building (Scotland) Regulations 2004 but in particular section 3: Environment has a close affiliation with energy efficiency, regarding:

- heating of *dwellings;*
- ventilation of *domestic buildings;*
- condensation;
- natural lighting;

- combustion air and cooling air for combustion appliances;
- drying facilities;
- storage of woody biomass.

6.0.3 General guidance

This section covers the energy guidance for *domestic buildings*, namely *houses, flats* and *maisonettes*. When determining how the Technical Handbook guidance for energy efficiency applies to *domestic buildings*, recognition should be given to the following:

a. this guidance applies irrespective of the lifespan or relocatability of the *dwelling* or block of *dwellings*;
b. all parts of a *dwelling* should be within an *insulation envelope*;
c. design of ancillary and subsidiary accommodation to *dwellings* (some of which could be *stand-alone buildings*) that are to be heated (disregarding heating rated at a maximum of 25 W/m^2 floor area, installed solely for the purpose of frost protection);
d. *stand-alone buildings* that are heated (see paragraph below);
e. *work* on existing *buildings* (see paragraph below).

Heated *stand-alone buildings*

The EU Directive on the energy performance of *buildings* 2002/91/EC has introduced the category of ' *stand-alone building'* and within Appendix A of the Technical Handbooks a definition has been provided. The Directive exempts such *buildings* that are less than 50 m^2 in floor area from both the need to use a methodology for compliance with energy standards and also, the need to have an energy performance certificate, standards 6.1 and 6.9, respectively. The defined term not only includes detached *buildings* , but also enables thermally divided parts of a *building* with separate heating shut-down control, to be included. For *stand-alone buildings* that are less than 50 m^2 in floor area, compliance with standards 6.2 to 6.8 and 6.10 must still be met. The guidance to standard 6.2 recommends that the *insulation envelope* achieves the level of performance applicable to an extension. There are no exemptions for those which are 50 m^2 or greater.

Examples

Common examples of *stand-alone domestic buildings* that could be less than 50 m^2 and which would therefore be eligible for exemption are: a heated stair enclosure which is associated with a block of *flats;* a heated summerhouse ancillary to a *dwelling* ; and a *conservatory* (attached to either a new or an existing *dwelling*).

Work on existing buildings

In general, as for the other standards within Scottish building regulations, the energy standards apply to *conversions* and also *work* on existing *buildings*, such as; extensions, *conservatories*, alterations and replacements. For certain situations however, it is either inappropriate that they apply, or the guidance to the standards is different and this is usually to meet the constraints of the existing *building*. It is advisable in the first instance to check the functional standard as sometimes a limitation removes certain classes of this type of *work*. A standard that does apply, will apply in full to the new *work* on the existing *building*, the exception to this could be where the standards are brought into effect by *conversion* and this is identified in the introduction to the guidance supporting each standard. Where the guidance that supports a functional standard varies from that for new *buildings,* this is identified towards the end of the guidance for each standard.

6.0.4 U-values

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

Measurements of *U-values* should be made in accordance with BS EN ISO: 8990:1996. In calculation thermal bridging may be disregarded where the difference in thermal resistance between bridging and bridged material is less than 0.1 m^2K/W. Normal mortar joints need not be taken into account in calculations for brickwork, but should be taken into account for lightweight insulating blockwork, for example.

www.bre.co.uk

Taking into account guidance from BRE publication BR 443 (2006 Edition) 'Conventions for U-value calculations', individual *U-values* of *building* elements forming the *insulation envelope* should be established:

a. by using insulation to a thickness derived from manufacturers' data relating to thermal conductivities (W/m·K) and thermal transmittances (*U-values*: W/m^2K) certified by a *notified body*;

www.sbsa.gov.uk

b. by using insulation to a thickness derived from the tables in Part A of the SBSA Technical Guide: 'U-values';
c. by calculation taking into account thermal bridging effects of, e.g. timber joists, structural and other framing and normal bedding mortar, by using the Combined Method set out in BS EN ISO 6946:1997 or CIBSE Guide Section A3, 2006 Edition (for worked examples see Part B of the SBSA Technical Guide: 'U-values');
d. for floors adjacent to the ground and basements, by using the method outlined in Part C of the SBSA Technical Guide: 'U-values' and set out fully in BS EN ISO 13370: 1998 or CIBSE Guide Section A3, 2006 Edition;
e. for windows, doors and rooflights, by using BS EN ISO 10077-1: 2000 or BS EN ISO 10077-2: 2003, for rooflights BS EN ISO 12567-2:2005, or the tables in Part A of the SBSA Technical Guide: 'U-values'.

6.0.5 Thermal conductivity

The thermal conductivity (the λ-value) of a material is a measure of the rate at which that material will transmit heat and is expressed in units of Watts per metre per degree of temperature difference (W/m.K). Establishing the thermal conductivity of materials in a *building* element forming part of the *insulation envelope* will enable the thermal transmittance of the element to be calculated.

www.bsi-global.com

Measurements of thermal conductivity should be made in accordance with BS EN 12664: 2001, BS EN 12667: 2001 or BS 12939: 2001. SBSA Technical Guide: 'U-values' gives the thermal conductivity of some common *construction* materials, but where available, preference should be given to values that are certified by a notified body. The additional guidance given in BRE publication BR 443 should also be followed.

6.0.6 Insulation envelope where u-value should be ignored

Thermal transmittance through *separating walls* or *separating floors* between 2 *dwellings* or between a *dwelling* and other heated parts of the same *building* (e.g. between a *flat* and a *protected zone* with space heating) should be ignored. The accommodation on both sides of the separating element is expected to be at a similar temperature when the *dwellings* or *building* are occupied.

6.0.7 Buffering effects on the insulation envelope

If a *dwelling* or part of a *building* consisting of *dwellings* is separated from an unheated enclosed area, (e.g. solid waste storage accommodation, a *porch*, garage, *protected zone* or underground car park) the *U-values* of the walls/floors (including doors and translucent *glazing*) may be calculated by:

a. disregarding the buffering effects and treating the element as if it is directly exposed to the outside;
b. using the formulae in clause 3.3 of SAP 2005;
c. following the procedure in BS EN ISO 6946: 1997; or
d. following the procedure in BS EN ISO 13789: 1999.

www.bre.co.uk/sap

6.0.8 Roofs that perform the function of a floor

A roof of a *dwelling* or *building* consisting of *dwellings* that also performs the function of a floor or similar loadbearing surface (e.g. an *access deck*, *escape route*, roof garden or car park), should be considered as a roof.

6.0.9 Conservatories and atria

A *conservatory* allows natural light and natural ventilation to be 'borrowed' through *glazing* and *ventilators* into adjacent *rooms* of a *dwelling*. In view of this, a large area of translucent material is required in the *conservatory* fabric to ensure that such *rooms* are not adversely affected. It is important to read the definition of *conservatory* given in the Technical Handbooks in conjunction with the SAP 2005 document. Further guidance is given on how the standards apply to *conservatories* in clauses 6.1.7, 6.2.12, and 6.3.13.

In a *dwelling* with an atrium, it should be assumed that the atrium is to gain heat transfer from the surrounding *building*. The continuity of the *insulation envelope* occurs at the roof level (usually predominantly *glazed* with translucent material) and the atrium is considered to be a heated part of the *dwelling*.

6.0.10 Annexes to guidance

At the back of this section are annexes. These give guidance in respect of calculation procedures, and energy certificates.

6.0.11 Calculation of areas

When calculating areas for the purposes of this section and in addition to regulation 7, schedule 4, the following should be observed:

a. all areas should be measured in m^2, unless stated otherwise in this guidance;
b. the area of a floor, wall or roof is to be measured between finished internal faces of the *insulation envelope*, including any projecting bays and in the case of a roof, in the plane of the insulation;
c. floor areas are to include stairwells within the *insulation envelope* and also non-useable space (for example service *ducts*);
d. the area of an opening (e.g. window or door) should be measured internally from ingo to ingo and from head to sill or threshold.

6.0.12 Latest changes

There were no major changes made to this section between 1 May 2007 and 30 April 2008 but a few minor corrections have been made. A summary of these corrections can be found on the 2008 Technical Handbooks website page.

6.0.13 Relevant legislation

EU Directive 2006/32/EC

Reference should be made to UK legal requirements enforcing article 13 of the Energy End-Use Efficiency and Energy Services Directive 2006/32/EC. When *building work* is carried to an existing *building* with a floor area of more than 1000 m^2 or a new *building* is *constructed*, the energy supply companies providing services to such *buildings* should be notified.

6.1 Carbon dioxide emissions

contents

standard

6.1

mandatory

Every *building* must be designed and constructed in such a way that:

(a) the energy performance is calculated in accordance with a methodology which is asset based, conforms with the European Directive on the Energy Performance of Buildings 2002/91/EC and uses UK climate data; and

(b) the energy performance of the *building* is capable of reducing carbon dioxide emissions.

Limitation:

This standard does not apply to:

(a) alterations and extensions to buildings;

(b) conversions of buildings;

(c) non-domestic buildings and buildings that are ancillary to a *dwelling* that are *stand-alone* having an area less than 50 square metres;

(d) buildings, which will not be heated or cooled other than by heating provided solely for the purpose of frost protection; or

(e) limited life buildings which have an intended life of less than 2 years.

6.1.0 Introduction

Standard 6.1 focuses on the reduction of carbon dioxide emissions arising from the use of heating, hot water, and lighting in a new *dwelling.* The guidance sets an overall level for maximum carbon dioxide emissions in buildings by use of a methodology which incorporates a range of parameters which will influence energy use. This means that for new dwellings a designer is obliged to consider energy as a complete package rather than looking only at individual elements such as insulation or boiler efficiency. In other words standard 6.1 involves a 'whole *dwelling* approach' to energy. Such an approach offers a good degree of design flexibility and favours the use of localised or building-integrated low and zero carbon technologies (LZCT).

For the majority of new buildings, standard 6.1 has the greatest influence on design for energy performance, standards 6.2 to 6.10 in the main recommend only base minimum levels or back-stops to be achieved for the individual elements. To reach compliance with standard 6.1, it is usual to go beyond these back-stop levels by incorporating additional energy efficiency measures.

Conversions

In the case of conversions, as specified in Regulation 4, this standard does not apply.

6.1.1 Dwellings

Objective

The calculated carbon dioxide emissions (measured in kilograms per square metre of floor area per annum) for the proposed *dwelling* should be less than or equal to the target carbon dioxide emissions for a 'notional *dwelling*'.

Summary of procedure

In order to establish the target carbon dioxide emissions rate (TER) for the 'notional *dwelling'* (i.e. a *dwelling* of the same size, shape and 'living area fraction' as the proposed), the dimensions and 'living area fraction' of the proposed *dwelling* and a set of standard values are inputted into the methodology. To calculate the emissions for the proposed *dwelling* (DER) a second calculation is carried out where the proposed values are inputted into the methodology. An alternative way of meeting standard 6.1 which avoids the use of the calculation methodology is to design to the set of values used for the 'notional *dwelling*'. This elemental type approach is described in clause 6.1.6.

www.bre.co.uk/sap

The Government's Standard Assessment Procedure for Energy Rating of Dwellings (SAP 2005) is a calculation tool which may be used with the methodology which conforms with the European Directive 2002/91/EC and is recommended to calculate the energy performance and the carbon dioxide emissions of an individual *dwelling*. At all stages the conventions in the SAP document should be read in conjunction with the specific guidance given in the clauses to this section.

Non-domestic use within dwellings

Some new dwellings may incorporate surgeries, consulting rooms, offices or other accommodation of a floor area not exceeding in the aggregate 50 m^2, used by an occupant of the *dwelling* in a professional or business capacity. Where this occurs, the accommodation should be considered as a part of the *dwelling*.

6.1.2 Setting the target carbon dioxide emissions level

To set the target carbon dioxide emissions level, (i.e. the level that should not be exceeded, the TER), refer to the table to this clause. The package of measures for the fuel type which is to be used for the main space heating of the proposed *dwelling* is selected. This package of measures is used in the methodology and no improvement factors are applied. In addition this 'notional *dwelling'* is to have the same size, shape (including floor, roof, exposed wall areas and *storey* heights) and 'living area fraction' as the proposed *dwelling*. These terms are explained in SAP 2005.

www.bre.co.uk

Software vendors providing BRE approved SAP 2005 software will incorporate a function that with 'Scotland' selected automatically generates the target CO_2 emissions level when the fuel type is selected and the 'notional *dwelling*' dimensions and 'living area fraction' have been inputted into the programme.

Measures to calculate target carbon dioxide emissions for the 'notional dwelling'

	Main space heating system fuel					
Element or system	**Gas (Package 1)**	**LPG (Package 2)**	**Oil (Package 3)**	**Electricity (Package 4)**	**Biomass [1] (Package 5)**	**Solid fuel (Package 6)**
Walls	U = 0.25	U = 0.25	U = 0.25	U = 0.25	U = 0.25	U = 0.20
Floors	U = 0.22	U = 0.22	U = 0.20	U = 0.22	U = 0.22	U = 0.20
Roofs	U = 0.16	U = 0.16	U = 0.16	U = 0.16	U = 0.16	U = 0.16
Openings [2]	U = 1.8	U = 1.8	U = 1.7	U = 1.8	U = 1.8	U = 1.5
Allowance for thermal bridging	0.08 x total exposed surface area [3]	0.08 x total exposed surface area [3]	0.08 x total exposed surface area [3]	0.08 x total exposed surface area [3]	0.08 x total exposed surface area [3]	0.06 x total exposed surface area
Open flues	None	One	One	None	One	One
Heating system (pump in heated space)	Gas boiler roomsealed fan flued 90% efficiency	LPG boiler roomsealed fan flued 90% efficiency	Oil boiler roomsealed fan flued 93% efficiency	Air to water heat pump	Wood pellet boiler HETAS approved	Anthracite boiler autofeed in heated space HETAS approved
Heating system controls	Programmer +room thermostat +TRVs +Boiler interlock	Programmer +room thermostat +TRVs +Boiler interlock	Programmer +room thermostat +TRVs +Boiler interlock +weather compensation	Programmer +room thermostat	Programmer +room thermostat +TRVs	Programmer +room thermostat +TRVs
Hot water (HW) system (not applicable if combi-boiler)	Stored HW (from boiler) separate time control for space and water heating	Stored HW (from boiler) separate time control for space and water heating	Stored HW (from boiler) separate time control for space and water heating	Stored HW by electric immersion	Stored HW (from boiler) separate time control for space and water heating	Stored HW by dual electric immersion and solar
Secondary space heating	10% electric	10% closed wood log-burning room heater [4]	10% closed wood log-burning room heater [4]	10% electric	10% electric	10% electric
Solar panel evacuated tube - collector efficiency n=0.6, a1=3	none	none	none	none	none	4 m^2 panel between SE and SW, not more than 45º pitch, no overshading

For the 'notional dwelling' in addition all of the following applies in every fuel type:

Windows, doors, and rooflights	area 25% of total floor area [5]
Orientation	all *glazing* orientated east/west
Shading	average overshading
Number of sheltered sides	2
Chimneys	none
Ventilation system	natural ventilation with intermittent extract fans, 4 for dwellings with floor area more than 80 m^2 3 for smaller dwellings
Air permeability	10 m^3/m^2 h at 50 Pa
Hot water cylinder (not applicable if combi boiler) (for solar water heating a combined cylinder with solar store 75 litre, no solar powered pump)	150 litre cylinder insulated with 50 mm of factory applied foam (cylinder in heated space) cylinder temperature controlled by thermostat
Primary water heating losses (not applicable to combi-boiler or immersion)	primary pipework insulated
Low energy light fittings	50% of fixed outlets

Notes:

1. The biomass column should be used not only where biomass fuel is to be used but also for biogas, large scale waste combustion from boilers and waste heat from power stations. It does not however include dual or multi-fuel which should be taken under the 'solid fuel' column.
2. U is the average *U-value* of all openings (windows, doors, rooflights) based on one opaque door 1.85 m^2 of U=1.8, any other doors fully glazed. For windows, doors etc a frame factor of 0.7, light transmittance 0.80 and solar energy transmittance 0.72 for U greater than or equal to 1.7, 0.63 for U less than 1.7 are assumed.
3. Construction using 'Accredited Construction Details (Scotland)' is considered to correspond to the default figure of 0.08 for thermal bridging (refer clause 6.2.3).
4. Under secondary heating the closed wood log-burning room heater is capable of burning wood only, not multi-fuel.
5. If total exposed façade area is less than 25% of the floor area, the area of windows, doors and roofs should be taken as the area of the total exposed façade area.

6.1.3 Calculating carbon dioxide emissions for the proposed dwelling

The second calculation involves establishing the carbon dioxide emissions for the proposed *dwelling* (DER). To do this the values proposed for the *dwelling* should be used in the methodology i.e. the U-values, air permeability, heating system, etc.

The exceptions to inputting the *dwelling* specific values are:

a. it may be assumed that all *glazing* is orientated east/west;
b. average overshading may be assumed if not known. 'Very little' shading should not be inputted;
c. 2 sheltered sides should be assumed if not known. More than 2 sheltered sides should not be inputted;
d. 50% low energy light fittings should be inserted (even if more than 50% low energy fittings are proposed);
e. if secondary heating is not proposed, 10% electric heating should always be assumed. However if a *chimney* or *flue* is present but no appliance installed the worst case should be assumed i.e. a *decorative fuel-effect gas appliance* with 20% efficiency. If there is no gas point, an open fire with 37% efficiency should be assumed, burning solid mineral fuel for *dwellings* outwith a smokeless zone and smokeless solid mineral fuel for those that are within such a zone.

These values can be varied, but before inputting values into the methodology, the designer is advised to check:

- the back-stop U-values are met (see standard 6.2), and;
- the other guidance supporting standards 6.3 to 6.6.

6.1.4 Buildings with multiple dwellings

Where a *building* contains more than one *dwelling* (such as a block of flats or terrace of houses) the average carbon dioxide emissions for the proposed block or terrace (DER) may be compared to the average target CO_2 emissions (TER) for the ‘notional block or terrace'.

The average emissions for the block or terrace is the floor-area-weighted average for all the individual emissions i.e. {(emissions$_1$ x floor area$_1$)+(emissions$_2$ x floor area$_2$)+(emissions$_3$ x floor area$_3$)+…..)} ÷ {(floor area$_1$+ floor area$_2$ + floor area$_3$) + …..}

The degree of flexibility which is provided by averaging out *building* emissions should be used carefully. It is not intended that one or more dwellings are super-insulated (in a *building* consisting of dwellings) so that another may be constructed with a high percentage of *glazing*.

6.1.5 Common areas in buildings with multiple dwellings

Heated communal rooms or other areas in blocks of dwellings (which are exclusively associated with the dwellings) should be assessed using the guidance for non-domestic buildings. Another approach would be to ensure that the *glazing* does not exceed 25% of the total communal floor area of the *building*; and the *u–values*, thermal bridging, air infiltration values equal or better those given for the gas 'notional *dwelling*' (package 1 in the table to clause 6.1.2). Where the common area is less than 50 m^2 these rooms or areas may be treated as a *stand-alone building* and are not therefore subject to standard 6.1.

6.1.6 A simplified approach

Where a *dwelling* is designed to one of the packages of measures in the table to clause 6.1.2, it will reduce carbon dioxide emissions to the same level as by use of the methodology.

In using a package of measures east/west orientation, average overshading and 2 sheltered sides may be assumed for the proposed *dwelling*.

The simplified approach may still be used where there are minor deviations of input values that will clearly achieve the same or a better level of emissions.

For example:

- a boiler with a higher SEDBUK efficiency;
- a ground source heat pump instead of an air source heat pump;
- a secondary space heating system of equal or better performance (e.g. a room-sealed gas fire with fan assisted *flue* or a closed biomass room heater instead of electric);
- area of openings between 20% and 25% of total floor area (windows, doors, rooflights, and roof windows);
- air permeability lower than 10 m^3/m^2h at 50 Pa as established by air-tightness testing;
- a hot water cylinder with a declared heat loss figure (BS 1566 :1-2002) not exceeding 2.11 kWh/day.

This simplified approach should not be used where there is any deviation from values in the table which will result in higher CO_2 emissions. An example is if the *dwelling* has more than 4 extract fans or windows of a poorer *U-value*. Likewise, if some elements offer poorer performance and others offer higher performance, the simplified approach should not be used. This approach should also not be used where there is a likelihood of high internal temperature in hot weather or where air-conditioning is proposed. Reference should be made to the guidance to standard 6.6.

6.1.7 Conservatories and stand-alone buildings

Conservatories less than 50 m^2 in area are stand-alone buildings and therefore the *dwelling* should be assessed using the methodology as if there was no *conservatory* proposed. For conservatories and other ancillary stand-alone buildings of 50 m^2 or more the guidance and methodology for non-domestic buildings should be followed.

6.2 Building insulation envelope

standard

6.2

mandatory

Every *building* must be designed and constructed in such a way that an *insulation envelope* is provided which reduces heat loss.

Limitation:

This standard does not apply to:

(a) non-domestic buildings which will not be heated, other than heating provided solely for the purpose of frost protection;

(b) communal parts of domestic buildings which will not be heated, other than heating provided solely for the purposes of frost protection; or

(c) buildings which are ancillary to dwellings, other than conservatories, which are either unheated or provided with heating which is solely for the purpose of frost protection.

6.2.0 Introduction

The levels set out in the guidance to this standard are robust back-stops and these are necessary for the following reasons:

- to prevent inefficient use of some of the more mature low and zero carbon energy generating technologies (LZCT); and
- to ensure that a good level of fabric insulation is incorporated, especially to construction elements that would be difficult and costly to upgrade in the future.

Thermal bridging at the junctions of *building* elements and round openings in the *building* structure have now been quantified and embedded in SAP 2005. (see clause 6.1.1). The principal reason for this is that the heat loss through such junctions, if poorly designed and constructed can contribute as much as 10% to the overall heat loss through the *insulation envelope.*

As fabric insulation levels improve, the heat lost through air infiltration becomes proportionally greater. For example, in a typical 1960s *house* with non-draughtstripped windows 20% of the total heat could be lost through air infiltration and ventilation. If the same *house* was upgraded to 2002 levels of fabric insulation but no attempt made to upgrade the air infiltration measures then the ventilation heat losses could represent up to 40% of total heat losses. Limiting air infiltration whilst providing controlled ventilation are therefore important aspects of energy efficiency and good indoor air quality.

Conversions

In the case of conversions, as specified in regulation 4, the *building* as converted shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the conversion (regulation 12, schedule 6).

6.2.1 Maximum U-values

Area-weighted average U-values

Column (a) of the table below sets out robust backstop measures. In most cases standard 6.1 will effect even better levels of thermal insulation unless the design of a *dwelling* involves extensive use of building-integrated or localised low and zero carbon technologies (LZCT).

Individual element U-values

Localised areas of the same type of element may be designed to give poorer performance. These in turn will need to be compensated by the rest of the element being designed to a more demanding level. An example of this would be a meter box set into an *external wall*. These areas should not be any worse than the figures given in column (b) of the table below. This is particularly important with regard to condensation control matters (see section 3: Environment). N.B. 'Repeating' thermal bridges (e.g. timber studs in a timber frame wall) are already taken in account in a BS EN ISO 6946: 1997 *U-value* calculation and should not be considered as individual element U-values.

Common areas

For communal areas refer to clause 6.2.13.

Maximum U-values for building elements of the insulation envelope

Type of element	(a) Area-weighted average U-value (W/m^2K) for all elements of the same type	(b) Individual element U-value (W/m^2K)
Wall [1]	0.30	0.70
Floor [1]	0.25	0.70
Roof	0.20	0.35
Windows, doors, rooflights	2.2	3.3

Notes:

1. Excluding separating walls and separating floors where thermal transmittance should be ignored.

6.2.2 Areas of windows, doors, and rooflights

Due to the carbon dioxide emission standard 6.1, there is no guidance on minimum or maximum area for windows, doors, rooflights and roof windows in dwellings. The use of a methodology for establishing compliance with standard 6.1 addresses conflicting energy issues of heat loss, natural lighting, and artificial lighting. In certain cases where there is a desire to have a large proportion of glass it will be difficult to demonstrate compliance with standard 6.2. In such cases innovative solutions will need to be looked at. All relevant standards and guidance should be considered, including standard 6.6.

Common areas

For communal areas refer to clause 6.2.13.

6.2.3 Resisting heat loss through thermal bridging

The *insulation envelope* of the *dwelling* or *building* consisting of dwellings should be *constructed* in such a way that there are no substantial thermal bridges or gaps where the layers of insulation occur. Significant in-use energy consumption can occur, through incorrect detailing at both the design stage or poor construction work. The key areas of concern are:

- within *building* elements;
- at the junction between *building* elements;

- at the edges of *building* elements where openings in the structure are formed.

SAP 2005, referred to in the guidance to standard 6.1, takes account of thermal bridges, giving:

www.sbsa.gov.uk

- onerous default figures for 'no information';
- less onerous default figures for designs that follow 'Accredited Construction Details (Scotland)'; or
- accurate figures from 'numerical modelling'.

6.2.4 Limiting air infiltration

All *building* fabric will allow a certain degree of air leakage. It is widely recognised that it is impossible to make the *insulation envelope* 100% airtight. Where it is desirable to either vent or ventilate the *building* fabric to the outside air (to allow moisture due to either precipitation or condensation to escape), this should be designed into the construction. Reliance on fortuitous ventilation should be avoided. Measures should be introduced however, to reduce unwanted air leakage and thereby prevent an increase in energy use within the heated part of the *building.*

The guidance given here should not be used to compromise ventilation required for:

- health of the occupants of the *building* (section 3);
- any smoke control system (section 2);
- combustion appliances (section 3).

The main principle of limiting air infiltration is to provide a continuous barrier to air movement around the *insulation envelope* and thereby reduce external air paths into each of the following:

- the inside of the *dwelling* or *building* consisting of dwellings;
- the internal *building* elements;
- the 'warm' side of the insulation;
- spaces between the component parts of exposed *building* elements, where such parts contribute significantly to the thermal performance of the element.

www.sbsa.gov.uk

Correct *cavity barrier* design for the purposes of structural fire precautions, with airtight materials can often contribute to achieving this objective. One approach to addressing these issues would be to design and build to 'Accredited Construction Details (Scotland)'.

Common areas

In buildings consisting of dwellings, other areas that need consideration are common stair entrances and shafts which extend through most of the floors (e.g. lift and common stair enclosures).

Air-tightness

The move to methodology based energy standards for new buildings means that improving the air-tightness of a *building* can allow greater design flexibility using other traditional energy performance measures while meeting the carbon dioxide standard in 6.1.

6.2.5 Air-tightness testing

An air-tightness testing industry is not yet fully established. In order to allow testing procedures in Scotland to develop at a rate that is manageable to industry, the guidance below recommends that testing need only be carried out when better than routine air-tightness levels are declared at the *building* warrant application stage.

The following points will assist in establishing if air-tightness testing should be carried out:

www.sbsa.gov.uk

- if the *dwelling* is designed and built following the guidance in 'Accredited Construction Details (Scotland)' the input data to the methodology (see clause 6.1.3) should be taken as air permeability $10m^3/m^2h$ at 50 Pa and air-tightness testing is considered unnecessary;
- if the *dwelling* is not designed and built following the guidance in 'Accredited Construction Details (Scotland)' the input data to the methodology (see clause 6.1.3) should be taken as air permeability 15 m^3/m^2h at 50 Pa and air-tightness testing is considered unnecessary. However if the designer does not wish to default to a figure of 15 m^3/m^2h air-tightness testing can be used to justify the input data; or
- if the input data to the methodology (see clause 6.1.3) for the proposed *dwelling* is that the air permeability will be less than 10 m^3/m^2h at 50 Pa, air-tightness testing should be carried out to justify that this more demanding level is being achieved on *site*.

Frequency of testing dwellings

Where air-tightness testing is to be carried out, the verifier should select the dwelling(s) to be tested. The frequency of test on completion of *work*, should be 1 in 20 dwellings, however where there are less than 20 at least 1 *dwelling* should be tested.

6.2.6 Conversion of unheated buildings

A *building* that was originally designed to be unheated in most instances has the greatest void to fill in terms of energy efficiency. Heating such buildings will adversely affect energy efficiency and because of this, the most demanding of measures are recommended when conversion occurs. Where conversion of a unheated *building* (e.g. a barn) or part of a *dwelling* is to be carried out, the *building* should be treated as if it were an extension to the *insulation envelope* of a *domestic building* by following the guidance in clauses 6.2.9 and 6.2.10. This category also includes conversion of buildings with heating rated at a maximum of 25 W/m^2 floor area and installed solely for the purposes of frost protection.

Conversion of part of a *dwelling*

Examples of *work* which involve conversion of part of a *dwelling* are; changing a roof space, an unheated garage or a deep solum space into an *apartment*:

- in the case of a *roof space*, this will usually involve extending the *insulation envelope* to include, the gables, the collars, a part of the rafters and the oxters, as well as any new or existing dormer construction. The opportunity should be taken at this time to upgrade any remaining poorly performing parts of the roof which are immediately adjacent to the conversion, for example, insulation to parts of the ceiling ties at the eaves;
- in the case of an unheated garage, this will usually involve extending the *insulation envelope* to include, the existing floor, perimeter walls and the roof/ceiling to the new habitable part;
- in the case of a deep solum space, this will usually involve extending the *insulation envelope* to include, the solum/existing floor and perimeter walls to the new habitable part.

6.2.7 Conversion of heated buildings

In the case of a *building* that was previously designed to be heated, the impact on energy efficiency as a result of the conversion, may be either negligible, none whatsoever or in some circumstances even an improvement.

In view of this, a less demanding approach is recommended which at the same time still ensures that some overall improvements are being made to the existing *building* stock.

Where an extension or *conservatory* is formed and/or alterations are being made to the *building* fabric at the same time as the conversion, the guidance given in clauses 6.2.9 to 6.2.12 should also be followed.

U-values

Where conversion of a heated *building* is to be carried out, the *insulation envelope* should be examined and upgraded (if necessary) following the table below:

Maximum U-values for building elements of the insulation envelope

Type of element	**Area-weighted average U-value (W/m^{2}K) for all elements of the same type**
Wall [1][3]	0.70
Floor [1][3]	0.70
Roof [1]	0.35
New and replacement windows, doors, rooflights [2]	1.8

Notes:

1. Where upgrading work is necessary to achieve the recommended U-values, reference should be made to 'Reconstruction of elements' in clause 6.2.11 and more demanding U-values achieved, where *reasonably practicable.*
2. The total area of windows, doors and rooflights, should not exceed 25% of the floor area of the *dwelling* created by conversion.
3. Excluding separating walls and separating floors where thermal transmittance should be ignored

6.2.8 Conversion of historic buildings

With historic buildings, the energy efficiency improvement measures that should be invoked by conversion can be more complex. The number of these types of buildings in the country is finite. The majority of them have visual features that are not only worth preserving but the industry of today can have difficulty in replicating such construction.

No specific guidance is given here on this subject. Each case will have to be dealt with on its own merits. Any improvements to the fabric insulation of the *building* will often depend on whether or not the installation *work* can be carried out using a non-disruptive method. For example, insulating the ceiling of an accessible *roof space.* In certain cases, buildings are given historic status because of the features that exist on one particular façade and in these circumstances it may be possible to make some improvements to other less critical elevations or areas. In all cases the 'do nothing' approach should not be considered initially. Innovative but sympathetic and practical solutions on energy efficiency, which are beyond the scope of this guidance, can often result in an alternative package of measures being developed for a historic *building*. This could consist of reducing carbon dioxide emissions through improvements to the heating system (refer to standards 6.3, 6.4), the lighting system (refer to standard 6.5) or incorporation of LZCT (including biomass boilers and heat pumps). Consultation on such matters at an early stage with both the verifier and the development control officer of the relevant local authority is advisable.

6.2.9 Extensions to the insulation envelope

The majority of the *construction* for an extension will be new and seldom will there be the need to *construct* to a lesser specification as is sometimes the case for alteration *work*. For example to allow the transition occur proprietary metal 'wall starter' ties may be used where the existing brickwork stops and new cavity blockwork begins. Other *building* standards should still be met with regard to the transitionary construction.

U-values

Where the *insulation envelope* of a *dwelling* or a *building* consisting of *dwellings* is extended the new *building* fabric should be designed in accordance with the table below:

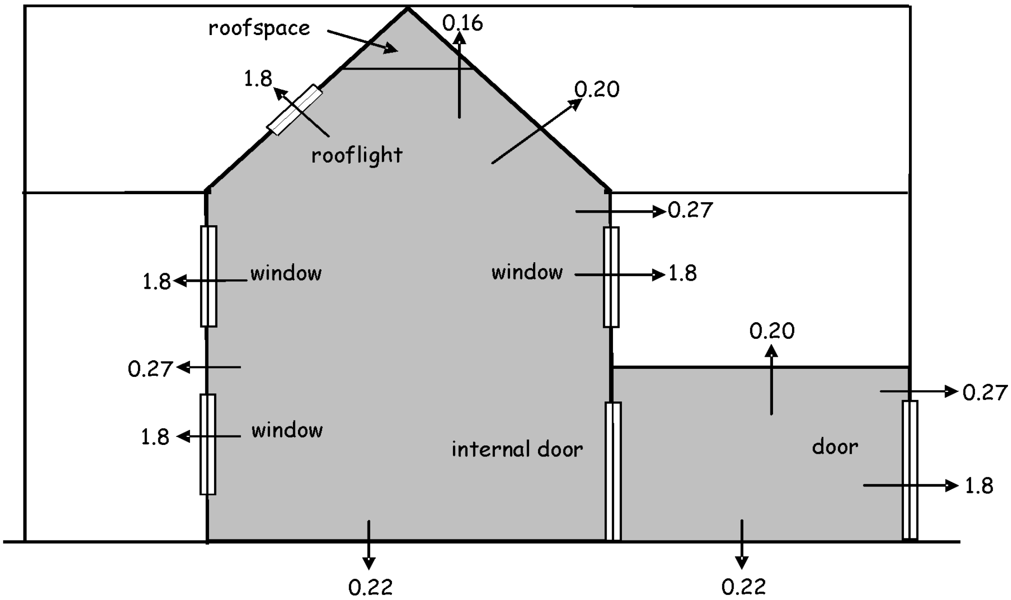
Maximum U-values for building elements of the insulation envelope

Type of element	(a)Area-weighted average U-value (W/m^2K) for all elements of the same type	(b) Individual element U-value (W/m^2K)
Wall	0.27 [2]	0.70
Floor	0.22 [2]	0.70
Pitched roof (insulation between ceiling ties or collars)	0.16	0.35
Flat roof or pitched roof (insulation between rafters or roof with integral insulation)	0.20	0.35
Windows, doors, rooflights	1.8 [1]	3.3

Notes:

1. Window energy rating band D is acceptable as an alternative to *U-value* 1.8. (www.bfrc.org)
2. Excluding separating walls and floors where thermal transmittance should be ignored

The U-values (area weighted average u-values) in the table to this clause are summarised in the diagram below. The extension is the shaded portion, the existing dwelling is in elevation behind.



Area of windows, doors, rooflights

Where the *insulation envelope* of a *domestic building* is extended the area of windows, doors, rooflights and roof windows should be limited to 25% of the floor area of the extension (the equivalent area of openings built over and removed as a result of the extension *work* can be incorporated in addition to this percentage). The 25% may be varied if the compensatory approach below is adopted.

Varying U-values - 'Compensatory approach'

The U-values for the elements involved in the *work* may be varied provided that the area-weighted overall *U-value* of all the elements in the extension is no greater than that of a 'notional' extension. The 'notional' extension should be the same size and shape as one designed to the elemental U-values in the table above with the area of windows, doors and rooflights taken as 25% of the total extension floor area (plus equivalent area of 'built over openings'). An example of this approach is given in annex 6B.

6.2.10 Thermal bridging and air infiltration for existing buildings

The elements involved/affected by the *work* should follow the guidance in clauses 6.2.3 and 6.2.4. In addition Building Research Establishment (BRE) Report 262 'Thermal insulation, avoiding risks' 2002 edition can be followed.

It should be noted that the methodology (SAP 2005 calculation tool) does not apply to this type of *work* and air-tightness testing is not necessary.

6.2.11 Alterations to the insulation envelope

For alterations it is more than likely that the existing construction will be from a different era, in *building* regulation terms. In many instances each *building* will need to be considered on its own merits. Some of the guidance given in this clause is written in specific terms, but in certain cases (e.g. historic buildings), it may be necessary to adopt alternative energy efficiency measures which relate to the amount of alteration work being undertaken.

Extending the *insulation envelope*

Alterations that involve increasing the floor area and/or bringing parts of the existing *building* that were previously outwith the *insulation envelope* into the heated part of the *dwelling* are considered as extensions and/or conversions (regulation 4, schedule 2).

Infill of small openings

The infill of an existing opening of approximately 4 m^2 or less in the *building* fabric should have a *U-value* which matches at least that of the remainder of the surrounding element. In the case of a wall or floor however, it should not be worse than 0.70 W/m^2K, and for a roof, not worse than 0.35 W/m^2K.

Infill of large openings

The infill of an existing opening of greater area (than approximately 4 m^2) in the *building* fabric should have a *U-value* which achieves those in column (a) of the table to clause 6.2.9. Another way would be to follow the guidance in the paragraph above, but compensate for the energy efficiency deficit by improving the overall *U-value* of other parts of the *insulation envelope.*

Insulation envelope formed from internal elements

Where the alteration causes an existing internal part or other element of a *building* to form the *insulation envelope*, that part of the *building* (including any infill construction) should have U-values which achieve those in column (a) of the table to clause 6.2.9. This will most likely occur where a part of a *building* is permanently removed as a phase of the alteration *work*. Another approach would be to follow the guidance given for 'infill of small openings' above, but compensate for the energy efficiency deficit by improving the overall *U-value* of other parts of the *insulation envelope*. Where this occurs at a *boundary*, no upgrading need be carried out if the element is a wall that is exclusively the property of the adjoining *building*.

Windows, doors, rooflights

Where windows, doors and rooflights are being created or replaced, they should achieve the *U-value* recommended in column (a) of the table to clause 6.2.9. A compensating approach may be used and an example of this is given in annex 6A. For secondary *glazing,* an existing window, after alteration should achieve a *U-value* of about 3.5 W/m^2K. Where the *work* relates only to 1 or 2 replacement windows or doors, to allow matching windows or doors be installed, the frame may be disregarded for assessment purposes, provided that the centre pane *U-value* for each glazed unit is 1.2 W/m^2K or less.

Area of windows, doors, rooflights

Where additional windows, doors and rooflights are being created, the overall total area (including existing) should not exceed 25% of the total *dwelling* floor area. In the case of a heated communal *room* or other area (exclusively associated with the dwellings), it should not exceed 25% of the total floor area of these rooms/areas.

Reconstruction of elements

Where the build-up of an element forming part of the *insulation envelope* is to be altered or dismantled and rebuilt, the opportunity should be taken to improve the level of thermal insulation. Column (a) of the table to clause 6.2.9 gives benchmark U-values and in many cases these can be achieved without technical risk, within the constraints of the existing construction. It is recognised however that certain constructions are easier to upgrade than others. A *building* that was in a ruinous state should, after renovation, be able to achieve almost the level expected of new construction. It may not however be *reasonably practicable* for a *dwelling*, which is in a habitable condition, to have its internal space significantly reduced in area or height in order to accommodate insulation; or for excessive enabling alterations to be caused by the fitting of external thermal insulation, unless the owner/*occupier* of the *dwelling* intends that these changes are to be made. Other *building* standards and the impact that they will have when upgrading thermal insulation should be taken into account. In the majority of cases however, after an alteration of this nature to the *insulation envelope*, a roof should be able to achieve at least an average *U-value* of 0.35 and in the case of a wall or floor, 0.70 W/m^{2}K.

www.est.org.uk/bestpractice

Further guidance on this subject can be found in the Energy Efficiency Best Practice in Housing publication, 'Effective use of insulation in dwellings' Ref CE23 – September 2003.

Thermal bridging and air infiltration

When alterations are carried out, attention should still be paid to limiting thermal bridging at junctions and around windows, doors and rooflights and limiting air infiltration (see clause 6.2.10). As far as alterations are concerned, only the *work* that forms the alteration and the impact of that *work* on the existing *building* need be considered.

6.2.12 Conservatories

U-values

Although *conservatories* are attached to *dwellings* they are *stand-alone buildings*. For the *glazing* to *conservatories* of less than 50 m^2 floor area, a maximum *U-value* of 2.2 is recommended and for those 20 m^2 or less a maximum *U-value* of 3.3. Non-*glazed* elements should follow the guidance in the table to clause 6.2.9. Some smaller *conservatories* can be exempt from both building warrant and the standards (see section 0). *Conservatories* of 50 m^2 or more are subject to standard 6.1.

Dividing elements

A *conservatory* should be thermally divided from the *insulation envelope* of the *dwelling*. The dividing elements (wall, door, window and on the rare occasion floor) should have *U–values* equal or better than the corresponding exposed elements in the rest of the *dwelling*.

Thermal bridging and air infiltration conservatories

In order to limit air infiltration and thermal bridging at junctions and around windows, doors and rooflights, the guidance in BR 262 may be followed. If using the SBSA Technical Handbook: 'Conservatories', these issues will be considered to have been taken into account. Draught stripping for windows and doors which are part of the thermal division between the *conservatory* and the *dwelling* should be of a similar standard as the exposed windows and doors elsewhere in the *dwelling.*

6.2.13 Stand-alone buildings

For *stand-alone buildings* of less than 50 m^2 the guidance in the table to clause 6.2.9 and guidance clause 6.2.10 should be followed. *U-value* recommendations should be met, but the percentage *glazing* is unrestricted. (Thermal division from the remainder of the *dwelling* is explained in the clause above). *Stand-alone buildings* of 50 m^2 or more are subject to standard 6.1.

Common areas

Where the area of a communal *room* or other heated accommodation associated with a block of dwellings is less than 50 m^2, these rooms or accommodation may be treated as a stand-alone building. Elements (including dividing elements) should have U-values equal to or better than those chosen for the rest of the *building,* as determined in conjunction with the methodology in standard 6.1. In these rooms or accommodation, the area of windows, doors, rooflights and roof windows should be limited to 25% of the total floor area of these parts.

6.3 Heating system

contents

standard

6.3

mandatory

Every *building* must be designed and constructed in such a way that the heating and hot water service systems installed are energy efficient and are capable of being controlled to achieve optimum energy efficiency.

Limitation:

This standard does not apply to:

(a) buildings which do not use fuel or power for controlling the temperature of the internal environment;

(b) heating provided solely for the purpose of frost protection; or

(c) individual solid-fuel or oil-firing stoves or open-fires, gas or electric fires or room heaters (excluding electric storage and panel heaters) provided as secondary heating in domestic buildings.

6.3.0 Introduction

In the design of domestic buildings, the energy efficiency of the heating plant is an important part of the package of measures which contributes to the overall *dwelling* carbon dioxide emissions. In practice the backstop levels given in this guidance for appliance efficiencies and controls will normally be exceeded to achieve compliance with standard 6.1 for new buildings.

This guidance refers to main heating systems for dwellings. Both the primary heating and secondary heating systems are taken account of in SAP 2005.

When the guidance in section 3 on heating requirements for dwellings is considered along with standard 6.1, central heating (rather than using several individual appliances as primary heating) will usually be the most practical way to satisfy the standards.

Conversions

In the case of conversions, as specified in regulation 4, the *building* as converted shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the conversion (regulation 12, schedule 6).

6.3.1 Gas and oil wet central heating efficiency

Boilers and appliances installed in a *dwelling* or *building* consisting of dwellings should have minimum appliance efficiencies as set out below:

Heating system	Efficiency
Gas and oil central heating boilers (natural gas or LPG)	SEDBUK [1] 86% i.e. condensing boiler
Gas or oil (twin burner) range cooker central heating boilers (www.rangeefficiency.org.uk)	SEDBUK [1] 75%
Gas fired fixed independent space heating appliances used as primary space heating	58% gross
Oil fired fixed independent space heating appliances used as primary space heating	60% gross

Notes:

1. Seasonal Efficiency of Domestic Boilers in the UK. (www.sedbuk.com www.boilers.org.uk)

Vented copper hot water storage vessels associated with the system should meet the heat loss and heat exchanger requirements in BS 1566: 2002.

6.3.2 Solid fuel wet central heating efficiency

www.hetas.co.uk

The appliance efficiency should be at least that required for its category as designated by the Heating Equipment Testing Approval Scheme (HETAS) as given in the table below:

Category	Appliance type	Efficiency (gross calorific value)
D	Open fires with high output boilers	63% (trapezium) 65% (rectangle)
F	Room heaters and stoves with boilers	67%
G	Cookers with boilers	50% (not more than 3.5 kW) 60% (3.5 -7.5 kW)
J	Independent boilers (including pellet and log boilers)	65% (batch fed) 70-75% (automatic anthracite)

Vented copper hot water storage vessels associated with the system should meet the heat loss and heat exchanger requirements in BS 1566-1: 2000 or BS 3198: 1981.

6.3.3 Electric wet central heating efficiency

Electric flow boilers should be constructed to meet the requirements of the Low Voltage Directive and Electromagnetic Compatibility Directive, preferably shown by a third party electrical approval e.g. British Electrotechnical Approvals Board (BEAB) or similar. Vented copper hot water storage vessels associated with the system should meet BS 1566: 2002 or BS 3198: 1981.

For the most efficient use of electrical supplies it is recommended that an electric flow boiler is used to provide space heating alone, with the bulk of the hot water demand of the *dwelling* being supplied by a directly heated water heater utilising 'off-peak' electricity tariffs.

6.3.4 Heat pump systems efficiency (warm and hot water)

All heat pumps are at their most efficient when the source temperature is as high as possible, the heat distribution temperature is as low as possible and pressure losses are kept to a minimum. If radiators are used they should be high efficiency radiators with high water volume. Supply water temperatures should be in the range 40° C to 55° C to radiators, 30° C to 40° C to an underfloor heating system and 35° C to 45° C to fan coil units.

Electrically driven heat pumps should have a coefficient of performance of not less than 2.0 when operating at the heating system design condition. Reference can be made to the DEFRA/Carbon Trust Energy Technology List. The water distribution system should be arranged for reverse return operation.

6.3.5 Dry central heating systems efficiency

Gas fired warm air systems

For a new gas-fired warm air system, the appliance should meet the recommendations of BS EN 778: 1998 or BS EN 1319: 1999, depending on the design of the appliance. The system should be installed in accordance with the recommendations in BS 5864: 2004. Where a gas-fired circulator is incorporated in the warm-air unit to provide domestic hot water, it should be of a type that is able to deliver full and part load efficiency at least equal to that recommended by BS EN 483: 2000.

Heat pump warm air systems

Refer to guidance in clause 6.3.4 on warm water systems. Minimum clearances adjacent to all airflow paths, as recommended by the manufacturer should be maintained. For ground to air and water to air systems constant water flow should be maintained through the heat pump.

6.3.6 Solar water heating efficiency

Solar water heating has low or zero carbon dioxide emissions and low or no associated running costs and is inherently energy efficient. Reference may be made to BS EN 12975 -1: 2006/2:2006 for information on collector performance for indirect systems. Location and orientation for optimum energy efficiency and to avoid overshading should be considered and SAP 2005 takes account of these issues in order to meet standard 6.1.

6.3.7 Micro combined heat and power efficiency

www.bre.co./sap 2005

Appendix N of SAP 2005 takes account of micro-CHP efficiency in order to meet standard 6.1.

6.3.8 Controls for wet space heating and hot water systems

Independent time and temperature control of heating and hot water circuits should be provided along with a boiler interlock (refer to table below) to ensure that the boiler and pump only operate when there is a demand for heat.

small dwellings
large dwellings

Zone controls are not considered necessary for single apartment dwellings. For large dwellings with a floor area over 150 m^2 independent time and temperature control of multiple space heating zones is recommended. Each zone (not exceeding 150 m^2) should have a room thermostat, and a single multi-channel programmer or multiple heating zone programmers. For hot water systems in large dwellings, more than one hot water circuit each with independent time and temperature control should be provided.

Hot water systems

A hot water system (other than for combi boilers with storage capacity 15 litres or less) should have controls that will switch off the heat when the water temperature required by the occupants has been achieved and during periods when there is no demand for hot water. For hot water central heating systems this thermostat should be interconnected with the other controls which are needed to form a boiler interlock.

Wet gas, oil, electric and solid fuel systems

The following tables summarise minimum recommendations for controls for space and hot water gas, oil, electric and solid fuel 'wet' central heating systems (radiators, convectors):

Controls for combis, CPSU boilers, electric boilers

Type of control	Means to achieve
Boiler control	Boiler interlock Automatic bypass valve [1][2]
Time control	Time switch (7 day for space heating) Full programmer for electric
Room temperature control	TRV's (all radiators except in rooms with room thermostats or where 'heat bleed' required), Room thermostat(s)

Notes:

1. As advised by boiler manufacturer in conjunction with any requirements for a minimum pipe length.
2. An electric flow boiler should be fitted with a flow temperature control and be capable of modulating the power input to the primary water depending on space heating conditions.

Controls for other boilers

Type of control	Means to achieve
Boiler control	Boiler interlock (for solid fuel as advised by manufacturer) Automatic bypass valve [1]
Time control	Full programmer (7 day for space and hot water) [2]
Room temperature control	as above table
Cylinder control	Cylinder thermostat plus 2 port valves or a 3 port valve [3] Separately controlled circuits to cylinder and radiators with pumped circulation
Pump control	Pump overrun timing device as required by manufacturer

Notes:

1. As note 1 to first table.
2. For solid fuel the level of sophistication of time controls should be selected to be compatible with the appliance. The highest levels should only be used for appliances with automatic ignition.
3. A zone valve is not recommended for a thermal store.

Boiler management systems

An alternative to the controls shown in the tables above would be a boiler management control system.

www.est.org.uk/bestpractice
www.bre.co.uk/sap 2005

Definitions and explanations of the various controls and heating types can be found in Good Practice Guide 302 (Energy Efficiency Best Practice in Housing) and in SAP 2005.

Solid fuel boilers

These should be thermostatically controlled to reduce the burning rate of the fuel, by varying the amount of combustion air to the fire. For safety reasons, a suitable heat bleed (slumber circuit) from the system should be formed, for example a gravity fed radiator without a TRV or a hot water cylinder that is connected independent of any controls. For hot water systems, unless the cylinder is forming the slumber circuit, a thermostatically controlled valve should be fitted, provided that the appliance manufacturer's requirements for dealing with excess heat created during a pump over-run are met.

Hot water systems

Gas or oil (twin burner) range cooker central heating boilers

An appliance with 2 independently controlled burners (one for cooking and one for the boiler) is recommended.

Gas and oil fired fixed independent space heating appliances

Each appliance should be capable of providing independent temperature control in areas with different heating needs. This could be independent or in conjunction with room thermostats or other appropriate temperature sensing devices.

Hot water underfloor heating

System temperature controls

The controls described below should be fitted to ensure safe system operating temperatures:

a. a separate flow temperature high limit thermostat should be used for warm water systems connected to any high water temperature heat supply; and
b. mixed systems containing both radiators and underfloor heating, connected to a common high water temperature supply operating at more than 60° C should be provided with a separate means of reducing the water temperature to the underfloor heating system.

Minimum recommendations for *room* temperature, time and boiler controls are:

Controls for underfloor heating

Type of control	Means to achieve
Room temperature control	Thermostats for each *room* (adjacent rooms with similar functions may share [1]) Weather compensating controller
Time control	Automatic setback of *room* temperature during unoccupied periods/at night time
Boiler control	Boiler interlock

Notes:

1. Bathrooms or en-suites which share a heating circuit with an adjacent bedroom provide heat only when the bedroom thermostat is activated. In such cases, the bathroom or ensuite areas should be fitted with an independent towel rail or radiator.

Heat pumps hot water systems

Unit controls

Heat pump unit controls should include:

a. control of water temperature for the distribution system;
b. control of water pumps (integral or otherwise);
c. defrost control of external airside heat exchanger (for air to water units);
d. control of outdoor fan operation (for air to water units);
e. protection for water flow failure;
f. protection for high water temperature;
g. protection for high refrigerant pressure; and
h. protection for external air flow failure (on air to water units).

External controls

Controls which are not integral to the unit should include:

- room thermostat to regulate the space temperature and interlocked with the heat pump unit operation; and
- timer to optimise operation of the heat pump.

6.3.9 Controls for dry space heating and hot water systems

Small dwellings

Large dwellings

Zone controls are not considered necessary for single *apartment* dwellings. For large dwellings with a floor area over 150 m^2, independent time and temperature control of multiple space heating zones is recommended. Each zone (not exceeding 150 m^2) should have a room thermostat, and a single multi-channel programmer or multiple heating zone programmers.

Electric storage heaters

Electric storage heater controls should include:

a. Charge control: there should be automatic control of input charge, able to detect the internal or external temperature and adjust the charging of the heater accordingly; and
b. Temperature control: heaters should have manual controls for adjusting the rate of heat release from the appliance. This may take the form of an adjustable damper or some other thermostatically controlled means.

Panel heaters

Time and temperature control should be provided using:

a. a programmable time switch and thermostat integral to the appliance; or
b. a separate time switch and separate room thermostats.

Electric warm air systems

Time and temperature control should be provided either integral to the heater or external, using either:

a. a time switch/programmer and room thermostat; or
b. a programmable room thermostat.

Gas fired warm air systems (without water heating)

Time and temperature control should be provided using:

a. controls outwith the heater: time switch/programmer and room thermostat, or programmable room thermostat; or
b. controls integrated with heater: time-switch/programmer and room temperature sensor linked to heater firing and fan speed control.

Electric underfloor heating

The guidance relating to hot water underfloor heating should be followed (disregarding the boiler interlock). For electric storage, direct acting systems and under-tile systems programmable room timer/thermostats with manual over-ride feature *room* controls are recommended for all heating zones, with air and floor (or floor void) temperature sensing capabilities to be used individually or combined. A storage system should have anticipatory controllers installed controlling low tariff input charge with external temperature sensing and floor temperature sensing. A manual override facility should be available for better user control. Controls for storage systems with room timer/thermostats should take advantage of low tariff electricity except where the system has anticipatory controllers controlling low tariff input charge with external temperature and floor temperature sensing.

Heat pumps warm air systems

In addition to the controls that are not integral to the unit for heat pump hot water systems (refer above clause) and the controls b-h for such systems, warm air system controls should include:

- control of *room* air temperature (integral or otherwise); and
- control for secondary heating (if fitted) (on air to air systems).

6.3.10 Controls for combined warm air and hot water systems

The first paragraph of the above clause provides guidance on zones for small and large dwellings. However the following controls should be provided in all cases:

a. independent time control of both the heating and hot water circuits (achieved by means of a cylinder thermostat and a timing device, wired such that when there is no demand for hot water both the pump and circulator are switched off);
b. pumped primary circulation to the hot water cylinder;
c. a hot water circulator interlock (achieved by means of a cylinder thermostat and a timing device, wired such that when there is no demand from the hot water both the pump and circulator are switched off); and
d. time control by the use of either:
   - a full programmer with separate timing to each circuit;
   - two or more separate timers providing timing control to each circuit;
   - a programmable room thermostat(s) to the heating circuit(s);or
   - a time switch/programmer (two channel) and room thermostat.

6.3.11 Controls for solar water heating

A means of control should be provided to:

a. optimise the useful energy gain from the solar collectors into the system's dedicated storage vessel(s);
b. minimise the accidental loss of stored energy by the solar hot water system, whether originating from solar collectors, cold intake or auxiliary heat sources;
c. ensure that hot water produced by auxiliary heat sources is not used when adequate grade solar pre-heated water is available;
d. provide a means of control consistent with the solar system being inherently secure against the adverse affects of excessive primary temperatures and pressures; and
e. the inlet temperature of any separate domestic hot water heating appliance where provided (such as a combi boiler) should be limited as necessary.

6.3.12 Work on existing buildings

The guidance in the above clauses also relates to:

Conversions, extensions and complete systems

- space heating/hot water system alterations or installations (including new or replacement appliances) for conversions and extensions to the *insulation envelope;* and
- where alterations are being made to an existing heating/hot water system or a new or replacement heating/hot water system is being installed in an existing *dwelling* (or *building* consisting of dwellings).

e.g. TRVs should be installed to all new radiators in an extension even when the heating is from an existing boiler.

Part systems

If a heating and/or hot water system is being replaced in part, the guidance in the above clauses should be followed but only as it affects the new or replaced components of the system. Such alterations should not allow the heating system as a whole to be downgraded in terms of energy efficiency or compromised from a safety point of view.

Condensing boilers

www.sbsa.gov.uk

There may be exceptional circumstances which make it impractical or uneconomic to install a condensing boiler as recommended in the guidance to clause 6.3.1. This can be shown by following the criteria set out in the 'Guide to Condensing boiler Installation Assessment Procedure for dwellings (Scotland)'. Where this occurs the minimum SEDBUK efficiencies are: mains natural gas 78%, LPG 80%, oil 85%, oil combi 82%. Alternatively a replacement back boiler with a SEDBUK of 3 percentage points less than the above recommended figures may be installed. In addition existing gas and oil systems with semi-gravity circulation should be converted to fully pumped systems.

Historic buildings

For historic buildings the guidance in the above clauses should be referred to taking into account circumstances. In many cases heating system improvements will be more feasible than any other energy efficiency measures such as improving wall insulation. Therefore systems which go beyond these minimum backstop levels may help offset the deficiency in other areas of energy efficiency and in carbon dioxide emissions terms.

6.3.13 Conservatories

As a *conservatory* which is heated will be inefficient in energy terms, the general guidance to occupiers is that they should be heated as little as possible. In view of the fact that heating is often desired particularly at the start and end of the heating season any *conservatory* with heating installed should have controls that regulate it from the rest of the *dwelling* e.g. a TRV to the radiator.

6.4 Insulation of pipes, ducts and vessels

contents

standard

6.4

mandatory

Every *building* must be designed and constructed in such a way that temperature loss from heated pipes, ducts and vessels, and temperature gain to cooled pipes and ducts, is resisted.

Limitation:
This standard does not apply to:
(a) buildings which do not use fuel or power for heating or cooling either the internal environment or water services;
(b) buildings, or parts of a *building,* which will not be heated, other than heating provided solely for the purpose of frost protection;
(c) pipes, ducts or vessels that form part of an isolated industrial or commercial process; or
(d) cooled pipes or ducts in domestic buildings.

6.4.0 Introduction

Thermal insulation to heating pipes and ducts and hot water storage vessels will improve energy efficiency by preventing:
- uncontrolled heat loss from such equipment;
- an uncontrolled rise in the temperature of the parts of the *building* where such equipment is situated.

Conversions

In the case of conversions, as specified in regulation 4, the *building* as converted shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the conversion (regulation 12, schedule 6).

6.4.1 Insulation of pipes and ducts

Warm air ducts and hot water pipes serving a space heating system should be thermally insulated against heat loss unless the use of such pipes or ducts always contribute to the heating demands of the *room* or space. In some cases this will not be necessary where pipe and *duct* runs occur just behind the internal wall or ceiling linings of the *insulation envelope.* This will not only address energy conservation issues but will also assist with frost protection. Further information on this subject is contained in BR 262.

www.bre.co.uk

Hot water pipes to appliances

Pipes that are used to supply hot water to appliances within a *domestic building* should be insulated against heat loss. This is to conserve heat in the hot water pipes between frequent successive draw-offs. All pipes of a solar water heating primary system should be insulated.

www.bsi-global.com

Insulation for such pipes and ducts may be provided by following the guidance for 'environmental thickness' given in BS 5422: 2001 'Methods for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range 40° C to +700° C'.

The *building* design should be considered at an early stage to ensure complete insulation of pipes and ducts, where such services pass through or around structural *building* components, floor joists, for example.

6.4.2 Insulation of vessels

A hot water storage vessel should be insulated against heat loss. This can be achieved by following the guidance given for 'environmental thickness' in BS 5422: 2001. The pipes that connect to the vessel, the vent pipe and primary flow and return, for example, should also be insulated to a distance of about 1 m back from their points of connection (in addition to the guidance above on pipe insulation).

Unvented hot water sytsems

Where an unvented hot water system is installed, additional insulation should be considered to reduce the heat loss that can occur from the safety fittings and pipework. Such insulation should not compromise the safe operation of the system, including the visibility of warning discharges.

6.4.3 Work on existing buildings

Where a new or replacement boiler or hot water storage vessel is installed, or where existing systems are extended, new or existing pipes that are accessible or exposed as part of the *work* should be insulated as for new systems. Replacement hot water storage vessels should be insulated as for a new vessel.

It is recognised that complete insulation will sometimes not be possible, where such services pass through or around structural *building* components, floor joists, for example.

6.5 Artificial and display lighting

contents

standard

6.5

mandatory

Every *building* must be designed and *constructed* in such a way that the artificial or display lighting installed is energy efficient and is capable of being controlled to achieve optimum energy efficiency.

Limitation:

This standard does not apply to:

(a) process and emergency lighting components in a *building*;

(b) communal areas of *domestic buildings*; or

(c) alterations in *dwellings*.

6.5.0 Introduction

Artificial lighting can account for a substantial proportion of the electricity used within a *building*. Appropriate lighting design (including use of natural daylight) can reduce carbon dioxide emissions and running costs, and can also reduce internal heat gains.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard (regulation 12, schedule 6).

6.5.1 Artificial lighting

A minimum of 50% of the fixed light fittings and lamps installed in a *dwelling* should be low energy type.

The fittings may be either:

- dedicated fittings which will have a separate control gear and will only take fluorescent lamps (pin based lamps); or
- fittings including lamps with integrated control gear (bayonet or Edison screw base lamps).

e.g. tubular fluorescent and compact fluorescent fittings (CFL's) with luminous efficacy at least 40 lumens/circuit watt.

In this guidance:

- a minimum of 50% of fixed light fittings means at least 1 in a *dwelling* which has 2 fittings, 2 where there are 3, 2 of 4, 3 of 5 etc;
- fixed light fittings include only the main light sources to a *room*; not display or feature lighting such as picture lights, *kitchen* wall cupboard lights, over mirror lights. A light fitting may contain one or more lamps and a group of lamps operated by the same switch could be counted as one fitting, e.g. a pair of wall lights;
- low energy light fittings include the provision of lamps/bulbs.

6.6 Mechanical ventilation and air conditioning

contents

standard

6.6

mandatory

Every *building* must be designed and *constructed* in such a way that:

(a) the form and fabric of the *building* minimises the use of mechanical ventilating or cooling systems for cooling purposes; and

(b) in non-domestic *buildings*, the ventilating and cooling systems installed are energy efficient and are capable of being controlled to achieve optimum energy efficiency.

Limitation:

This standard does not apply to *buildings* which do not use fuel or power for ventilating or cooling the internal environment.

6.6.0 Introduction

It is not desirable that *dwellings* or *buildings* consisting of *dwellings* have air-conditioning systems or use mechanical ventilation systems for cooling purposes, as this leads to increased energy use and higher carbon dioxide emissions. In view of this the guidance is intended to prevent the need for such systems in *dwellings* and no information is provided on the efficiency of these systems.

Standard 6.6(a) can be now applied to *domestic buildings* because the SAP 2005 document provides a method for estimating uncontrolled heat build up through solar gains which can lead to ‘high internal temperature in hot weather’.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirements of this standard in so far as is *reasonably practicable*, and in no case be worse than before the *conversion*(regulation 12, schedule 6).

6.6.1 Form and fabric of the building

Reducing overheating
CE 129 EST

In order to minimise any need for mechanical ventilation for cooling or air-conditioning due to high internal temperatures in hot weather the following issues should be considered with regard to the form and the fabric of the *dwelling*:

a. proportion of translucent *glazing* taking into account the need for daylighting and artificial lighting (section 3 and standard 6.5);
b. orientation of translucently *glazed* areas;
c. solar shading or other solar control measures where areas of the external *building* fabric are susceptible to solar gain;
d. natural ventilation (including night cooling);
e. thermal mass.

Poor cross ventilation or a lot of translucent *glazing*

Where a *dwelling* has little or no cross ventilation (e.g. *flats* with all external windows/rooflights on one southerly elevation which is orientated between due east and due west) or a high proportion of translucent *glazing*:

a. the *dwelling* should be designed to avoid high internal temperature (refer advice above);
b. then it should be shown by calculation that the 'likelihood of high internal temperature in hot weather' in the *dwelling* is 'not significant, slight or medium'. The recommended method to assess this is Appendix P to SAP 2005. The intention is to avoid the situation where a *dwelling occupier* installs mechanical cooling or air-conditioning at a later date.

www.bre.co.uk/sap 2005

Cooling system

Where a cooling system is proposed for a *dwelling*:

a. the *dwelling* should be designed to avoid any need for a cooling system (refer to advice above);
b. then the 'likelihood of high internal temperature in hot weather' should be assessed using Appendix P.

If the 'likelihood of high internal temperature' is 'not significant, slight or medium' an air-conditioning system should not be installed.

6.7 Commissioning building services

standard

6.7

mandatory

Every *building* must be designed and *constructed* in such a way that energy supply systems and *building* services which use fuel or power for heating, lighting, ventilating and cooling the internal environment and heating the water, are commissioned to achieve optimum energy efficiency.

Limitation:

This standard does not apply to:

(a) major power plants serving the National Grid;

(b) the process and emergency lighting components of a *building*;

(c) heating provided solely for the purpose of frost protection; or

(d) energy supply systems used solely for industrial and commercial processes, leisure use and emergency use within a *building*.

6.7.0 Introduction

Commissioning in terms of this section means, raising the *building* services systems (covered by this guidance) from a level of static completion to full working order and achieving the levels of energy efficiency that the component manufacturers expect from their product(s). Commissioning however, should also be carried out with a view to ensuring the safe operation of the system.

Although there is no requirement within section 6 for minimum efficiency levels of either, building-integrated or localised energy supply systems (e.g. diesel generators, micro wind turbines or photovoltaic arrays), there is a need for commissioning to be carried out to ensure efficient use, unless they are exempt under schedule 1, regulation 3. Major power plants which serve a number of *buildings* (e.g. *housing* estates) and only export surplus electricity to the National Grid will also need to be commissioned, unless exempt in terms of schedule 1, regulation 3.

Conversions

In the case of *conversions*, as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

6.7.1 Inspection and commissioning

A heating, hot water service, ventilating or cooling system and any decentralised equipment for power generation in a *dwelling* or other area of a *building* consisting of *dwellings* should be inspected and commissioned in accordance with manufacturers' instructions to ensure optimum energy efficiency.

6.8 Written information

contents

standard

6.8

mandatory

The *occupiers* of a *building* must be provided with written information by the owner:

(a) on the operation and maintenance of the *building* services and energy supply systems; and

(b) where any air-conditioning system in the *building* is subject to regulation 17, stating a time-based interval for inspection of the system.

Limitation:

This standard does not apply to:

(a) major power plants serving the National Grid;

(b) *buildings* which do not use fuel or power for heating, lighting, ventilating and cooling the internal environment and heating the water supply services;

(c) the process and emergency lighting components of a *building*;

(d) heating provided solely for the purpose of frost protection;

(e) lighting, ventilation and cooling systems in a *domestic building*; or

(f) energy supply systems used solely for industrial and commercial processes, leisure use and emergency use within a *building*.

6.8.0 Introduction

Correct use and maintenance of *building* services equipment is essential if the benefits of enhanced energy efficiency are to be realised from such equipment. The intention of this standard is to make the information that will help achieve this, available to the *occupier* of the *building.*

Although there is no requirement within section 6 for minimum efficiency levels of either, building-integrated or localised energy supply systems (e.g. diesel generators, micro wind turbines or photovoltaic arrays), there is a need for user and maintenance instructions to ensure efficient use, unless they are exempt under schedule 1, regulation 3. Major power plants which serve a number of *buildings* (e.g. *housing* estates) and only export surplus electricity to the National Grid will also need to have user and maintenance instructions, unless exempt in terms of schedule 1, regulation 3.

Conversions

In the case of *conversions,* as specified in regulation 4, the *building* as *converted* shall meet the requirement of this standard (regulation 12, schedule 6).

6.8.1 Written information

Written information should be made available for the use of the *occupier* on the operation and maintenance of the heating and hot water service system and any decentralized equipment for power generation to encourage optimum energy efficiency. If an air-conditioning system is installed in a *dwelling* the guidance to regulation 17 should be followed.

6.8.2 Work on existing buildings

Where alterations are carried out to *building* services on a piecemeal basis, the alterations may not result in optimum energy efficiency being attained for the whole system. In this case a list of recommendations which would improve the overall energy efficiency of the system should be provided.

6.9 Energy performance certificates

contents

standard

6.9

mandatory

Every *building* must be designed and constructed in such a way that:

(a) **an energy performance certificate for the *building* is affixed to the *building*, indicating the approximate annual carbon dioxide emissions and energy usage of the *building* based on a standardised use of the *building*;**

(b) **the energy performance for the certificate is calculated in accordance with a methodology which is asset-based, conforms with the European Directive 2002/91/EC and uses UK climate data; and**

(c) **the energy performance certificate is displayed in a prominent place within the *building*.**

Limitation:

(a) This standard does not apply to *buildings* which do not use fuel or power for controlling the temperature of the internal environment;

(b) this standard does not apply to non-domestic *buildings* and *buildings* that are ancillary to a dwelling that are stand-alone having an area less than 50 square metres;

(c) this standard does not apply to *conversions,* alterations and extensions to *buildings* other than alterations and extensions to *stand-alone buildings* having an area less than 50 square metres that would increase the area to 50 square metres or more, or alterations to *buildings* involving the fit-out of the shell which the subject of a continuing requirement;

(d) this standard does not apply to *limited life buildings* which have an intended life of less than 2 years;

(e) Standard 6.9(c) only applies to *buildings* with a floor area of more than 1000 square metres, which are occupied by public authorities and institutions providing public services, which can be visited by the public.

6.9.0 Introduction

Article 7 of EU Directive (2002/91/EC) on the energy performance of *buildings* requires energy performance certificates (EPCs) to be made available to prospective owners and tenants when *dwellings* are *constructed.* Standard 6.9 achieves this by making EPCs fixtures within *buildings.*

It is intended that Scottish Ministers will direct local authorities to apply standard 6.9 to all existing *buildings* using Section 25 (2) of the Building (Scotland) Act 2003. The direction will limit the description of dwelling to which it applies to those that are being sold or rented out. It is proposed that guidance leaflets will be produced explaining the action that building owners need to take in order to comply.

Conversions

In the case of *conversions,* as specified in regulation 4 standard 6.9 does not apply.

6.9.1 Calculating the carbon dioxide emissions for a certificate

The EU Directive allows energy performance to be reflected in one or more numeric indicators. For this to be done in a transparent manner that is meaningful in terms of Scottish building regulations, the measure to be used is carbon dioxide.

Simplified approach

The certification should be carried out using the Directive compliant methodology and the calculation tool which was used to assess compliance with standard 6.1. In most cases SAP 2005 will have been used for the new *dwelling.* However, if the simplified approach referred to in clause 6.1.6 has been adopted for the new *dwelling,* the construction specification is well enough defined to allow the certificate to be generated using the simplified approach embedded in SAP software.

Use of actual values

For the purpose of establishing a rating for the energy performance certificate for a new *dwelling* the values and specifications used to obtain a building warrant (as varied by any subsequent amendments to warrant) should be adopted. Where a *domestic building* contains multiple dwellings a rating is required for each individual *dwelling.* However for certification purposes the rating may be recalculated with the percentage of low energy lighting and the type of heating as installed. Note, there will be no need to assume 10% electric secondary heating if secondary heating is not present.

Non-domestic use within dwellings

Accommodation up to 50 m^2 used by an occupant of a *dwelling* in their professional or business capacity should be considered as a part of the *dwelling.*

6.9.2 Information to be provided for dwellings

The energy performance certificate should display the following information:

- the postal address of the *building* for which the certificate is issued;
- *building* type;
- the name of the SBSA protocol organisation issuing the certificate (if applicable) and may include the member's membership number;
- the date of the certificate;
- the conditioned floor area of the *dwelling*;
- the main type of heating and fuel;
- the calculation tool used for certification;
- a specific indication of current CO_2 emissions and an indication of potential emissions;
- a seven band scale in different colours representing the following bands of carbon dioxide emissions; A, B, C, D, E, F and G, where A = excellent and G = very poor;
- the approximate energy use expressed in kWh per m^2 of floor area per annum;
- a list of cost-effective improvements (lower cost measures); and
- a statement to the effect of 'N.B. THIS CERTIFICATE MUST BE AFFIXED TO THE BUILDING AND NOT BE REMOVED UNLESS IT IS REPLACED WITH AN UPDATED VERSION'.

www.sbsa.gov.uk

A model form for an energy performance certificate for a *dwelling* is given on the SBSA website.

Cost-effective improvements

There are only limited cost-effective, low-cost, energy efficiency improvements that can be made to a new *dwelling* (when no other *work* is proposed) such as upgrade insulation in an accessible roof space or fit low energy lamps throughout the *dwelling*. Measures presented on the certificate must meet Scottish building regulations, should be technically feasible and specific to the individual *dwelling.*

Additional advice

A piece of advice that is worthwhile including is that a *conservatory* (where one is installed) is only an energy efficiency benefit to the *dwelling* if it remains unheated and is not mechanically cooled. Certificates may give additional advice on projected energy costs and improvements that are cost-effective only when additional *work* is being carried out e.g. providing insulation when replacing *flat roof* coverings. Some experts providing certificates may wish to add extra value and give additional advice to their clients on improvements that are aspirational (e.g. photovoltaics). All of this is welcome, but in every case, such information should only be provided as an appendix to the certificate and be accompanied by advice on relevant warrants and building regulations.

6.9.3 Location of an energy performance certificate

The energy performance certificate should be indelibly marked and located in a position that is readily accessible, protected from weather and not easily obscured. A suitable location could be in a cupboard containing the gas or electricity meter or the water supply stopcock.

6.9.4 Conservatories and other stand-alone buildings

For conservatories and for other ancillary stand-alone buildings of less than 50 m^2 floor area, an energy performance certificate need not be provided. For those buildings of a floor area of 50 m^2 or more, the guidance in the non-domestic Technical Handbook should be followed and an additional certificate supplementing the one for the *dwelling* should be provided.

6.10 Metering

standard

6.10

mandatory

Every *building* must be designed and *constructed* in such a way that each part of a *building* designed for *different occupation* is fitted with fuel consumption meters.

Limitation:

This standard does not apply to:

(a) *domestic buildings;*

(b) communal areas of *buildings* in *different occupation* ;

(c) district or block heating systems where each part of the *building* designed for *different occupation* is fitted with heat meters ; or

(d) heating fired by solid fuel or biomass.

6.10.0 Introduction

This standard does not apply to *domestic buildings* as fuel providers e.g. gas companies, provide meters to *dwellings* to enable correct charging for fuel used by the customer.

Annex
6.A Compensating U-values for windows, doors and rooflights

contents

annex 6.A

6.A.0 Introduction

This annex gives guidance on how to calculate the average *U-values* for windows, doors, and rooflights and supports the guidance to standards 6.1 and 6.2. It may be used with the elemental methods provided and in particular:

- the simplified approach in the guidance to standard 6.1, where it is not possible to input the individual *U-values* for all the windows, doors and rooflights for the proposed new *dwelling* into the methodology (usually SAP 2005); and
- for *work* on existing *domestic buildings*, namely, *conversions*, extensions, replacements, alterations, and *conservatories* (clauses 6.2.6 to 6.2.12).

Individual windows, doors or rooflights may have *U-values* that exceed the *U-values* in these clauses provided that the average *U-value* for all the windows, doors and rooflights is no greater than the value in the relevant table or text.

The example that follows illustrates how this trade-off can be done.

6.A.1 Example of trade-off between windows, doors and rooflights

A semi-detached *house has* a total window area of 16.9 m^2 (including frames) and a total door area of 3.8 m^2. It is proposed to use 2 external quality timber finished 'fire' doors with a *U-value* of 2.0 W/m^2K. In order to follow the guidance to standards 6.1 and 6.2, the additional heat loss due to the use of the external doors should be compensated for by more demanding *U-values* in the windows and/or rooflights so that the average overall *U-value* of such elements does not exceed 1.8 W/m^2K.

Windows with a *U-value* of 1.7 W/m^2K can achieve this requirement, as shown in the following table and subsequent calculation:

Average U-value calculation

Element	**Area (m^2)**		**U-value (W/m^2K)**		**Rate of heat loss (W/K)**
Windows	16.9	x	1.7 [1]	=	28.73
Doors	3.8	x	2.0	=	7.60
Rooflights	0.9	x	1.9 [1]	=	1.71
Total	21.6				**38.04**

Notes:

1. These *U-values* correspond to double-glazed windows or rooflights with a wood or plastic frame, with a 16 mm argon-filled space between the panes and a soft low-emissivity coating on the glass. Note that although the windows and rooflights have the same design the rooflight *U-value* is 0.2 W/m^2K higher than the window *U-value.*

This gives an average *U-value* of 38.04÷21.6, or 1.76 W/m^2K. The windows, doors and rooflights can therefore be considered to follow the objectives of the requirement for the *insulation envelope*.

Annex
6.B Compensatory approach - heat loss example

contents

annex 6.B

6.B.0 Introduction

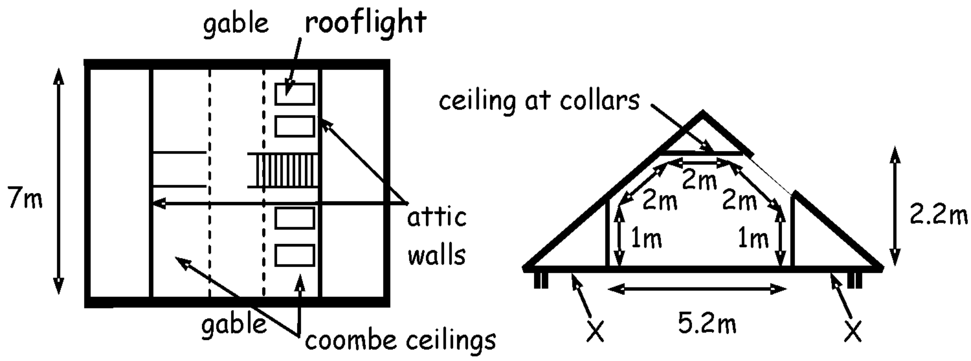
This annex gives an example of the compensatory approach for use in the design of *conversions,* extensions and alterations. This is likely to be of use where there is a need to specify one or more *constructions* with a *U-value* higher than the recommended maximum area-weighted average *U-values* given in column (a) of the table to clause 6.2.9. The example given in this instance is for an attic *conversion,* however the same principles apply to extensions and substantial alterations.

6.B.1 Alteration to create rooms in a roof space

First the internal exposed surface areas of all the elements with different area-weighted *U-values* are calculated. Then the heat loss for the proposed attic development is calculated. One or more *U-values* may be higher or lower than those recommended in column (a) of the table to clause 6.2.9 and the percentage windows/doors/rooflight area as proposed may be greater or less than 25%. After that the heat loss for a ‘notional attic’ development (i.e. an attic the same size and shape as the proposed and with its area of window/doors/rooflights taken as 25% of its floor area) is calculated using the *U-values* in the table to clause 6.2.9. Finally, the heat loss calculated for the proposed attic should be less than or equal to that for the 'notional' one.

Compensatory approach example

It is proposed to form 2 *rooms* in the *roof space* of an existing single *storey dwelling.* The extra floor area created (including opening for stairway) will be 36.4 m^2. A plan and section of the proposed layout is shown in the figure below. A key part of the design is to create as much headroom as possible below the new coombe ceilings. The existing rafters are only 150 mm deep therefore it is difficult to achieve the recommended elemental *U-value* of 0.20 (see column (a) in the table to clause 6.2.9), without using branders or having an excessive thickness of insulated ceiling lining. The principal compensatory measure will be to highly insulate the attic walls that occur directly below the lowest part of the coombes. The existing gables will be provided with insulated internal wall lining to improve the *U-value* where the *insulation envelope* now occurs. The four no. 1.5 m^2 rooflights installed have timber frames. The floor that will be formed at the line of the existing ceiling ties is wholly within the *insulation envelope* and is therefore disregarded for the purposes of this calculation.



Plan **Section**

6.B.2 Proposed attic

Then calculate the rate of heat loss from the proposed attic as follows:

Data for proposed attic alteration

Exposed element	**Exposed surface area (m^2)**		**U-value (W/m^2K)**		**Rate of heat loss (W/K)**
Gables	19.0	x	0.40	=	7.60
Attic walls	14.0	x	0.20	=	2.80
Ceiling at collars	14.0	x	0.16	=	2.24
Coombe ceiling	22.0	x	0.35	=	7.70
Rooflights	6.0 (16.5%)	x	1.8	=	10.8
Total rate of heat loss				=	**31.14**

6.B.3 'Notional attic'

Then calculate the rate of heat loss from the 'notional attic' as follows:

Data for 'notional' attic alteration

Exposed element	**Exposed surface area (m^2)**		**U-value (W/m^2K)**		**Rate of heat loss (W/K)**
Gables	19.0	x	0.27	=	5.13
Attic walls	14.0	x	0.27	=	3.78
Ceiling at collars	14.0	x	0.16	=	2.24
Coombe ceiling	18.9	x	0.20	=	3.78
Rooflights	9.1 (25%)	x	1.8	=	16.38
Total rate of heat loss				=	**31.31**

6.B.4 The comparison

The rate of heat loss from the proposed attic is less than that from the 'notional attic'.

6.B.5 Additional insulation work

The existing *dwelling* is of an age where there was no insulation provided in the *roof space* at the time of the original *construction*. Clause 6.2.11 advises that additional *work* should be carried out to upgrade the *U-values* of parts of the roof which are immediately adjacent to the alterations. In this example, there is no technical or other reason which prevents the level ceiling at the eaves of the roof (see X on the section) being upgraded to achieve a *U-value* of 0.16 as given in column (a) of the table to clause 6.2.9.