Scottish Government
Riaghaltas na h-Alba
gov.scot

Building Standards Domestic Technical Handbook (extract)

Consultation proposals – Section 6 'Energy'

July 2021

The Building Standards Technical Handbooks provide guidance on achieving the standards set in The Building (Scotland) Regulations 2004.

Further information on the Scottish building standards system can be found at: www.gov.scot/policies/building-standards/.

This document sets out proposed changes to the mandatory standards and supporting guidance issued in support of **section 6 'energy'** within the Building Standards **Domestic Technical Handbook**.

Where text is amended from the current, published 2015 edition of the handbook, this is shown by highlighting relevant passages in yellow.

The subject matter of these changes is set out in more detail within sections 2 & 3 of the consultation document 'Scottish Building Regulations – Proposed Changes to Energy Standards and associated topics', published online at: https://consult.gov.scot/local-government-and-communities/building-regulations-energy-standards-review/.

Contents

Section 6 – Energy (extract)

6.1 Limiting energy demand and associated greenhouse gas emissions

Mandatory Standard

Standard 6.1

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

a) the energy performance is calculated in accordance with a methodology of calculation approved under regulation 7(a) of the Energy Performance of Buildings (Scotland) Regulations 2008;

b) energy demand which is within the scope of the methodology is reduced to a defined level;

c) greenhouse gas emissions associated with the calculated energy demand are reduced to a defined level; and

d) it is a nearly zero-energy building.

Limitation:

This standard does not apply to:

e) alterations and extensions to buildings, other than:

i. 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

ii. extensions to non-domestic buildings where the extension will have an area which is both greater than 100 square metres and greater than 25% of the area of the existing building, and

iii. alterations to buildings involving the fit-out of the building shell which is the subject of a continuing requirement

f) conversions of buildings:

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

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

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

The defined level in standard 6.1c shall not apply where all heat and cooling within a building is supplied from zero direct emissions sources.

6.1.0 Introduction

Standard 6.1 focuses on the reduction of energy demand and associated greenhouse gas emissions arising from the use of heating, hot water, lighting, ventilation and cooling systems in a new dwelling.

The guidance which supports this standard sets a target for overall energy and emission performance in buildings by use of a calculation methodology which assesses performance at a building level, considering a wide range of parameters which influence energy use.

This means that, for new dwellings, a designer is obliged to consider energy performance as a complete package rather than looking only at individual elements such as insulation or heat generator efficiency - a 'whole dwelling approach' to energy, which offers a significant degree of design flexibility.

For the majority of new buildings, Standard 6.1 has the greatest influence on design for energy performance, setting two challenging performance targets for both energy and building emissions which must both be met.

Standards 6.2 to 6.6 recommend minimum performance levels to be achieved for individual elements or systems within a building. To achieve compliance with Standard 6.1, it will be necessary to improve upon some or all of these minimum levels or incorporate additional energy efficiency measures, such as generation of renewable heat or power to offset energy demand.

Nearly zero energy buildings

Initially introduced in response to a European Directive, "nearly zero-energy building" means a building that has a very high energy performance, as determined in accordance with the methodology cited in this standard, where the 'nearly zero' or very low amount of energy required by the building should be covered, to a very significant extent, by energy from renewable sources, produced on site or nearby.

Review of standards in 2021 is the first improvement since this provision was introduced into regulation as part of standard 6.1 in March 2016. Standards now set, via the approved methodology and supporting guidance, should result in buildings with very low energy demand at levels which are more widely associated with the concept of 'nearly zero'.

In this context, "energy from renewable sources" means energy from renewable non-fossil sources, namely wind, solar, aero-thermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases. In this context, current and ongoing decarbonisation of grid electricity is also now considered to contribute as a renewable source, as noted in our draft Heat in Buildings Strategy.

High-efficiency alternative systems

For all new buildings, it remains the case that the technical, environmental and economic feasibility of high-efficiency alternative systems (such as decentralised energy supply systems using renewable energy, co-generation, district or block heating/cooling and heat pumps are considered and taken into account in developing proposals. Further information

on this process is provided in Annex 6.C -'Consideration of High-Efficiency Alternative Systems in New Buildings'.

Zero Direct Emissions solutions

It is proposed that, from 2024, all new homes will be heated with 'zero direct emission' (ZDE) sources.

> *"Zero direct emissions from heating and cooling will ensure that no greenhouse gas emissions are produced at all from the heating or cooling system contained within a building at the point of use. We propose that electricity and thermal energy from heat networks would, therefore, be considered 'zero-rated' (i.e. considered to produce zero direct emissions at the point of heat consumption)".*

In advance of this change, all homes heated or cooled only from ZDE sources do not require to undertake a target emissions calculation under standard 6.1.

Where the heat demand in a new building is not met from ZDE sources, information must be provided to illustrate how such a source can be retrofitted to the dwelling. This should be both part of the building warrant application and be provided to the building owner as part of the written information required under standard 6.8.

Conversions - in the case of conversions as specified in regulation 4, this standard does not apply.

6.1.1 Dwellings

NOTE: proposals for the new energy target are expressed in terms of Primary Energy in the following text.

Objective 1 - the calculated greenhouse gas emissions for the proposed dwelling (the Dwelling Emissions Rate (DER) measured in kilograms of carbon dioxide (equivalent) per square metre of floor area per annum, kg.CO_{2e}/m²/yr) should be less than or equal to the Target Emissions Rate (TER) calculated for a 'notional dwelling' of the same size and shape.

Objective 2 - the calculated primary energy demand for the proposed dwelling (the Dwelling Primary Energy Rating (DPER) measured in kilowatt hours per square metre per year, kWh/m²/yr) should be less than or equal to the Target Primary Energy Rate (TPER) calculated for a 'notional dwelling' of the same size and shape.

Summary of procedure - in order to establish the Target Emissions Rate (TER) and the Target Primary Energy Rate (TPER) for the 'notional dwelling' (i.e. a dwelling of the same size, shape and 'living area fraction' as the proposed dwelling), the dimensions and 'living area fraction' of the proposed dwelling and a set of standard values are input into the methodology (see clause 6.1.2). To calculate the Dwelling Emissions Rate (DER) and Dwelling Primary Energy Rate (DPER) for the proposed dwelling a second calculation is carried out where the specification proposed by the applicant are input into the methodology.

Exemption from TER/DER calculation

Where the only heat supplied to a new dwelling is from 'zero direct emissions' sources (electricity or thermal energy from a heat network), Standard 6.1c does not apply and the Target and Dwelling Emission Rate calculation need not be undertaken. The operation of the dwelling is deemed to produce 'zero direct emissions'. Compliance with Standard 6.1 will still be demonstrated by the energy target calculation.

Standard Assessment Procedure (SAP) - The Government's Standard Assessment Procedure for Energy Rating of Dwellings (SAP 10) is the calculation tool which forms part of the UK National Calculation Methodology and is the methodology for the calculation of energy and emissions performance of new dwellings approved under standard 6.1(a). At all stages, the conventions associated with the SAP document should be read in conjunction with the specific guidance given in the clauses to this section. Designers should be familiar with the SAP methodology and their chosen software tool and be able to explain the input and calculation process in the context of the information submitted as part of the building warrant.

Non-domestic use within dwellings - some new dwellings may incorporate surgeries, consulting rooms, offices or other accommodation of a floor area not exceeding 50 m² in aggregate, 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 emissions and primary energy rates

NOTE: the following specification for Option 1 & Option 2 are implemented within the iSAP tool for Scotland, available in support of this consultation at: www.scotland.isap.org.uk.

To set the target emissions and primary energy rates, (i.e. the level that should not be exceeded, the TER/TPER), refer to the table to this clause. The targets set are based on a specification linked to the choice of main heating type fuel. This specification of 'fuel package' is applied within the methodology to define a 'notional dwelling' having 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 10.

Where the dwelling is to be served by an electric heat pump, one specification is defined. For any other heat solution, a second specification is defined. This is to provide a degree of equitability in performance outcomes for the heat pump systems that generally operate with a very high energy efficiency. A further adjustment is made to the calculation where heat is supplied to the dwelling from an external network.

Software vendors providing BRE approved SAP 10 software [http://www.bre.co.uk/] will incorporate a function that, with 'Scotland' selected, automatically generates the target rates once the choice of heating solution to the actual building, together with the 'notional dwelling' dimensions and 'living area fraction' have been input into the programme.

Measures to calculate target rates for the 'notional dwelling'

The measures identified in the tables below are set to deliver, on aggregate, a 32% (improved specification) and 57% (advanced specification) reduction in emissions over application of the 2015 standards. Whilst a dwelling can be constructed using these

packages of measures, it is stressed that the following specifications are provided solely for the purpose of setting the targets (TER/TPER) for the 'notional' dwelling. Designers will find more cost-effective and relevant solution when considering the nature of the new home they propose.

Accordingly, it is not necessary that values or elements present in these tables form part of the proposed dwelling. Designers are free to develop cost-effective and appropriate solutions which meet the TER and TPER, subject to meeting or improving upon the minimum levels identified in guidance to Standards 6.2 to 6.6.

Low carbon equipment element of the TER/TPER (generation of power)

The 'all other solutions' specification for the 'notional' building includes an element of low carbon equipment (LCE) represented, as a proxy, by the inclusion of roof mounted photovoltaic panels, expressed as a fixed percentage of the building gross internal area. This is included to assist in reducing the overall delivered energy total for the building and thus the target emissions and primary energy rates.

This PV element is applied only to that portion of the actual building where space heating demand is not met by an electric heat pump. This is in recognition of the higher efficiency of heat pump solutions which will reduce the delivered energy total. Accordingly, a building where heat demand is met 100% by electric heat pump will have no assigned PV in the notional building calculation.

The incorporation of LCE within design proposals, is encouraged where this is considered an appropriate and cost-effective part of the overall building solution and the generating capacity can be shown to be utilised on site. Noting that, from 2021, the calculation of notional and actual building will no longer include any component of generated power which is identified as exported from the building. This change in approach seeks to reinforce the need for design choices to be effective in reducing the total delivered energy needed at a building, to the benefit of those using the building.

Table 6.1. Notional building specification - fabric and fixed building services values for TER/TPER.

Element	Option 1 - 'Improved'	Option 2 - 'Advanced'
Openings (windows, doors, etc) [1]	Same as actual dwelling up to a maximum total area of openings of 25% of total floor area. If the total area of openings exceeds 25% of the total floor area, reduce to 25%	
Walls	0.15 W/m²K	0.13 W/m²K
Party walls	0.0 W/m²K	
Floors	0.12 W/m²K	0.10 W/m²K
Roofs	0.09 W/m²K	
Doors	1.2 W/m²K	1.0 W/m²K
Windows [2]	U = 1.2 W/m²K Frame factor = 0.7 Solar energy transmittance = 0.63 Light transmittance = 0.80	U = 0.8 W/m²K Frame factor = 0.7 Solar energy transmittance = 0.57 Light transmittance = 0.70

Element	**Option 1 - 'Improved'**		**Option 2 - 'Advanced'**	
Roof windows	U = 1.5 W/m²K) Overshading factor 1.0 Other parameters as for windows		U = 1.0 W/m²K) Overshading factor 1.0 Other parameters as for windows	
Rooflights [3]	U = 1.7 W/m²K Overshading factor 1.0 Other parameters as for windows		U = 1.3 W/m²K Overshading factor 1.0 Other parameters as for windows	
Thermal mass	Same as actual dwelling			
Number of sheltered sides	Same as actual dwelling (but must not exceed 2)			
Allowance for thermal bridging [4]	Assigned y-value of 0.06		Assigned y-value of 0.04.	
Ventilation system	Natural ventilation with background ventilators and intermittent extract fans.		Mechanical Supply and Ventilation with Heat Recovery, 86% efficient	
Air permeability	5 m³/(h.m²)@50Pa		3 m³/(h.m²)@50Pa	
Chimneys/open flues	None			
Extract fans/points	Number of extract fans/points the same as the actual building.			
Main heating fuel (space and water) [5]	**Heat pump (Electric)**	**All other solutions [6]**	**Heat pump (Electric)**	**All other solutions [6]**
Heating system	Air Source Heat Pump, 250% (SPF as modelled in SAP) Boiler and radiators (large); Design flow temperature of 55 °C	Flat - combi boiler; House - system boiler. SEDBUK2009 = 89.5% Room-sealed, fan-assisted flue. Modulating burner control Boiler and radiators (large); central heating pump 2013 or later, in heated space Design flow temperature of 55 °C	Air Source Heat Pump, 250% (SPF as modelled in SAP) Boiler and radiators (large); Design flow temperature of 45 °C	Flat - combi boiler; House - system boiler. SEDBUK2009 = 89.5% Room-sealed, fan-assisted flue. Modulating burner control Boiler and radiators (large); central heating pump 2013 or later, in heated space Design flow temperature of 55 °C
Heating system controls	Time and temperature zone control	Time and temperature zone control, interlock, ErP Class V controls, delayed start	Time and temperature zone control	Time and temperature zone control, interlock, ErP Class V controls, delayed start
Hot water system	As for space heating			

Element	**Option 1 - 'Improved'**		**Option 2 - 'Advanced'**	
Showers and baths	Number of showers and baths same as actual dwelling. If shower(s) specified, shower flow rate(s) to be 8 l/min. Shower(s) supplied by main water heating system (not instantaneous electric shower).			
Main heating fuel (space and water)	**Heat pump (Electric)**	**All other solutions**	**Heat pump (Electric)**	**All other solutions**
Waste water heat recovery	None	All showers connected to WWHR - 55% recovery efficiency Utilisation of 0.98, waste water fraction 0.9.	None	All showers connected to WWHR - 55% recovery efficiency Utilisation of 0.98, waste water fraction 0.9.
Hot water cylinder	180 litre (integral)	200 litre (detached house) 150 litre (all other houses)	180 litre (integral)	200 litre (detached house) 150 litre (all other houses)
Hot water cylinder declared loss factor	1.35 kWh/day	1.65 kWh/day (detached house) 1.39 kWh/day (all other houses)	1.35 kWh/day	1.65 kWh/day (detached house) 1.39 kWh/day (all other houses)
Primary water heating losses	Fully insulated primary pipework; cylinder thermostat; cylinder in heated space; separate timer			
Secondary heating	None			
Electrical Supply	Standard Tariff			
Lighting	Fixed lighting capacity (lm) = 185 x total floor area; Efficacy of all fixed lighting = 80 lm/W			
Main heating fuel (space and water)	**Electric, heat pump**	**Other**	**Electric, heat pump**	**Other**
PV system [7]	None	Houses - kWp = 0.4 x ground floor area (m²) / 6.5. Flats- kWp = 0.4 x dwelling floor area (m²) / (6.5 x number of storeys in block)	None	Houses - kWp = 0.4 x ground floor area (m²) / 6.5. Flats- kWp = 0.4 x dwelling floor area (m²) / (6.5 x number of storeys in block)

Notes

1. If there is a need to reduce the area of openings in the notional building to 25%:

a. Include all opaque and semi-glazed doors with the same areas as the actual dwelling (excluding any doors not in exposed elements, e.g. entrance door to a flat from a heated corridor); then

b. Reduce area of all windows and roof windows/rooflights by a factor equal to [25% of total floor area less area of doors included in (a) above] divided by [total area of windows and roof windows/rooflights in actual dwelling].

2. Orientation same as actual dwelling. Over shading - average if actual dwelling has very little or average overshading; same as actual dwelling if greater overshading.

3. U-values for rooflights is already calculated on the horizontal plane.

4. For the purposes of setting the TER/TPER, a y-value of 0.08 is identified. Note: for DER/DPER, this element of calculation must have this additional heat loss element (H_{tb}) calculated from lengths of junctions and individual psi values.

5. Two specifications are applied: if space heating is proposed via an electric heat pump, the notional building has a heat pump solution; if any other heating solution is proposed, the notional building has a mains gas boiler solution and assignment of both photovoltaics and wastewater heat recovery. Where more than one fuel is used to heat different parts of the building the calculation will assign each specification based upon the proportion of each solution present by heated floor area.

6. Where heating is proposed via an external Heat Network connection, the notional building will follow the 'any other solution' specification but an adjustment is made to the calculation for the emissions and primary energy totals for the actual building. See clause 6.1.3.

7. The cited PV element of the specification is calculated on the basis of a panel specification of 6.5 m²/kWp. For purpose of calculating the benefit of the PV element in TER/TPER reporting, the contribution will be capped to the amount of generated energy that is not assessed as an export component, following the methodology set out in Appendix M1 of SAP 10. The same assessment will be applied to the DER/DPER calculation – see clause 6.1.3

6.1.3 Calculating Dwelling Emissions Rate and Dwelling Primary Energy Rates

The second calculation involves establishing the Dwelling Emissions Rate and Dwelling Primary Energy Rate for the proposed dwelling (DER and DPER). To do this the actual specification values proposed for the dwelling should be used in the methodology i.e. the U-values, air infiltration, heating system, etc.

As noted in clause 6.1.1, where the only heat supplied to a new dwelling is from 'zero direct emissions' sources the Target and Dwelling Emission Rate calculation need not be undertaken.

All values input should be dwelling-specific values and be for the location and orientation of the individual dwelling, as proposed. No standardised/default assumptions can be included.

Before determining these values for input into the methodology, reference should be made to:

- the minimum U-values identified in guidance to Standard 6.2, and
- guidance on systems and equipment referenced in guidance to Standards 6.3 to 6.6 and the Domestic Building Services Compliance Guide for Scotland.

On-site generation of power – export limitation

As with the notional building calculation, the calculation of the performance of the actual building will assess the contribution of on-site generation of power and this will be capped to the amount of generated energy that is not assessed as an export component, following the methodology set out in Appendix M1 of SAP 10. Where the calculated generating capacity exceeds that which is assessed as utilised on site, this will be reported to the designer. This is to provide assurance that the assignment of such generation to a building is effective in reducing the delivered energy total for the dwelling.

Demonstrating compliance for buildings with a supplied heat connection

Compliance with standard 6.1 for a building supplied with heat from an external network source will be demonstrated against the 'gas' notional building (as noted in clause 6.1.2), but the calculated energy demand totals for the actual building will have the primary energy and emissions factors for grid electricity applied to the calculated heat demand rather than the SAP default or network-specific values for supplied heat.

This recognises that supplied heat can be utilised with 100% efficiency at the building, with adjustment only needed to recognise any standing losses from heat interface units that do not contribute usefully to reduce the heating demand at the building. Application of these factors enables the designer to demonstrate an equivalent outcome in terms of limiting energy demand at the building, for supplied heat solutions compared to on-site heat solutions.

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 and primary energy rate for the proposed block or terrace (DER and DPER) may be compared to the average target CO_2 emissions and primary energy rate (TER and TPER) for the 'notional block or terrace'.

The average rates for the block or terrace is the floor-area-weighted average for all the individual dwelling rates, i.e.:

$\{(\text{emissions}_1 \times \text{floor area}_1) + (\text{emissions}_2 \times \text{floor area}_2) + (\text{emissions}_3 \times \text{floor area}_3) + \ldots)\} \div \{(\text{floor area}_1 + \text{floor area}_2 + \text{floor area}_3) + \ldots\}$

The average Target Primary Energy Rate should be calculated using the formula above but replacing emissions total with energy totals.

The degree of flexibility which is provided by averaging out building emissions and primary energy 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 Heated common areas in buildings with multiple dwellings

Where the heated common areas in a domestic building are less than 50m^2 in total these rooms or areas may be treated as a small stand-alone building and are not therefore subject to Standard 6.1.

Where subject to Standard 6.1, communal rooms or other areas in blocks of dwellings (which are exclusively associated with the dwellings) should be assessed either by:

a. a SBEM calculation using the methodology and guidance to Standard 6.1 for non-domestic buildings, or

b. ensuring that the glazing does not exceed 25% of the total communal floor area of the building; and the actual building fabric and services specification is equal to or better than that given for the applicable notional dwelling specification set out in clause 6.1.2

Note that an Energy Performance Certificate (EPC) will still be required, on completion of such areas, to meet Standard 6.9.

6.1.6 Conservatories and stand-alone buildings

Conservatories of less than 50m^2 in area are stand-alone buildings, thermally separated from the dwelling. A new dwelling to which one is attached should be assessed as if there was no conservatory present.

For conservatories and other ancillary stand-alone buildings of 50m^2 or more subject to Standard 6.1, a SBEM calculation using the methodology and guidance to Standard 6.1 for non-domestic buildings should be provided, applying the standards set for domestic buildings in all other respects.

6.2 Building insulation envelope

Mandatory Standard

Standard 6.2

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:

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

k) communal parts of domestic buildings **which will not be heated, other than heating provided solely for the purpose of frost protection, or**

l) 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 minimum values. These are needed for the following reasons:

- to help reduce energy demand for space heating, particularly in new dwellings, where use of low carbon equipment (LCE) may reduce greenhouse gas emissions but not primary energy consumption, and
- to ensure that a good level of fabric insulation is incorporated in building work, especially to construction elements which would be difficult or costly to upgrade in the future.

Non-repeating thermal bridging at the junctions of building elements and around openings in the building envelope form part of the calculation of energy performance in the Standard Assessment Procedure (SAP 10, see clause 6.1.1). Such junctions, if poorly designed and constructed can contribute significantly to the overall heat loss through the insulation envelope.

As fabric insulation levels improve, the rate at which heat is lost through air infiltration through the building envelope (air permeability) becomes proportionally greater. For example, in a typical 1960's house with poorly fitted windows 20% of the total heat could be lost through air infiltration. If the same building was upgraded to 2002 levels of fabric insulation but no attempt was made to improve the air permeability then the heat loss through infiltration could represent over 40% of total heat losses. When addressing infiltration, the provision of adequate, controllable ventilation is essential if both energy efficiency and good indoor air quality are to be achieved.

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 for fabric elements of the building

Where a balanced and practical approach is taken to reducing energy demand in new dwellings, a consistent and good level of fabric insulation will limit heat loss through the building envelope.

Table 6.3 below sets out robust minimum standards for the thermal performance of building elements in both new buildings and where undertaking alteration, extension or conversion of existing buildings.

For new buildings, meeting Standard 6.1 may result in even better levels of thermal insulation being achieved unless the design of a building involves improved specification of building services or use of on-site generation of heat or power.

Localised areas of the same building element may be designed to give a poorer performance. These in turn will need to be compensated by the rest of the element being designed and built to a more demanding level. It is recommended that variation on the performance of elements be limited where practicable to enable a consistent level of reduction in heat loss throughout a dwelling and maintain continuity of insulation across accommodation.

Any localised areas (individual elements) should have a U-value no worse than 0.7 (Walls and floors) or 0.35 (roofs). Glazing with a U-value poorer than 3.3 should not be used. This is particularly important with regard to the control of surface and interstitial condensation (see Section 3: Environment).

To minimise such risks, designers should seek to specify and maintain individual element values significantly better than the above figures where practical to do so. Repeating thermal bridges (e.g. timber studs in a timber frame wall) need not be considered as an individual element in this respect, as these are already taken into account within a BS EN ISO 6946: 2017 U-value calculation.

For communal areas refer also to clause 6.2.12.

Table 6.3. Maximum U-values for building elements of the insulation envelope

Type of element	Area-weighted average U-value (W/m²K) for all elements of the same type	
	Option 1 – 'Improved'	Option 2 – 'Advanced'
Wall [1]	0.17	0.16
Floor [1]	0.15	0.13
Roof	0.12	0.11
Windows and doors	1.4	1.2
Rooflights [2]	1.9	1.7

Cavity separating wall	0.0	0.0

Notes:

1. Excluding separating walls and separating floors between heated areas where thermal transmittance need not be assessed, beyond measures to limit heat loss arising from air movement within any cavity separating wall.
2. U-value for rooflights is calculated on the horizontal plane.

Cavity separating walls

Unanticipated heat loss can arise via air movement, within a cavity separating wall, from heated areas to points outwith the insulation envelope. To limit heat loss, a separating wall cavity should have effective perimeter sealing around all exposed edges and in line with insulation layers in abutting elements which separate the dwelling from another building or from an unheated space.

Any cavity separating wall should also be fully filled with a material that limits air movement, allowing a U-value of 0.0 to be assigned. In considering this issue, it is important that solutions also address the need to limit noise transmission (see Section 5: Noise).

Alternative approach to limiting space heating demand

Where more design flexibility is sought, beyond the use of the minimum values set out in Table 6.3 above, an alternative solution would be to demonstrate that the overall space heating demand for the dwelling is no more than the calculated total derived by the values in the table, subject to application of the notional building values for both infiltration and heat loss at junctions. This provides, in effect, an informal 'space heating demand target', which can applied where elemental values are not used in full to demonstrate compliance.

To enable this approach and raise awareness of the overall impact of design specification on building fabric performance, SAP 10 tools will to report the calculated space heating demand for each dwelling as part of output from SAP tools. This is already an output from the calculation (this is calculated in box 99 of the SAP worksheet) and will be presented for both the actual building and as a recommended limit as described above.

6.2.2 Areas of windows, doors and rooflights

Due to Standard 6.1, there is no need for guidance on minimum or maximum area for windows, doors and rooflights in new dwellings. The use of a methodology for establishing compliance with Standard 6.1 provides an equitable approach to balancing the issues of heat loss versus solar gain and natural lighting versus artificial lighting.

In certain cases where there is a desire to have a large proportion of glass it may be difficult to demonstrate compliance with Standard 6.1. In such cases, innovative solutions will need to be considered. All relevant standards and guidance should be considered, including the impact that large areas of glazing can have on summer overheating risk (see standard 3.28).

Guidance on alterations, extensions and conversions is provided in clauses 6.2.6 to 6.2.12. For communal areas, refer to clause 6.2.12.

6.2.3 Limiting heat loss through thermal bridging

Note: The Scottish Government will no longer publish thermal bridging detail sets in support of this topic. Introductory advisory guidance will be retained.

As insulation values of new buildings improve, the need to limit heat loss through thermal bridging becomes increasingly important. Incorrect detailing at design stage or poor construction work can have a significant adverse effect on building performance.

The insulation envelope of any heated building should be designed and constructed to limit heat loss through thermal bridging. The key areas of concern are:

- repeating thermal bridging within building elements, and
- non-repeating thermal bridging at the junction between building elements and at the edges of building elements where openings in the envelope are formed.

Whilst repeating thermal bridges are taken into account in the BS EN ISO 6946: 2017 U-value calculation, a separate assessment of non-repeating thermal bridging should be carried out for new buildings which are subject to Standard 6.1. Advice and further information on assessment of the effects of thermal bridging can be found in BRE Information paper IP 1/06 – 'Assessing the effects of thermal bridging at junctions and around openings' http://www.brebookshop.com/.

The SAP calculation tool referred to in the guidance to Standard 6.1 includes an assessment of heat loss arising from non-repeating thermal bridges in new dwellings. The overall heat loss is derived from numerical modelling of individual Ψ (psi) values calculated in accordance with BS EN ISO 10211: 2017 'Thermal bridges in building construction - heat flows and surface temperatures - detailed calculations'. Guidance on this process is given in BR 497, 'Conventions For Calculating Linear Thermal Transmittance and Temperature Factors'.

To determine the value for heat loss arising from non-repeating thermal bridging (transmission heat transfer coefficient or H_{tb}) for the proposed dwelling, designers should identify the presence of junctions listed in Appendix K of SAP 10 and assign Ψ values to each junction, based upon the following options:

c. input of default Ψ values for each junction listed within Appendix K of SAP 10

d. where construction of a junction follows published and substantiated construction detail sets, input of Ψ values of the relevant junction(s) from that document

e. input of Ψ values calculated by a person with suitable expertise and experience following the guidance set out in BR 497.

Note that a combination of Ψ values from these sources can be used to produce a calculated heat loss.

Further commentary on this process and use of other published documents providing sources of pre-calculated values can be found within introductory volume of the 'Accredited Construction Details (Scotland) 2021'.

For new building work, the designer should demonstrate that the principles for reducing heat loss at junctions have been applied in the creation of the insulation envelope and the detailing of constructions, providing continuity of the insulation layer and of the air and vapour control layer.

6.2.4 Limiting uncontrolled air infiltration

Addressing infiltration in new dwellings can significantly reduce heat loss and result in lower carbon dioxide emissions. This can provide flexibility when applying the methodology used to meet the targets for carbon dioxide emissions and primary energy (see Standard 6.1).

To limit heat loss, any heated building should be designed to limit air infiltration through the building fabric. This is done by providing a continuous barrier that resists air movement through the insulation envelope and limits external air paths into each of the following:

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

The infiltration rate used to set the target for emissions and primary energy calculation is set out in Table 6. In clause 6.1.2. Whilst no minimum value is set for uncontrolled infiltration, it is recommended that buildings are designed to achieve a value of 7 $m^3/(h.m^2)$@50Pa or better to allow a balanced approach to managing building heat loss. Where the designer specifies a higher infiltration rate they should set out their justification for this to the verifier.

Due to the contribution of both detailing and workmanship, it remains difficult to achieve a specified air infiltration rate with any degree of accuracy. To ensure the dwelling will deliver the intended thermal performance without adversely affecting air quality, air tightness testing should be undertaken to verify as-built air infiltration rates (see clause 6.2.5).

Limiting air infiltration to improve energy performance should not compromise ventilation required for:

- the health of the occupants of the building (Section 3)
- the removal of moisture from building fabric (Section 3)
- the safe operation of combustion appliances (Section 3), and
- any smoke control system (Section 2).

Lower air infiltration rates, of less than 5 $m^3/(h.m^2)$@50Pa, may give rise to problems with internal air quality and condensation unless this is addressed through an appropriate ventilation strategy which will commonly involve continuous mechanical extract ventilation.

Reference should be made to recommended options for ventilation to maintain indoor air quality under Standard 3.14.

Similarly, work to improve an existing dwelling which includes measures which reduce infiltration should also consider the impact of such work on condensation risk and moisture movement within affected construction elements (see clause 6.2.10).

Common areas - in building consisting of dwellings, common areas which need particular consideration to limit air infiltration include common stair entrances and shafts which extend through most of the floors (e.g. lift and common stair enclosures).

6.2.5 Air-tightness testing

Low air infiltration rates will contribute to energy performance but should not be so low as to adversely affect the health of occupants or the building fabric as a consequence of a poorly-considered ventilation strategy. There is, therefore, a need to establish dwelling performance by test to provide assurance of compliance in both these respects.

EPC data indicates that around one third of new dwellings have been subject to an air tightness test in recent years are achieving air infiltration rates below 5 $m^3/(h.m^2)$@50Pa. As this level of airtightness requires a different ventilation strategy to be adopted, all new homes should be tested. This will provide greater assurance that the infiltration rate declared at the design stage is achieved on completion and that issues of both energy performance and ventilation are addressed.

Air pressure tests should be performed following the guidance set out in CIBSE TM23: 'Testing buildings for air leakage'.

Note: An amended edition of TM23 is awaiting publication at the time of writing. This will extend the methodology to cover both fan pressurisation and pulse testing.

Testing should only be carried out by persons who can demonstrate relevant, recognised expertise in measuring the air permeability of buildings. This should include membership of a professional organisation which accredits its members as competent to test and confirm the results of testing.

Further advice on these matters can be found in chapter 5 of the BSD publication 'Sound and Air-tightness Testing', 2021 Edition. *[in preparation]*

6.2.6 Introducing heating to unheated buildings and conversion of buildings

A building that was originally designed to be unheated has, in most instances, the greatest void to fill in terms of energy efficiency. The introduction of heating to such buildings will, if not accompanied by fabric insulation, result in disproportionate heat loss and wasteful use or fuel and power.

In this context, existing buildings where heating is provided solely for the purpose of frost protection (rated at a maximum of 25W per m² of floor area) shall be treated as unheated buildings.

Where such a building, or part of a dwelling, is converted, or heating is introduced to a building that was previously designed to be unheated, the building should achieve a level of performance similar to that expected for new construction and follow the guidance in clause 6.2.1.

In the case of a building that was previously designed to be heated, the impact on energy efficiency as a result of the conversion will generally be less significant but the act of conversion should still trigger an assessment of the capacity to improve the building fabric and follow the guidance given in clause 6.2.1.

In each case, the provisions set out in clause 6.2.1 should be met or, if not, evidence provided to demonstrate the extent to which an equivalent level of overall heat loss can be delivered to the extent that such work is reasonably practicable. Such evidence should clearly set out the options considered and the justification for the best values that the designer has arrived at, identifying any limitations arising from factors such as conflicting statutory requirements, lack of space, cost or issues of technical risk arising from the nature of the retained elements of building envelope.

The total area of windows, doors and rooflights, should not exceed 25% of the floor area of the dwelling created by conversion. Alternatively, a compensatory approach should be taken.

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, and
- 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 historic, listed or traditional buildings

With historic, listed or traditional buildings, the energy efficiency improvement measures that should be invoked by conversion can be more complex.

Whilst achieving the U-values recommended in clause 6.2.1 should remain the aim, a flexible approach to improvement should be taken, based upon investigation of the traditional construction, form and character of the building in question and the applicability of improvement methods to that construction. Provisions under other legislation (e.g. planning consent for listed buildings or those within conservation areas, where there is a

need to maintain character, form or features) are also relevant. The manner in which proposed improvements may affect moisture movement or the permeability of existing construction will also require assessment to address the risk of adverse consequences.

For all buildings, it would be advisable to consider the feasibility of upgrading fabric to at least the U-values for individual elements noted in clause 6.2.1 (0.7 for walls and floors, 0.35 for roofs and 3.3 for glazing). In many cases, specialist advice will be helpful in making an assessment to ensure that, in improving energy efficiency, there is no other, adverse effect to the building fabric.

Accordingly, each building will have to be dealt with on its own merits. Improvements to the fabric insulation of the building will often depend on factors such as whether or not improvement work can be carried out in a non-disruptive manner without damaging existing fabric (for example, insulating the ceiling of an accessible roof space), or whether potential solutions are compatible with the existing construction.

In certain cases, buildings are given historic or listed status because of specific features present in certain parts of the building. In these circumstances, it may be possible to make greater improvements to other less sensitive areas.

In all cases the 'do nothing' approach should not be considered initially. Innovative but sympathetic and practical solutions to energy efficiency, which are beyond the scope of this guidance, can often result in an alternative package of measures being developed for a building. For example, energy demand and greenhouse gas emissions can be reduced without affecting building fabric through improvements to the heating system (refer to Standards 6.3 and 6.4), the lighting system (refer to Standard 6.5) or incorporation of renewable heating or on-site generation of heat or power. Consultation on such matters at an early stage with both the verifier and the planning officer of the relevant authority is advised.

Further guidance on issues that merit consideration and potential approaches to improvement can be found in the Historic Scotland Document 'Guide for Practitioners 6 - Conversion of Traditional Buildings'.

6.2.8 Extensions to the insulation envelope

Extension of a domestic building is not subject to Standard 6.1. In view of this, measures to limit energy demand and greenhouse gas emissions rely primarily upon the performance of the new building fabric.

As the majority of construction work for an extension will be new, there will seldom be the need to consider construction to a lesser specification as is sometimes the case for conversions and alterations. The exception to this is at the junction between existing and new, for example the need for proprietary metal 'wall starter' ties where the existing brickwork stops and new cavity blockwork begins. However other building standards should still be met with regard to such transitional construction elements.

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 maximum U-values set out in clause 6.2.1.

To limit heat loss through openings, the area of windows, doors, and roof lights within an extension should be limited to 25% of the floor area of the extension plus the area of any existing openings built over within the extensions. This may be exceeded where the compensatory approach (described below) is used to demonstrate that this results in no additional heat loss.

Areas of the same building element may have a poorer than average performance provided the area-weighted average U-value for all elements of the same type is maintained (e.g. by some elements having correspondingly better performance). To reduce the risk of condensation, the maximum individual element U-values should be no worse than the figures given in guidance clause 6.2.1.

'Compensatory approach' using a notional extension

A compensatory approach allows U-values for the elements involved in the work to be varied provided that the resulting overall heat loss for an extension is not greater than that of a 'notional' extension. The 'notional' extension should be the same size and shape as the proposed extension, and have the area weighted average U-values from the guidance to clause 6.2.1 and have an area of windows, doors and rooflights equal to 25% of the total extension floor area plus the area of built over openings.

Examples of this approach are given in Annex 6B.

Whole dwelling approach - where SAP data is available for the existing dwelling, it may be practical to provide a revised SAP calculation to demonstrate compliance of a dwelling, as proposed, including extension, using the target-based methodology (DER not more than TER) set out in guidance to Standard 6.1 (carbon dioxide emissions). This option will generally only be viable where both extension and dwelling are built to the same, current edition of the standards.

6.2.9 Thermal bridging and air infiltration for existing buildings

Where works to alter, extend or convert a building, the elements involved in the building work should follow the guidance in clauses 6.2.3 and 6.2.4 on limiting heat loss from thermal bridging and air infiltration and reference should be made to the principles set out in the introductory volume of the BSD document 'Accredited Construction Details (Scotland) 2021'.

Calculation of heat loss from linear thermal bridging is not necessary unless the SAP methodology is being used to demonstrate compliance. Instead, as noted in clause 6.2.3, the designer should demonstrate that the principles for reducing heat loss at junctions have been applied in the creation of the insulation envelope and the detailing of constructions, providing continuity of the insulation layer and of the air and vapour control layer.

In addition, the recommendations within Building Research Establishment (BRE) Report 262 'Thermal insulation: avoiding risks (2002 edition)' can be followed.

6.2.10 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, listed or traditional buildings), it may be necessary to adopt alternative energy efficiency measures which relate to the amount of alteration work being undertaken.

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) and reference should be made to the relevant guidance clause for such work.

The extent to which improvement can be delivered will be affected by a range of issues, such as:

- the form and construction of the existing envelope and the scope of works
- the extent to which improvement is technically feasible without the risk of adverse consequences, and
- the impact of any other statutory requirements to which the building is subject (e.g. listing, conservation area).

Alterations to the insulation envelope of a building should be considered using the guidance in the following paragraphs.

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 the table to clause 6.2.1. 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.

Internal elements which become part of the insulation envelope - alteration can cause an existing internal element of a building to become part of the insulation envelope. This will most likely occur where a part of a building is permanently removed as a phase of the alteration work. Where this occurs, that part of the building (including any infill construction) should have U-values which achieve those in the table to clause 6.2.1. Another approach would be to follow the guidance given in the previous paragraph, but compensate for the energy efficiency deficit by improving the overall U-value of other parts of the insulation envelope.

However, 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 and rooflights - where windows, doors and rooflights are being created or replaced, they should achieve the U-value recommended in the table to clause 6.2.1. A compensating approach may be used and an example of this is given in annex 6A.

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/m²K or less. For secondary glazing, an existing window, after alteration should achieve a U-value of about 3.5 W/m²K.

Areas of windows, doors and rooflights - where additional windows, doors and rooflights are being created, the total area (including existing) of these elements 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. Alternatively, the designer should show that the work to provide additional glazing will not result in an increase in the overall heat loss in the dwelling.

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.

The table to clause 6.2.1 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 certain constructions are easier to upgrade than others and these values should be met as far as is reasonably practicable.

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 W/m²K and in the case of a wall or floor, 0.70 W/m²K.

For older buildings of traditional construction, further guidance to assist in this assessment can be found in the Historic Scotland Document 'Guide for Practitioners 6 - Conversion of Traditional Buildings'.

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 (clause 6.2.9). However, only the work that forms the alteration and the impact of that work on the existing building need be considered.

6.2.11 Conservatories

Conservatories are a common addition to many dwellings. Traditionally used as an ancillary space, occupied for part of the year, conservatories are now often used year-round leading to an increased heating demand. Accordingly, such buildings should, like

other heated stand-alone buildings, be constructed to limit energy demand and reduce CO_2 emissions.

Some smaller conservatories can be exempt from both building warrant and building standards (see Section 0). Conservatories of 50 m^2 or more are subject to Standard 6.1 (see clause 6.1.6).

Thermal division - a conservatory should be thermally divided from a dwelling, being outwith the insulation envelope of the dwelling. The dividing elements (e.g. wall, door, and window) should have U–values equal or better than the corresponding exposed elements in the rest of the dwelling.

U-values - although conservatories are attached to dwellings, they are stand-alone buildings. Where not exempt, a conservatory (heated or unheated) should be built to the same maximum U-values as any other new work, as listed in the table in clause 6.2.1. The exception is that glazing and framing elements forming the walls or roof of a conservatory are unlimited in area and should have a maximum area-weighted average U-value of 1.8 W/m^2K and a maximum individual element U-value of 3.3 W/m^2K.

U-values of glazing elements forming the roof are usually quoted in the vertical plane and should therefore be adjusted allowing for the angle of the roof. Further guidance and U-value adjustments can be found in BR 443: 2019 'Conventions for U-value calculations'.

Varying U-values - 'Compensating U-values for windows, doors and rooflights' - individual U-values for the glazed and framing elements may exceed 1.8 W/m^2K provided that the average U-value for all the glazed and framing elements is no greater than 1.8 W/m^2K. An example of this approach is given in annex 6A.

Thermal bridging and air infiltration - in order to limit air infiltration and thermal bridging at junctions and around windows, doors and rooflights, guidance in clause 6.2.9 should be followed.

If using the Building Standards Division document: 'Conservatories', these issues will be considered to have been taken into account. Draught stripping for existing 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.

6.2.12 Stand-alone buildings

Thermal division of a stand-alone building from the remainder of a dwelling or domestic building is explained in clause 6.2.11.

For heated stand-alone buildings of less than 50m^2, the fabric values identified in the table to clause 6.2.1. U-value recommendations should be met, though it should be noted that the area of glazing is not limited. This allows, for example, a dwelling to be extended to create a highly-glazed stand-alone building such as a sunroom, with glazing in excess of the limits identified in clause 6.2.8.

Stand-alone buildings of 50m^2 or more are subject to Standard 6.1. Reference should be made to clause 6.1.6 and use of the non-domestic calculation methodology to assess carbon dioxide emissions.

Common areas - where the total area of a communal room or other heated accommodation associated with a block of dwellings is less than 50m^2, these rooms or accommodation should also 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. As part of a new building, the area of windows, doors, rooflights and roof windows in these rooms or accommodation should be limited to 25% of the total floor area of these common areas.

6.3 Heating system

Mandatory Standard

Standard 6.3

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; and

Limitation:

This standard does not apply to:

m) buildings which do not use fuel or power for controlling the temperature of the internal environment, or

n) heating provided solely for the purpose of frost protection.

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. The notional dwelling standard specifications already indicate this (refer to clause 6.1.2).

This guidance refers to main heating systems for dwellings. Both the primary heating and secondary heating systems are taken account of in SAP 10.

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.

Zero Direct Emissions solutions

It is proposed that, from 2024, all new homes will be heated with 'zero direct emission' (ZDE) sources. In advance of this change, where the heat demand in a new building is not met from ZDE sources on initial construction, we have introduced a requirement that information must be provided to illustrate how such a source can be retrofitted to the dwelling. Such information is necessary to support a simple and cost-effective transition to such heat solutions in the future.

This information should be documented and available for verification purposes and a statement should therefore accompany the building warrant application. The ZDE assessment should be provided to the building owner as part of the written information required under standard 6.8.

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 Performance of fixed heating systems in new and existing buildings

Note: Link below is to the consultation version of the Domestic Building Services Compliance Guide.

The minimum performance of, space heating and hot water systems, heating appliances and controls is set out in the Domestic Building Services Compliance Guide for Scotland.

The document replicates guidance published in support of building standards elsewhere in the UK and supports standardisation of the specification and expected performance of fixed building services throughout the UK. The guidance applies to new systems and replacement, in whole or in part, of existing systems. It also addresses improvement work to existing systems as a consequence of replacing components.

Clause 6.3.2 provides information on situations not addressed in that document.

Historic, listed or traditional buildings

In many cases heating system improvements to historic, listed or traditional buildings will be more feasible than other energy efficiency measures such as improving wall insulation. Where this is the case, systems which go beyond these minimum backstop levels may help offset the deficiency in other areas of energy efficiency and carbon dioxide emissions.

6.3.2 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 thermostatic radiator valve (TRV) to each radiator.

6.4 Insulation of pipes, ducts and vessels

Mandatory Standard

Standard 6.4

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, or**

c. **pipes, ducts or vessels that form part of an isolated industrial or commercial process.**

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 or heat gains from such equipment, and
- 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 as is reasonably practicable, and in no case be worse than before the conversion (regulation 12, schedule 6).

6.4.1 Insulation of pipes, ducts and vessels in new and existing buildings

Note: Link below is to the consultation version of the Domestic Building Services Compliance Guide.

Guidance on the insulation of pipes, ducts and vessels is set out, in the context of the systems of which they form a part, in the Domestic Building Services Compliance Guide for Scotland.

The document replicates guidance published in support of building standards elsewhere in the UK and supports standardisation of the specification and expected performance of fixed building services throughout the UK. The guidance applies to new systems and replacement, in whole or in part, of existing systems. It also addresses improvement work to existing systems as a consequence of replacing components.

Clause 6.4.2 provides information on situations not addressed in that document.

6.4.2 Work on existing buildings

Where a new boiler or hot water storage vessel is installed, or where existing systems are extended, new or existing pipes, ducts and vessels 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 new systems.

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, or where existing systems are wholly or partially retained as part of conversion works. In such cases, insulation should be fitted as for new systems as far as is reasonably practicable.

6.5 Artificial and display lighting

Mandatory Standard

Standard 6.5

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, or**

b. **alterations in dwellings or a building ancillary to a dwelling.**

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 in so far as is reasonably practicable, and in no case be worse than before the conversion (regulation 12, schedule 6).

6.5.1 Fixed lighting

Note: Link below is to the consultation version of the Domestic Building Services Compliance Guide.

Guidance on the efficiency of fixed internal and external lighting is given in the Domestic Building Services Compliance Guide for Scotland.

The document replicates guidance published in support of building standards elsewhere in the UK and supports standardisation of the specification and expected performance of fixed building services throughout the UK. The guidance applies to new systems and replacement, in whole or in part, of existing systems. It also addresses improvement work to existing systems as a consequence of replacing components.

Common Areas of domestic buildings - controls to enable the safe use of lighting in common areas such as corridors, stairs and other circulation areas, are identified in guidance to Section 4.

6.6 Mechanical ventilation and air conditioning

Mandatory Standard

Standard 6.6

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

o) the form and fabric of the building minimises the use of mechanical ventilating or cooling systems for cooling purposes, and

p) 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 greenhouse gas emissions. In view of this, guidance is intended to promote designs that avoid the need for such systems in dwellings, including an assessment of summertime overheating risk set out in standard 3.28 and advice to standard 3.14 on ventilation in certain dwelling types with limited facility for cross-ventilation. However, where such systems are installed, which should generally only be a consideration when working with existing buildings, a performance specification to limit energy use is set out.

With the drive to reduce greenhouse gas emissions and limit energy demand in buildings, the need arises to consider efficient use of mechanical systems, including ventilation. Accordingly, guidance is now offered on power consumption and controls of such systems and on the efficiency of systems that incorporate heat recovery.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirement 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

Reduce overheating –

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:

- proportion of translucent glazing taking into account the need for natural light in apartments (Standard 3.16) and artificial lighting (Standard 6.5)

- orientation of translucently glazed areas
- solar shading or other solar control measures where areas of the external building fabric are susceptible to solar gain
- natural ventilation (including night cooling), and
- thermal mass.

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, the risk of summer overheating is increased.

Provisions for the first four of these elements are addressed in more detail under standard 3.28 in the assessment and mitigation of summer overheating risk.

A simple calculated assessment of peak overheating risk is also undertaken by SAP 10 applying the assessment methodology set out in Appendix P of the document. This assessment should show that the risk rating for 'likelihood of high internal temperature in hot weather' in the dwelling is 'not significant, slight or medium'. Otherwise further review of the design should be undertaken.

Note: Appendix P of SAP 10 may be subject to further review prior to finalisation for use with revised building regulations.

Cooling system

A mechanical cooling system should only be considered for a dwelling where the designer has first demonstrate that all reasonable measures have been taken to limit high internal temperatures.

- For new dwellings, mitigation through passive measures should be achieved.
- For conversions and existing buildings, it is recognised that limitations arising from the building form and fabric may preclude an effective passive solution that fully mitigates risk.

6.6.2 Efficiency of mechanical ventilation and air conditioning systems in new and existing buildings

Note: Link below is to the consultation version of the Domestic Building Services Compliance Guide.

Guidance on the efficiency of mechanical ventilation and air conditioning systems is given in the Domestic Building Services Compliance Guide for Scotland.

The document replicates guidance published in support of building standards elsewhere in the UK and supports standardisation of the specification and expected performance of fixed building services throughout the UK. The guidance applies to new systems and replacement, in whole or in part, of existing systems. It also addresses improvement work to existing systems as a consequence of replacing components.

Clause 6.6.3 provides information on situations not addressed in that document.

6.6.3 Design and installation of Ductwork

The design and installation of ductwork design can have a significant effect on the effectiveness of a ventilation system. Further guidance on basic good practice in installation and commissioning of ventilation systems can be found in guidance to Standard 3.14 and Annex 3A.

6.7 Commissioning building services

Mandatory Standard

Standard 6.7

Every building must be designed and constructed in such a way that energy supply systems, control 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:

- **q) major power plants serving the National Grid**
- **r) the process and emergency lighting components of a building**
- **s) heating provided solely for the purpose of frost protection, or**
- **t) 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 enabling the safe operation of the installation.

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 enable efficient use, unless they are exempt under schedule 1, regulation 3. 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

Note: Link below is to the consultation version of the Domestic Building Services Compliance Guide.

All heating, hot water service, ventilating or cooling systems, control systems 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 enable optimum energy efficiency.

Guidance and supplementary information to assist the commissioning of installed building services is given in the Domestic Building Services Compliance Guide for Scotland. The document is intended to support standardisation of the specification and expected performance of fixed building services throughout the UK. The guidance applies to new and replacement systems and components.

6.7.2 Commissioning Plan at design stage

A schedule of proposed building systems should be provided as part of the building warrant application, setting out the following:

- the systems to test and the nature of commissioning tests applied;
- a schedule of commissioning tests and who will undertake them; and
- The documentation which will be provided as an output from commissioning.

6.7.3 Commissioning Report on completion of construction

On completion of building works, a document setting out the commissioning undertaken, including any changes made to the original design, should be provided to the verifier. This should record the actions taken to complete the design stage commissioning plan, confirming all services listed were commissioned and present the output from the commissioning work, confirming successful commissioning and operation of systems in accordance with the specified design intent. Any issues encountered and actions taken to rectify them should also be recorded.

A copy of this commissioning report should be appended to the information provided under standard 6.8.

6.8 Written information

Mandatory Standard

Standard 6.8

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

u) on the operation and maintenance of the building services and energy supply systems;

v) where any air-conditioning system in the building is subject to regulation 17, stating a time-based interval for inspection of the system; and

w) Where zero direct emissions heating or cooling is not provided to a new building, information to enable simple and low cost retrofit of such a solution is provided.

Limitation:

This standard does not apply to:

x) major power plants serving the National Grid

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

z) the process and emergency lighting components of a building

aa) heating provided solely for the purpose of frost protection

bb) lighting systems in a domestic building, or

cc) 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 enable efficient use, unless they are exempt under schedule 1, regulation 3.

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.

From 2024, new buildings will be required to use 'zero direct emissions' (ZDE) heat solutions. There is a similar intent for the for deployment of low and zero emissions heat

within our existing building stock. To assist building owners understand what such an alteration will entail, information should be provided which sets this out.

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, ventilation, cooling and hot water service system, any additional low carbon equipment installations and any decentralised 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 Quick Start Guide

In addition to comprehensive information provided under clause 6.8.1, a quick start guide, identifying all installed building services, the location of controls and identifying how systems should be used for optimum efficiency should be provided for each new dwelling. Further information and an example of such a guide can be found within Section 7 (Sustainability) – refer to Annex 7B.

The quick start guide should include a copy of the information required under standards 3.28 on mitigating measures to reduce overheating within the building.

6.8.3 Information to enable future retrofit of zero direct emissions heating

Where a new building is not constructed with a recognised Zero Direct Emission heat solution meeting all heat needs, the occupier shall be provided with information that sets out the process and work involved to deliver that adaptation, simply and without disruption beyond the immediate vicinity of the current heat source.

In this respect, where the current heat source is a combustion appliance (boiler), information on a zero direct emission replacement heat source shall include a solution in addition to any information on the direct replacement of the combustion appliance with an electric boiler.

The information provided shall include, but not be limited to:

- A specification which defines or would enable selection of a new heat source based upon the current calculated heat demand, heat distribution and hot water.
- Other information sufficient to enable a quotation for such a replacement heat source to be sought from an installer.
- Written advice on the impact of the suggested replacement heat source on the energy and emission performance of the dwelling and the comparative running costs for heating and hot water (this may be drawn from SAP data).

This information shall be appended to the Quick Start Guide noted in clause 6.8.2.

6.8.4 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

Mandatory Standard

Standard 6.9

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, and *

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

Limitation:

d) This standard does not apply to:

i. buildings which do not use fuel or power for controlling the temperature of the internal environment

ii. non-domestic buildings and buildings that are ancillary to a dwelling that are stand alone having an area less than 50 square metres

iii. conversions, alterations and extensions to buildings other than -

(aa) 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, and

(bb) alterations to buildings involving the fit-out of the building shell which is the subject of a continuing requirement, or

iv. limited life buildings which have an intended life of less than 2 years.

e) Standard 6.9(c) only applies to buildings:

i. with a floor area of more than 250 square metres

ii. into which members of the public have an express or implied licence to enter, and

iii. which are visited by members of the public on at least a weekly basis

* Standard 6.9(b) removed by the Building (Scotland) Amendment Regulations 2008 (http://www.legislation.gov.uk/ssi/2008/310/contents/made).

Note: Standard and Guidance not updated as part of this review.

6.10 Metering

Mandatory Standard

Standard 6.10

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

Limitation:

This standard does not apply to:

a) **domestic buildings**

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

c) **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.