BUILDING STANDARDS DIVISION

BSD WORKING GROUP FOR THE 2021 REVIEW OF STANDARDS AND GUIDANCE ON ENERGY

Existing Buildings - Domestic

1. Introduction

1.1 This paper sets out the existing approach for new work to existing buildings, offers some proposed changes to the approach and sets out key points for discussion.

2. Background to current guidance

2.1 In the guidance to the building standards there are 4 main types of work that relate to existing domestic buildings. These are:

a) Extension to a dwelling.

b) Conversion of a non-dwelling to a dwelling or dwellings or conversion of an unoccupied part of a dwelling to become habitable (e.g attic conversion)

c) Alterations to a dwelling.

d) Creation of a stand-alone building, e.g. a conservatory.

2.2 The term ‘conversion’ is defined as making “such change in the occupation or use of the building as specified in schedule 2 to regulation 4”. For example the creation of a dwelling or dwellings by converting an office or changing a garage to a bedroom in an existing dwelling.

2.3 A stand-alone building means a building, other than a dwelling, and includes an ancillary building or part of a building which is detached or thermally divided from the remainder of the main building.

2.4 A ‘conservatory’ is defined as a building with certain defined proportions of translucent glazing, attached to a dwelling with a door and other building elements dividing it thermally from that dwelling. It is a type of stand-alone building.

3. Principles being applied in review of current provisions

3.1 The following principles are applied in the proposals set out below:

- Values set in guidance as minimum performance standards will be based upon evidence, where available, of current construction practice and analysis of recent build trends.
- As review increases the level of fabric specification sought from work to existing buildings, it becomes more challenging to set or justify more than one set of elemental standards. The intent is therefore to set a simple and

robust set of elemental standards for all work to buildings, extending this further than just U-values where practicable (e.g. all newbuild construction).

- For situations where standards can be met as far as is 'reasonably practicable', be this for a conversion or where avoidance of technical risk from improvement is an issue, we will seek to reinforce the need for robust assessment to determine the optimal level of specification for a given situation. A more evidence-led assessment to optimise improvement also aligns with the intent set out within our Energy Efficient Scotland Programme and the Compliance Plan approach being developed for implementation.
- In setting elemental standards for fixed building services, we intend to continue to align guidance on performance of products and systems with that being considered by review across the UK. This is to reflect the status of such services as manufactured products, developed and placed on a UK or Europe-wide market and to enable continued access to a choice of readily available solutions.

4. Extension of dwellings

4.1 Standard 6.1 does not apply to extensions to domestic buildings (other than large stand-alone buildings), accordingly the primary driver for reducing energy demand and emissions in extensions relies primarily upon the performance of the new building fabric.

4.2 The guidance sets elemental area weighted average U-values that the extension should be built to. There are two sets of weighted average U-values cited for walls, floors, roof, windows, doors and rooflights and the relevant set the building should meet is determined by the energy performance of the existing building.

4.3 The weighted average U-value approach allows areas of the same building element to have a poorer average performance that the other parts of the element, however, this will require to be compensated for by improved average performance for the other parts of the element. The flexibility of performance is limited by the cited individual element values that cannot be exceeded.

4.4 At present, where the existing dwelling has wall or roof U-values poorer than 0.7 or 0.25 respectively then the more onerous elemental values should be met. For other dwellings the less onerous U-values may be met.

4.5 It is proposed to simplify the approach to setting the performance of extensions by citing a single set of area-weighted average U-values that will apply irrespective of the fabric performance of the existing building. The rationale for this is that, whilst we want all new construction work to achieve the highest practicable level of performance, as we set more challenging elemental values it becomes less viable to define an additional enhanced level

for poorer existing dwellings without this resulting in the need to consider different construction methods. Guidance should set a platform that supports consistency of approach and solution across all new construction, both new homes and extensions.

4.6 We propose to apply the same backstop values for extensions as are defined for other newbuild construction work and are used to set the proposed new fabric standard (see paper WG 22 (21)).

4.7 It is therefore proposed to consult on setting the area-weighted average U-values for all extensions at the two levels of improvement shown in the table below.

Element	**Current extension weighted average U-values**		**Proposed weighted average U-values to consult on**	
	U-Values for wall and roof of the existing dwelling are poorer than 0.7 and 0.25 respectively	All other existing dwellings	Improved	Advanced
Wall	0.17	0.22	0.17	0.16
Floor	0.15	0.18	0.15	0.13
Roof (ties)	0.11	0.15	0.12	0.10
Roof (flat or warm)	0.13	0.18	0.12	0.10
Openings	1.4	1.6	1.4	1.2
Thermal Bridging	n/a	n/a	0.08	0.06

Table 1 – revised backstop values for building fabric – all new work

4.8 As noted in commentary on the newbuild fabric target paper (WG 22 (21)), these values are currently being achieved in more than 50% of new construction (for ‘improved’) and 33% of new construction (for ‘advanced’). This again reinforces the need to respond to evidence from building completions that a default position in many developments is to build to the

fabric backstops. WG members will note that the former is robust and challenging from the perspective of new construction generally. This does not deliver an appreciable change in overall specification of 2015 elements for extensions where the existing dwelling has poorer fabric but, applying in all cases, will further reduce the overall heat loss associated with dwelling extensions.

4.9 Whilst further improved backstops are shown against the 'advanced' option, there is a need for discussion on the viability of their application at this time, as noted in paper WG 22 (21) for newbuild backstops.

4.10 We propose to remove individual element information from the table as this relates not to energy efficiency but to avoidance of condensation and mould growth. This will be presented as a paragraph of text instead with supporting information on the risks arising from areas of excessive local thermal bridging, linking to guidance within section 3 (environment).

4.11 Additionally, we will introduce guidance on the need to calculate heat loss from thermal bridging at junctions within any extension and set a limiting parameter for this value, again reflecting the expectation set for new homes.

Question 1: BSD welcome the thoughts of the working group on the proposed fabric performance values proposed for extensions.

4.12 To limit heat loss through openings, the area of windows, doors, and roof lights within an extension remains 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.

4.13 To provide further flexibility in design the building standards allow the compensatory approach to be followed. The 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 relevant area weighted average U-values 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.

4.14 The guidance also allows the standard to be met by taking a whole dwelling approach and using SAP where there is sufficient data available for the existing dwelling. At present, this references compliance of the whole dwelling, as extended, with current standards. We propose to amend this to act as an extension of the compensatory approach whereby the dwelling elements remain static and the calculation demonstrates that the dwelling plus proposed extension has a heat loss no greater that the dwelling plus notional extension.

4.15 It is proposed to retain the notional extension area of openings limitation (25%) and both the compensatory approach and amended SAP calculation option in the new guidance.

4.16 Given that the compensatory approach can be applied, we would welcome a short discussion on whether this should become more of a default premise – that it is the overall heat loss for an extension that is defined (via the performance of elements) and that the designer may then meet that in whatever way is deemed most useful for the building in question.

Question 2: Is the current elemental approach for extensions still considered appropriate?

5. Conversions

Conversion of unheated buildings

5.1 Where an existing building changes its use to become a dwelling, or dwellings, this constitutes a conversion as defined in schedule 2 to regulation 4 of the Building (Scotland Regulations 2004. A conversion also occurs where a previously unoccupied part of a dwelling becomes habitable, such as extending into the attic space.

5.2 It should be noted that the standard and guidance for conversions also apply where a defined conversion does not occur but heating is introduced to a building that was previously un-heated.

5.3 Standard 6.1 does not apply to conversions and the primary means of reducing heat demand in conversion remains the performance of the building fabric, supplemented by effective services and controls installed therein to meet that demand most effectively.

5.4 For conversions of unheated dwellings, it is the intention that the standards achieved in the converted building should be broadly similar to those achieved by extensions, where ‘reasonably practicable’. The verifier has discretion as to what can be considered ‘reasonably practicable’ in respect of work carried out, including the cost of carrying out the work. It is the area weighted U-values from column 3 of Table 1 (above) that the converted building is expected to achieve in that respect.

5.5 It is proposed to retain the existing approach taken for conversions of unheated buildings with the fabric values to be achieved matching that for extensions (and other new construction) as proposed in the table above.

5.6 It should be noted that, at present, the compensatory approach option for extensions may not be used where a building is converted unless elemental values are met in full. Any re-evaluation of that process for extensions (via an overall heat loss parameter) would also be available for use in demonstrating compliance of a conversion. Nothing that a more qualitative approach to non-repeating thermal bridging, rather than calculation, may be needed when working with existing building fabric.

5.7 To meet our climate change targets it is likely that the majority of our existing building stock will have to improve their energy performance along with installing appropriate low or zero emissions heating systems. To minimise the risk of converted buildings having to be retrofitted at some point in the future as a consequence of future legislation considering the improvement of the existing stock we will strengthen the guidance on the need for robust evidence to demonstrate the practical limitations of improvement to thermal elements to meet the recommended level of performance is not reasonably practical and how this is presented to the local authority verifier.

5.8 The intent of this revision is to give more assurance of the rigour of approach in the improvement of fabric in converted buildings so that they are more broadly compatible with low temperature heating systems or to meet energy performance targets set for the existing building stock through future legislation.

Question 3: Do the members consider maintaining the current approach to converting un-heated buildings should be retained, subject to the proposed more robust analysis and reporting?

Conversion of heated buildings

5.9 Where an existing heated building is converted the impact on emissions and primary energy use will not be to the same extent as converting an unheated building. Accordingly the weighted average U-values that should be achieved are less demanding than those called for in converting an un-heated building.

5.10 As outlined above, an outcome we wish to achieve through the next set of energy standards is the provision of buildings that are unlikely to require future retrofit to meet our climate change targets. Therefore, we propose that a conversion of a heated building should deliver the same level of energy performance as that of a new build construction in terms of fabric performance where it is reasonably practical to do so. As for conversions of unheated building we propose to strengthen the guidance on the need for robust evidence where achieving the recommended level of performance is not reasonably practical.

Question 4: What are the thoughts of the group on strengthening the guidance on the robustness of evidence required to demonstrate that meeting the cited U-values are not reasonably practical for all conversions?

Conversion of historic, listed or traditional buildings

5.11 Whilst the Planning terms ‘historic’ and ‘listed’ are familiar a ‘traditional building may be less so. Traditional buildings are defined as buildings constructed before, or around, 1919 that have permeable components that assist in dissipating moisture.

5.12 The guidance at present calls for the converted building to aim to meet the standards applicable to conversions of heated or un-heated buildings. However, the guidance is clear that a flexible approach to improvement needs to be taken which takes account of the compatibility of the form, character and construction of the building.

5.13 A 'do nothing' approach is not recommended and achieving the individual element U-values in the table above should at least be achieved.

5.14 Recognising the added complexity converting these types of buildings can present, we do not intend to amend the guidance for these buildings other than to cite the improved levels of performance that the developer should aim for and, as is the case with conversions more broadly, reinforce the need for a robust and evidenced assessment of the capacity for practical improvement.

6. Alterations

6.1 The table below summaries the current guidance covering alterations to a dwelling.

Alteration	Guidance
Infills <4m^2	Match the performance of the remainder of the surrounding element, however, walls and floors should be no worse than 0.7 respectively and 0.35W/m^{2}K for roofs.
Infills >4m^2	Meet the less onerous values for extensions (alternatively follow guidance for small infills and compensate the energy deficit elsewhere in the building).
Internal element that becomes external	As per infills>4m^2
Windows, doors and rooflights	Meet the less onerous values for extensions with the option to take a compensatory approach.
	Where only 1 or 2 units are being replaced they may achieve a centre pane U-value of 1.2W/m^{2}K.
	Where additional windows are proposed they (existing and new) should not exceed 25% of the total floor area of the dwelling.
Reconstruction of elements	Meet the less onerous values for extensions as far as is reasonably practicable but the values of 0.35 and 0.7 should at least be met for roofs and walls respectively.

	Buildings in a ruinous condition should be improved close to that expected of a new building as far as is reasonably practicable.

6.2 Due to the limited area being altered we do not propose amending the guidance for infills < 4m^2.

6.3 For infills exceeding 4m^2 and for internal elements becoming external we propose that such work should deliver the same level of energy performance as that of a new build construction in terms of fabric performance and the two options for uplift are offered within the consultation. Applying the revised approach to 'reasonably practicable' to enable solutions to consider issues of technical risk that may arise from improvement.

6.4 We are considering removing the option that allows applicants to follow the guidance for small infills and compensate for the energy deficit by upgrading other parts of the insulation envelope. The rationale for this approach is that it simplifies the guidance and consider it unlikely that building owners would consider upgrading other elements of the building that were no proposed to be altered.

6.5 For windows, doors and rooflights we propose calling for the elements to achieve the level of performance proposed for new dwellings but retain the compensatory approach.

6.6 Where only 1 or 2 units are being replaced we propose retaining the option to match the replacements with the remaining windows and allow a centre pane U-value of 1.2W/m^{2}K to be met.

6.7 We also propose retaining the limitation of 25% glazing as a percentage of the total floor area. We will consider alternative guidance on introduction of glazing not resulting in an increase in the overall heat loss of the dwelling by making improvements elsewhere in the dwelling.

6.8 Where elements are to be reconstructed we propose to call for such work to align with the performance level of new builds but only in so far as this is reasonably practicable and retain the backstop values of 0.35 for roofs and 0.7 for walls and floors.

Question 5: What are the groups thoughts on the proposed approach for alterations to existing buildings?

7. Thermal bridging and air infiltration

7.1 It is proposed to retain the guidance that calls for consideration to be given to heat loss from thermal bridges and air infiltration where an existing building is altered or converted. But for extensions, to seek a calculation of this element of heat loss as part of the assessment of heat loss.

8. Conservatories & Stand-alone buildings

8.1 Standard 6.2 calls for conservatories to have an insulated envelope that reduces heat loss irrespective of it being heated or not. This approach does not align with the application of the standards to any other building type. For example, standard 6.2 only applies to a stand-alone building where it is heated. Such buildings can bear a very similar resemblance to a conservatory.

8.2 We understand the rationale for this approach was in recognition that conservatories are now commonly used all year round and, therefore, heating will often feature in such buildings either from the outset or be introduced at a later date. To address carbon emissions associated with the latter the standard applies irrespective of whether the conservatory is heated or not.

8.3 Whilst this appears a sensible, pre-emptive approach to take, some concerns are expressed that it is not for the building standards system to implement standards based on a potential future heating situation. Furthermore, it does not appear equitable to apply the standard to an un-heated conservatory but not to other un-heated stand-alone buildings such as a highly glazed sunroom.

8.4 We therefore welcome the working groups thoughts on this matter in terms of application of standard 6.2 to all stand-alone buildings that are attached and accessible from the dwelling and are typically used as an extension to the dwelling.

Question 6: What are the working groups thoughts on the application of the standard to stand-alone buildings that are likely to be used as an extension to the dwelling irrespective of whether they are heated or not?

8.5 With regard to the fabric of conservatories and other stand-alone buildings we intend to follow the approach taken for the other construction work outlined in this paper and call for the elements to deliver the same level of energy performance as that of a new build construction and meet the values table 1 above.

Question 7: BSD welcome the thoughts of the working group on the proposed fabric performance values proposed for stand-alone buildings.

9. Services

9.1 The majority of the guidance supporting building standards 6.3 through to 6.8 is contained within the Domestic Building Services Compliance Guide. For the amendments to the energy standards in 2007, 2010 & 2015 the guidance provided on services in Scotland aligned with the recommendations for services adopted throughout the rest of the UK. We intend to replicate this approach for the revised standards.

9.2 The compliance guides, which applies to both new and existing buildings, provides guidance on the following aspects of building services:

a) System efficiencies

b) Controls

c) Limiting heat loss

d) Commissioning

e) Written information (for the building occupant)

9.3 To a large extent much of the proposed guidance on services developed for review elsewhere in the UK remains unchanged for the aspects relating to controls, commissioning and written information.

System efficiencies

9.4 The guidance has been updated in respect of the minimum efficiencies that new installations, and replacement systems in existing buildings, should meet.

System	**2015 Guidance**	**Proposed Guidance**
Gas Central Heating Boiler	88% SEDBUK 2009	92%ErP[1]
Oil Central Heating Boiler (Regular)	88% SEDBUK 2009	91% ErP[1]
MVHR (heat recovery efficiency)	70%	73%
Warm water and hot water heat pumps	Air to air < 12kw = SCOP D 2.5 space heating new new dwellings 2.2 space heating in existing dwellings 2.0 domestic hot water	No change 3.0 3.0 No change
Air cooled air conditioners	SEER 2.4	SEER 4.0
Internal Lighting	‘luminous efficacy greater than 45 lamp lumens /circuit watt for 3 out of 4 fittings	All fittings to have efficacy more than 75 lamp lumens/circuit watt
External lighting	Either: Lamp capacity < 100 lamp watts per fitting, and auto control to switch off	Where lamp efficacy <75 lumens/circuit watt auto control to switch off where area unoccupied

	where area unoccupied and all lamps switch of in daylight Or: Lamp efficacy >45 lumens/circuit watt, and All lamps switch off in daylight	Auto controls to switch off in daylight

[1] The Eco-design Regulation 2009/125/EC introduced a new standardised calculation method to determine the seasonal efficiency of heating appliances. In 2015 this metric was adopted in the UK replacing the UK specific SEDBUK system.

Question 8: Are there any services not included in the above table where members consider improved performance should be cited?

New provisions

9.5 The following new provisions are proposed for inclusion within the revised services guidance.

9.6 Replacement fixed building services

9.6.1 Replacement fixed building services should either:

- Use the same fuel as the service being replaced and have a seasonal efficiency not worse that the service being replaced, or
- Use a different fuel than the service being replaced. In such cases the system should not produce more carbon emissions or have a greater primary energy demand than the appliance being replaced.

9.6.2 This provision for no increase in carbon emissions is already required through English building regulations but has been amended to also account for primary energy.

9.6.3 In the 2015 energy standards, when transposing guidance on services from standards 6.3 to 6.8 into the Compliance Guides, the Scottish Government decided not to adopt this approach on the grounds that it may have prevented the replacement of a lower carbon fuel which was not performing for the building occupants with a more appropriate heating system using a different fuel source. However, we now consider such a requirement aligns with the agenda to decarbonise heating systems and should be introduced into the guidance.

9.7 Self-regulating temperature devices

9.7.1 The 2018 Energy Performance of Buildings Directive (EPBD)called for member states to introduce requirements for installing self-regulating

temperature devices (such as thermostatic radiator valves) in new buildings and in existing buildings where the heat generator is replaced where it is technically and economically feasible.

9.7.2 The current technical handbook guidance calls for individual radiator controls (such as TRVs) to be installed where new heating systems are being installed. However, there is no requirement to provide self-regulating devices where a boiler is being replaced.

9.7.3 Accordingly, the guidance will be amended to address the EPBD requirement for the provision of self-regulating devices where a heat generator is replaced. The guidance will also advise that provision of self-regulating devices is not required where zones may be controlled rather than individual rooms.

9.8 Insulating heating pipes.

9.8.1 The guidance will be updated with a new table (see table 4.4 below) that sets out the minimum insulation thickness that should be provided to heating pipes relevant to the internal pipe diameter (based on BS 5422: 2009).

9.8.2 This offers a simplified approach compared to the current table that specifies a maximum heat loss relevant to the internal pipe diameter.

Table 4.4 Minimum thicknesses of pipework insulation for hot water services and space heating applications using high performance insulation

Nominal internal pipe diameter (mm)	Minimum insulation thickness[1] (mm) for low temperature hot water systems
Less than or equal to 10	5
Less than or equal to 25	10
Less than or equal to 50	15
Less than or equal to 100	20

NOTES:
[1]Thicknesses apply for insulation with a thermal conductivity of 0.025W/m.K or better. For other circumstances consult **BS 5422**.

9.9 Standing heat losses from hot water storage cylinders

9.9.1 The guidance will be updated with a table (see table 4.5 below) that confirms the maximum daily heat loss for hot water cylinders.

Table 4.5 Maximum daily heat loss for a hot water cylinder[1]

Nominal volume (litres)	Heat loss (kWh/24h)	Nominal volume (litres)	Heat loss (kWh/24h)
50	1.03	400	2.59
100	1.49	500	2.80
150	1.88	600	2.98
200	2.06	700	3.14
250	2.22	800	3.29
300	2.36	900	3.44
350	2.48	1000	3.57

NOTES:
[1]The heat loss from cylinders larger than 1000 litres should not exceed $(16.66 + 8.33 \times V^{0.4})/(1000 \times 24)$ where V is the volume in litres.

9.10 Sizing of heating and hot water systems & Space/Comfort Cooling

9.10.1 New guidance will be provided that calls for space heating systems to be sized based on a suitable methodology such as the Energy Savings Trust CE54 Domestic Heating Sizing Method or the Chartered Institute of Plumbing and Heating Engineering's Plumbing Engineering Services Design Guide.

9.10.2 For new or replacement wet heating systems in existing buildings the guidance will call for the system to be sized to allow it to operate effectively at a flow temperature of 55°C. Where effective operation at this temperature is not possible then the system should be designed to operate at the lowest design temperature that will meet the needs of the dwelling.

9.10.3 For domestic hot water systems the guidance will call for the system to be sized for the anticipated hot water demand of the building based on BS EN 12831-1 or the Chartered Institute of Plumbing and Heating Engineering's Plumbing Engineering Services Design Guide.

9.10.4 New guidance will call for the specification of space cooling systems to be based on an appropriate heat gain calculation for the building, based on CIBSE's Design Guide A and by following the manufacturer's guidance.

9.11 Continuous supply input and extract ventilation

9.11.1 A new requirement is proposed to call for any packaged ventilation system providing both supply and extract ventilation to have:

a) Heat recovery system
b) Summer bypass
c) Variable speed controller

Question 9: Do the working group members consider this is an appropriate approach to take in Scotland?

9.12 'Boiler Plus'

9.12.1 'Boiler Plus' is the name given to requirements introduced in England in 2018 that apply to replacement of gas combi boilers. Where a gas combi boiler is being replaced an additional energy efficiency measure has to be installed with the options being:

a) Flue gas heat recovery
b) Weather compensation
c) Load compensation
d) Smart thermostat with automation and optimisation

9.12.2 We also propose to introduce these requirements which will provide some efficiencies in the most commonly adopted heating systems in Scotland.

10. Commissioning

10.1 There is an existing requirement in England for a Commissioning Plan to be provided to the building control body that sets out the systems that have to be tested and how they will be tested. In addition, on completion of the commissioning a commissioning notice has to be provided to both the building control body and the building owner. The notice confirms:

a) The commissioning plan has been followed
b) Every system has been inspected in an appropriate sequence
c) The test results confirm performance is reasonably in accordance with the design requirements.

10.2 The building control body may not consider it appropriate to issues a completion certificate.

Question 10: Do the working group consider adopting a similar requirement for a commissioning plan and notice would provide greater assurance that services have been installed and operating as designed?

11. Domestic Building Services Compliance Guide

11.1 Unlike the other sections of the building standards the guidance applicable to the services standards are provided with the Domestic Building Services Compliance Guide (services guide). A further deviation from the other guidance is the provision of additional good practice information. This aligns with the approach taken in England and Wales.

11.2 In England they intend to incorporate all the key guidance within the approved documents and no longer make reference to supplementary advice. This is to simplify the guidance for services.

Question 11: We would welcome the working group members thoughts on what approach Scotland should take to the services guide.

Options that could be considered are:

a) Retain the format as it currently exists.
b) Retain the services guide publication but only cite the guidance relevant to the standards and remove all the supporting good practice information.
c) Incorporate the guidance relevant to the standards within the Technical Handbooks.