BRE

RdSAP10 Specification

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BRE
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Reduced Data SAP specification v.10 for existing dwellings (former appendix S)

1 INTRODUCTION

Reduced data SAP (RdSAP) is the UK approved[1] methodology for assessing energy performance and generating EPCs for the existing dwellings.

According to The Energy Performance of Buildings (England and Wales) Regulations[2] the energy performance is expressed as "asset rating" (which is a numerical indicator of the cost of energy derived from the energy needed to meet different needs associated with standardised use of building) calculated in a way approved by the Secretary of State under Regulation 24 of the Building Regulations 2010[3].

The methodology is compliant with the Energy Performance of Buildings Directive (2018/844/EU)[4]. following the national annexes of the overarching standards, namely ISO 52000-1, 52003-1, 52010-1, 52016-1, and 52018-1, developed under mandate M/480 given to the European Committee for Standardisation (CEN).

RdSAP specification has been developed by BRE on behalf of the government for use in existing dwellings based on a site assessment of the property, when the complete data set for SAP calculation is not available. It consists of a system of data collection (defined in **Table 30 : Addendum**) together with defaults and inference procedures, as defined by the rules given in this document, that generate a complete set of input data for the SAP calculation. For any item not mentioned in this document, the procedures and data given elsewhere in the SAP10.2[5] specification apply.

The calculation should be conducted using a computer program that implements the RdSAP10 Specification (this document), the appropriate parts of SAP10.2 specification and the worksheet referred to in this document and is approved for RdSAP calculations.

Reduced Data SAP is for existing dwellings only. Any new dwelling must be assessed using SAP specification and software.

The RdSAP calculation starting from reduced data is done in two stages. First the collected data (reduced data set) is expanded into a full data set, and then the SAP calculation is undertaken using the expanded data set. The SAP calculation is therefore identical, whether starting from a reduced data set or a full data set.

This version of RdSAP forms part of SAP 10.2 specification and provides a data input set for use with version 10.2 of SAP. All references made to SAP in this document refer to SAP 10.2, unless otherwise stated. RdSAP Specification contains the data and rules for expanding the data collected in a Reduced Data assessment into the data required for the RdSAP calculation. **Table 31 : Data to be collected** lists the Reduced Data set.

Information in RdSAP Conventions[6] is primarily concerned with the consistency of data collection and is addressed to energy assessors. RdSAP Assessors should read RdSAP specification in conjunction with the RdSAP Conventions applicable at the time of assessment.

[1] Notice of approval of the methodologies for expressing the energy performance of buildings in England and Wales - GOV.UK (www.gov.uk)
[2] The Energy Performance of Buildings (England and Wales) Regulations 2012 (legislation.gov.uk)
[3] The Building Regulations 2010 (legislation.gov.uk)
[4] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast) (legislation.gov.uk)
[5] SAP 10.2 - 21-04-2022.pdf (bregroup.com)
[6] SAP10 - Standard Assessment Procedure - BRE Group

Any deviation from the RdSAP10 specification described in this document and RdSAP Conventions applicable at the time of assessment invalidates the calculation and therefore cannot be used for generating EPC.

This edition is RdSAP10.

Significant changes compared to RdSAP2012 specification include:
- Window measurements required for all windows
- Location of each window allocated to main walls or each extension, or alternative walls
- Thermal properties of insulation revised
- Roof insulation details have more options
- Floor insulation revised; heated basement details added
- Table of Window U-Values expanded
- U-values of brick wall revised to account wall thickness
- U-values of stone walls revised
- Curtain wall added as new wall type
- Window shutters added as a new feature
- Hot water tank size included
- Hot water tank insulation included
- Room in roof (RR) revised to take into the account all elements inclu9ding continuous main wall
- Additional alternative/shelter wall added
- Mechanical ventilation is treated as in full SAP allowing PCDB entry, still allowing default values
- PV calculated as in SAP10.2
- PV Diverter for water heating added
- PV Batteries added
- Ventilation algorithm allows more options
- Air pressure test result can be used if available
- New age-band M added, and all tables of U-values updated
- Data for Isle of Man added for completeness of information
- Table 32 with the RdSAP10-specific fuel prices replaces fuel prices in Table 12 of SAP10.2
- RdSAP10-specific metrics added to replace SAP metrics in SAP10.2
- Small scale hydro added as in SAP10.2
- Flue gas heat recovery -calculation according to SAP 10.2.
- Waste water heat recovery - calculation according to SAP 10.2.
- Heat pumps - Calculation according to SAP 10.2.

Changes to Table 21 of improvement measures (former RdSAP Appendix T) include:
- Improved U-values revised for all building elements
- Measure to insulate party wall removed
- Order of measures for Northern Ireland removed
- Air and ground source heat pumps not alternative measures anymore
- PV battery and PV diverters added

2 DEFINITIONS OF THE EXTENT OF THE DWELLING

2.1 Dwelling types

Dwellings are classified as one of
- house
- bungalow
- flat
- maisonette
- park home

For houses and bungalows one of
- detached
- semi-detached
- mid-terrace
- end-terrace
- enclosed mid-terrace
- enclosed end-terrace

For flats and maisonettes one of
- ground floor
- mid floor
- top floor

A house or bungalow has a complete heat loss ground floor and a completely exposed roof (it includes houses and bungalows with room in roof and with basements).

The approach to **Rooms in Roof** is given in section **4.9**.

The rules for including **Rooms in Roof** and **Basements** are included in the RdSAP Conventions applicable at the time of assessment.

A dwelling without a heat loss ground floor cannot be a house and must be treated as a flat or maisonette.

RdSAP makes no distinction between a flat and a maisonette as regards calculations; it is acceptable to select either type as definitions vary across the UK.

'Enclosed' is typically applicable for 'back-to-back' type of terraces and has the following meaning:
– a mid-terrace dwelling has external walls on two opposite sides; while
– an enclosed mid terrace dwelling has an external wall on one side only;
– an end-terrace dwelling has three external walls;
– an enclosed end-terrace dwellings has two adjacent external walls (effectively forming a corner) on two facades and two adjacent party walls on the other two facades.

2.1.1 Building part and Building element

Building parts are:
- main dwelling
- extension 1
- extension 2
- extension 3
- extension 4

Building elements of each building part are:
- wall
- roof
- floor
- window/door
- room in roof

2.2 Extensions

An extension is when another room/s added to the building to make an existing one/s larger.

The term 'extension' is used in RdSAP to identify areas of the dwelling that are thermally different to the main dwelling.

Provision is made for the main dwelling and **up to four extensions**, each with their own age band, dimensions and other characteristics.

2.3 Building elements having different construction

In addition, dwellings can have a different construction for some parts of the building elements (for example, a timber framed bay window in otherwise masonry construction).

If the area of a building element with a different construction is less than 10% of the total area of the building element, it can be assumed to be the same as prevailing building element of that building part.

However, if thermal properties of insulation are specified in form of U-values (rather than thickness of insulation) then the area of an alternative element which is less than 10% of the total area of the whole element can be accounted as area-weighted average U-value of the building element.

Generally, rooms and other spaces, such as built-in cupboards, are included as part of the dwelling where these are directly accessible from the occupied area of the dwelling, whereas unheated spaces clearly divided from the dwelling are not.

2.4 Walls (sheltered, alternative, party)

RdSAP allows the following types of walls: main walls, sheltered walls, alternative walls and party walls.

2.4.1 Sheltered walls

A sheltered wall is a wall adjacent to an unheated corridor or stairwell, typically found in blocks of flats, but can be found in houses and bungalows. Sheltered walls are always included in the heat loss perimeter.

The sheltered wall can be in any building part but must be recorded as an alternative wall.

See also sections **4.2.2**, **4.7** and **4.13.**

See RdSAP Conventions for the details of specifying shelter wall.

2.4.2 Alternative walls

If there are two areas of external wall of different construction types within a building part that should be regarded as alternative wall. Each building part can have two alternative walls.

An alternative wall can be:
(i) A sheltered wall (to unheated corridor or stairwell), or
(ii) A wall that has a construction type or heat-loss characteristics (U-value) different from the main external wall.

Alternative walls are always included in the assessment in case (i);
and in case (ii) treated according to section **2.3** if less than 10% of total exposed wall area of the building part (including windows and doors).

See also section **4.2.2** for areas and dimensions of alternative walls.

Refer for RdSAP conventions for further details.

2.4.3 Party walls

Party walls are walls between the dwelling being assessed and another heated space which can be:
- another dwelling
- commercial premises
- a heated corridor or stairwell in a block of flats
- a heated common area

2.5 Curtain wall (type of main wall)

Unlike other walls, a curtain wall system is thin and lightweight, usually consists of assemblies consisting of aluminium or steel frames and glass. These walls are not usually structural, and by design, they are only able to carry their own weight, while transferring the load of wind and gravity to the structure of the building. The assemblies are attached to the building structure by mullions and transoms. The design makes it air and water resistant, to ensure that the interior of the building remains airtight.

Regardless of which material used, curtain walls are usually non-structural, which differs from many forms of traditional construction where all external walls are an integral aspect of a building's primary structure.

Curtain wall system can be installed in small or large buildings, depending on the needs. The curtain walls may span the distance of the floor to ceiling or be installed across multiple floors. Some curtain wall systems also make use of other in-fills from materials such as stone, veneer or metal panels.

Curtain wall can be:
- main wall (in this case the available U-value is for the whole wall including translucent and non-translucent parts)
- an alternative wall
- treated according to section **2.3** if its area is less than 10% or total wall area (i.e. its area included into the area of prevailing wall)

2.6 Basements

Basement is the floor of the building which is partly (at least 50%) or entirely below ground level.

Included when accessed via a permanent fixed staircase such that one is able to walk downwards facing forwards and either:-
- basement is heated via fixed heat emitters, or
- basement is open to the rest of the dwelling, - (no door or internal door)

Does not necessarily contain habitable rooms.

See also section **4** for areas and dimensions and **Table 23 : Basement U-values**.

2.7 Rooms within a Mansard roof

A storey having non-vertical walls of at least 70° pitch constitutes a separate storey; it is not treated as roof rooms and 1.8m rule described in sections **2.16.2** and **4.9.2** is not applicable.

Use alternative wall if appropriate.

2.8 Whole dwelling (or building part) within roof

When property is a single storey entirely located within a roof, enter it as:

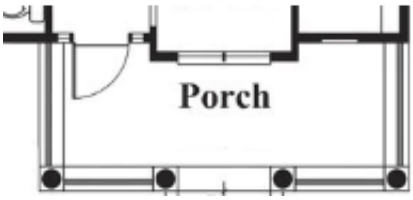
- Built form - flat
- Lowest occupied level
- Below this building part – another dwelling below
- timber frame construction of appropriate age band
- room height 2.2 m
- include area and perimeter measurements as a normal storey
- enter roof as pitched roof.

For such dwellings with non-timber gables treat gable walls as "alternative wall".
If there are two storeys within roof, enter the lower storey as above and the upper storey as rooms-in-roof.

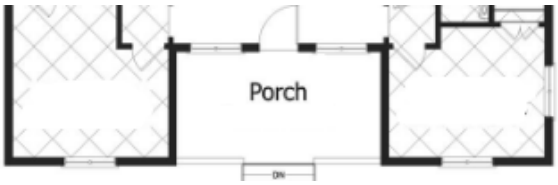
2.9 Porches

Porch is a shelter projecting of the heated envelope of the dwelling.
It could be an external porch (outside the door) usually with a separate roof or internal porch (behind the door).

A floor above internal porch is a semi-exposed floor.
See sections **2.3 Building elements having different construction** and **4.11 Heat loss area for houses and bungalows.**



External porch



Internal porch

If heated by fixed emitters always include (separated or not).
If external, thermally separated and not heated, disregard.
If internal, not heated and thermally separated, disregard.
('external' means an addition protruding from the line of the external wall of the dwelling).

2.10 Mezzanine floor

A mezzanine is an intermediate floor in a building which is partly open to the floor below, or which does not extend over the whole floorspace of the floor, e.g. where the original floor has been split horizontally into two floors.
Refer to RdSAP Conventions.

2.11 Extensions

An extension is when another room/s added to the building to make an existing one/s larger.
See relevant RdSAP conventions.

2.12 Store room / utility room

Rooms used as storage / rooms equipped with appliances for washing or other domestic work.

If heated by fixed emitters always include.

If accessible only via a separate external door and not heated, disregard.

If directly accessible, not heated and thermally separated, disregard.

2.13 Garages

Unheated garages are excluded from the assessment.

If heated from main heating system or fixed emitters, always include.

The presence of a boiler within the garage does not make it heated.

A door from inside the dwelling into the garage is included in the 'external' door count.

2.14 Dwelling adjacent to commercial premises or other unheated space above

If a dwelling has commercial premises or other unheated space above refer to **Table 18 : Assumed roof U-values when Table 16 or Table 17 do not apply**.

In the case of unheated space above a building part, use U-values for the "Flat roof" in **Table 18** column (3) and apply resistance Ru=0.5 m²K/W in the equation:

$$U = \frac{1}{\frac{1}{U_{flat\_roof}} + R_{unheated\_space}}$$ where $R_{unheated\_space}$ is 0.5 m²K/W

Where: U_{flat_roof} is value from column (3) in **Table 18**.

2.15 Sloping sites

Sites where an individual wall (elevation) is not a heat loss wall for its full height because of stepped arrangements either within the dwelling or between the dwelling and an adjacent one.

Refer to RdSAP Conventions.

2.16 Room in Roof (RR)

RdSAP10 distinguishes between RR fully within roof and RR where accessible part of common wall is part of RR.

2.16.1 Room in Roof fully within roof (true Room in Roof):

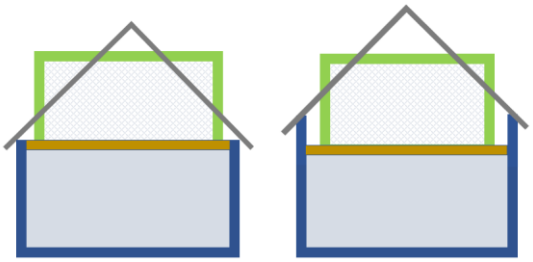


Figure 1: RR fully within the roof (RR type 1)

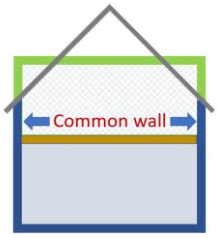
This RR type includes:

- Room in Roof fully within roof;
- Room in Roof built into a roof space where RR stud walls are bult inside the common walls, leaving the common walls outside the boundary of heated space).

Room in Roof fully within roof (true Room in Roof) is **always treated as "room in roof "** regardless of the height of the stud walls.

2.16.2 RR where accessible common wall is part of RR

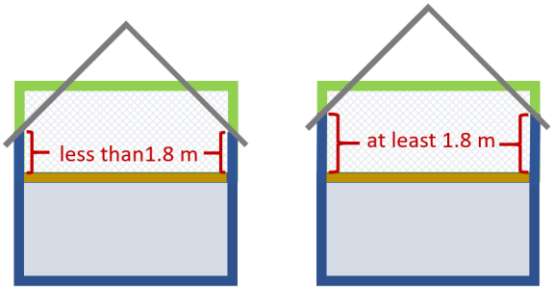
Figure 2: RR not fully within the roof ("RR Type 2"), where accessible common wall is part of RR



The common wall is a vertical continuation of the external wall of the storey below.

For the type of RR (where the accessible common wall is part of RR) to be classed as such **and not a separate storey**, the height of the common wall (measured from the floor to the point where the roof plane intersects with the wall head) must be less than 1.8 m for at least 50% of the common wall (excluding gable ends or party walls), see **Figure 3.**

There is no explicit allowance for dormer windows except to include in the floor area of the roof rooms.



Roof Room Separate storey, not Roof Room

Figure 3: Upper storey with common wall

Note: 1.8m rule applies only to Room in Roof where accessible common wall is part of Room in Roof. This rule does not apply to true Room in Roof.

2.17 Stairwells and Corridors

Stairwells and access corridors are not regarded as parts of the dwelling and not included in the assessment.
Heated stairwell/corridor is one with one or more controlled fixed heaters.
Refer to RdSAP Conventions.

2.18 Private access stairwell to a single dwelling

Refer to RdSAP Conventions.

2.19 Park homes

Park homes are detached bungalow-style homes. They are typically manufactured offsite and then placed on land that is owned privately or by a local authority.
The following data items apply to a park home.

Data items for park homes	
Data item	**Options**
Built form	Detached only
Measurements	Internal or external
Number of storeys	One only
Number extension	Up to 4. Extensions must have park home attributes (wall, floor and roof types)
Habitable rooms	Up to 99

Data items for park homes	
Data item	**Options**
Roof type and insulation	Pitched access Pitched no access • Insulation at joists – use Table 16 : when measured or documentary evidence of insulation thickness is available; otherwise use **Table 18 : Assumed roof U-values when Table 16 or Table 17 do not apply**. • Insulation at rafters – use **Table 18 : Assumed roof U-values when Table 16 or Table 17 do not apply** (park home column) • Unknown – use **Table 18** park home column • As built – use **Table 18** park home column • None Pitched sloping ceiling Flat As built – use park home column ○ Unknown – use **Table 18** park home column
Roof rooms	Disallowed
Walls	Park home wall only
Party walls	None – no party wall
Wall thickness	Measured or default from **Table 3**
Dry lining	Disallowed
Wall insulation	As built Unknown Internal (U-value entry only) External (U-value entry only)
Alternative walls	No alternative wall
Floor	Ground Suspended timber only U-value entry possible.
Floor insulation	As built Unknown Retro- fitted (U-value entry only)
Glazing	Measured
Heating and hot water	All options as normal
Conservatory	Possible (one storey)
Open fireplaces	Always none
Ventilation	Always natural

2.19.1 Insulation improvements for park homes

For the assessment of improvement measures for park homes the improved U-value of its wall, floor or roof is calculated using:

$$U_{insulated} = \frac{1}{\frac{1}{U_{existing}} + R_{insulation}}$$

where $U_{insulated}$ is the improved U-value, $U_{existing}$ is the U-value of the existing element and $R_{insulstion}$ is the thermal resistance added. Resistance $R_{insulstion}$ can be taken from **Table 14 : Insulation thickness and corresponding resistance**.

3 AGE BANDS

A set of age bands is defined according to **Table 1 : Age bands** for the purposes of assigning U-values and other data.

Table 1 : Age bands

	Years of construction				
Age band	**England**	**Wales**	**Scotland**	**Northern Ireland**	**Park home (UK)**
A	before 1900	before 1900	before 1919	before 1919	-
B	1900-1929	1900-1929	1919-1929	1919-1929	-
C	1930-1949	1930-1949	1930-1949	1930-1949	-
D	1950-1966	1950-1966	1950-1964	1950-1973	-
E	1967-1975	1967-1975	1965-1975	1974-1977	-
F	1976-1982	1976-1982	1976-1983	1978-1985	before 1983
G	1983-1990	1983-1990	1984-1991	1986-1991	1983-1995
H	1991-1995	1991-1995	1992-1998	1992-1999	(not applicable)
I	1996-2002	1996-2002	1999-2002	2000-2006	1996-2005
J	2003-2006	2003-2006	2003-2007	(not applicable)	(not applicable)
K	2007-2011	2007-2011	2008-2011	2007-2013	2006 onwards
L	2012-2022	2012-2022	2012 - 2023	2014 -2022	(not applicable)
M	2023 onwards	2023 onwards	2024 onwards	2023 onwards	(not applicable)

Age bands in **Table 1** relate to the age of each building part.

For Isle of Man use the same age bands as for England and Wales.

The basis of age bands: From the 1960s, constructional changes have been caused primarily by amendments to building regulations for the conservation of fuel and power, which have called for increasing levels of thermal insulation. The dates in **Table 1 : Age bands** are generally one year after a change in regulations, to allow for completion of dwellings approved under the previous regulations.

For age band of converted buildings refer to RdSAP Conventions applicable at the time of assessment.

Age band M can apply to extensions added to an older property.

4 AREAS AND DIMENSIONS

4.1 Building elements

The boundary of the assessment consists of all the building elements separating heated space from external environment, from adjacent dwellings or unheated spaces. Any internal elements (internal partition walls or intermediate floors within the dwelling) are disregarded.

Areas of building elements (walls, floors, roofs) are determined and specified separately for the main part of the dwelling and any extension.

Horizontal dimensions can be measured either internally or externally.

The measurements required are the floor area, exposed perimeter, party wall length and room height on each storey. For Room in Roof additional measurements required, see **4.9**.

Exposed floor perimeter is the perimeter between the dwelling and external environment, it includes the wall between the dwelling and an unheated garage or a separated conservatory and, in the case of a flat or maisonette, the wall between the dwelling and an unheated corridor/stairwell.

Internal dimensions are permissible in all cases. In the case of a house or bungalow external dimensions for area and perimeter are usually more convenient, except where access to all sides of the building is not possible or where there are differing wall thicknesses or other aspects that would make the dimensional conversion unreliable.
When using external measurements for a dwelling joined onto another dwelling (semi-detached and terraced houses) the measurement is to the mid-point of the party wall.

The internal and external measurements should not be mixed. If a heated basement is included in the assessment, it is likely that internal dimensions will be used throughout the basement.

Flats and maisonettes are measured internally.

Storey heights are always measured internally within the room.

It is recommended to state on site plans or floor plan sketches whether the dimensions recorded are external or internal.

When measuring internally, measure between the finished internal surfaces of the walls bounding the dwelling. Where that cannot be done directly (i.e. when measuring room by room) include an allowance for the thickness of internal partitions.

Measure all perturbations (e.g. bay windows) but disregard chimney breasts unless assessor considers significant e.g. large inglenook.

False ceilings should be disregarded (i.e. where a room has a lower ceiling than the adjacent rooms.)

Refer to RdSAP Conventions.

Vertical dimensions (room heights) are always measured internally within the room. Also, the floor area of room(s)-in-roof are always measured internally (irrespective of the dimensions basis for other storeys).

Length of party walls (see **2.4.3**) is included in the assessment.

Length and height of building elements (including dimensions of windows) are measured in meters to two decimal places (0.01m); for example 2m 35cm entered into RdSAP software as 2.35m.

Thickness of insulation is measured in mm (for example 50mm floor insulation). Note that all tables in this give thickness of insulation in mm.

4.2 Extensions and Alternative walls

4.2.1 Extensions

An extension can be alongside another part of the dwelling, or above another part of the dwelling or other premises. If alongside apply ground floor heat loss; if above another part of the same dwelling there is no floor heat loss for the extension and no roof loss for the part below it.

Dwellings may have one or more extensions either added to the main part of the dwelling, or built at the same time but of different construction or insulation compared to the main dwelling. In these cases, the dimensions and constructional details of the main part of the dwelling and each extension are recorded separately, to allow the assignment of different U-values to the original and to the extension.

Refer to RdSAP conventions for the details of specifying extensions.

4.2.2 Alternative wall(s)

Each building part (i.e. main dwelling or each of the extensions) can have one external wall and two additional wall types, -'alternative walls'.

The RdSAP software calculates the area of external wall from the exposed perimeter multiplied by the storey height for each level of the dwelling. The assessor calculates the area(s) of the alternative wall(s), which are then deducted by software from the external wall area of the building part calculated as described in section **4.6**.

The U-value of an alternative wall is established on the same basis as other walls, as described in section **6**.

In determining whether an alternative wall is applicable, RdSAP Assessor should assess the significant features are construction type, dry lining, age band, insulation and whether sheltered by an unheated corridor or stairwell.

A sheltered wall between the dwelling and an unheated corridor or stairwell is always counted as an alternative wall.

Walls of the same construction but different thickness within a building part are not considered alternative walls unless they are stone or solid brick walls.

For stone or solid brick walls in the dwellings of **age bands A to E,** assess thickness at each external elevation and at each storey and use alternative wall if the thickness varies by more than 100 mm.

When specifying windows and doors, for each building part assessor allocates windows and doors to the corresponding wall (the appropriate main wall or each alternative wall).

For each building part, software will deduct window/door areas contained in the relevant wall areas. This assumes that software has a provision for allocating each window/door to the corresponding external wall or one of alternative walls.

If there are two areas of external wall of different construction types (i.e. two alternative walls) and also there is a wall separating the dwelling from an unheated corridor or stairwell (sheltered wall), **consider the sheltered wall and one of the other alternative walls with the larger area.**

Note that the wall separating the dwelling from a heated corridor or stairwell is a party wall.

4.3 Adjustment to levels of storeys for houses and bungalows

In the RdSAP data set, the dimensions of each building part start at "lowest occupied" and these may not align if a building part has a heated or unheated space below the building part.

4.4 Conversion to internal dimensions

If horizontal dimensions are measured externally, they are converted to overall internal dimensions for use

in SAP calculations by application of the appropriate equations in **Table 2 : Conversion of dimensions**, using wall thickness of the main dwelling (or the appropriate wall thickness from **Table 3 : Wall thickness (mm)** if thickness is unknown).

The equations are applied on a storey-by-storey basis, for the whole dwelling (i.e. inclusive of any extension). This is done after any floor level adjustments (see **4.3**). Storey heights are always measured internally within each room and handled by software according to **4.6**.

Table 2 : Conversion of dimensions

Dwelling type	**Equations**
Detached	$P_{int} = P_{ext} - 8\ w$ $A_{int} = A_{ext} - w\ P_{int} - 4\ w^2$
Semi-detached or End-terrace	If $P_{ext}^2 > 8A_{ext}$: $P_{int} = P_{ext} - 5\ w$ $a = 0.5\left(P_{ext} - \sqrt{P_{ext}^2 - 8A_{ext}}\right)$ $A_{int} = A_{ext} - w\ (P_{ext} + 0.5\ a) + 3\ w^2$ otherwise $P_{int} = P_{ext} - 3\ w$ $A_{int} = A_{ext} - w\ P_{ext} + 3\ w^2$
Mid-terrace	$P_{int} = P_{ext} - 2\ w$ $A_{int} = A_{ext} - w\ (P_{ext} + 2\ A_{ext}/P_{ext}) + 2\ w^2$
Enclosed end-terrace	$P_{int} = P_{ext} - 3\ w$ $A_{int} = A_{ext} - 1.5\ w\ P_{ext} + 2.25\ w^2$
Enclosed mid-terrace	$P_{int} = P_{ext} - w$ $A_{int} = A_{ext} - w\ (A_{ext}/P_{ext} + 1.5\ P_{ext}) + 1.5\ w^2$
All types	Perimeter ratio = P_{int}/P_{ext} Area ratio = A_{int}/A_{ext}

Notes:
1. P_{ext} and A_{ext} are the measured external perimeter and area (of whole dwelling)
2. P_{int} and A_{int} are the calculated internal perimeter and area
3. **w** is the wall thickness of the main dwelling
4. After obtaining the perimeter ratio and area ratio for the whole dwelling, multiply separately the measured perimeters and areas of (a) the main part of the dwelling and (b) any extension, by these ratios.
5. In the case of a party wall reduce its length by 2w

4.5 Wall thickness

Measure wall thickness in mm of each external wall (elevation) and any alternative wall within a building part. It can be measured at door or window reveals or by internal/external measurement comparison (which can be direct measurement or estimated by counting bricks).

Where thickness varies, obtain a weighted average. For example, a detached house with all side of equal length where the rear wall is 250 mm thick and the remaining walls are 350 mm thick, the average is (0.25 × 250) + (0.75 × 350) = 325 mm.

Use the values in **Table 3** only when the wall thickness could not be measured.

Table 3 : Wall thickness (mm)

Age band	A	B	C	D	E	F	G	H	I,	J, K, L,M
Wall type										
Stone*	500	500	500	500	450	420	420	420	450	450
Solid brick	220	220	220	220	240	250	270	270	300	300
Cavity**	250	250	250	250	250	260	270	270	300	300
Timber frame	150	150	150	250	270	270	270	270	300	300
Cob	540	540	540	540	540	540	560	560	590	590
System build	250	250	250	250	250	300	300	300	300	300
Park home						50	50		75	100

* If in Scotland add 200 mm for bands A and B, and 100 mm for other bands
** If in Scotland add 50 mm

4.6 Heights and exposed wall areas

Heights are measured internally within each room, and **0.25 m** is added by software to each room height except for the lowest storey, to obtain the storey height. For this purpose, the lowest storey is considered separately for each building part (main dwelling and any extension). The lowest storey of a building part is the lowest for the dwelling unless it has been indicated as having the same dwelling below.

Gross areas (inclusive of openings) are obtained from the product of heat loss perimeter (after conversion to internal dimensions if relevant) and storey height, summed over all storeys. Party wall area is party wall length multiplied by storey height, summed over all storeys.

For the main dwelling and any extension(s), window and door areas are deducted from the gross areas to obtain the net wall areas for the heat loss calculations, except for the door of a flat/maisonette to an unheated stairwell or corridor which is deducted from the sheltered wall area.

If an alternative wall is present, the area of the alternative wall is subtracted from the net wall area of the building part prior to the calculation of wall heat losses.

4.7 Door and window areas

The area of an external door can be taken as **1.85 m²** (no need to measure doors because their dimensions are not as variable as dimensions of windows).

A door to a heated access corridor is not included in the door count.

External doors except doors to an unheated corridor or stairwell are taken as being in the:
- external wall of main part of the main dwelling or extension;
- alternative wall 1
- alternative wall 2

In RdSAP the definition of what is a window and what is a door is defined by the area of glazing in relation to the area of the whole opening, i.e. door and frame. To be classed as a window a glazed door and frame must contain glazing amounting to 60% or more or its surface area.

Generally, 60% or more glazing is likely to occur only in a patio door with a thin frame, e.g. metal frame as opposed to a uPVC frame.

However, a window with less than 60% glazing is not a door; a door always provides a means of entry to the property.

An external door is a door that forms part of the heat loss perimeter of the dwelling. A door to a heated access corridor/stairwell is not included in the door count. It is possible for a property to have no external

door in the RdSAP data set (when any entrance to the property is via patio doors with more than 60% glazing which are counted as windows in SAP, or via a heated corridor).

For more details see RdSAP Conventions.

4.7.1 Window data

Window area is assessed by measuring all windows and roof windows throughout the dwelling.
This does not include conservatories, which are treated separately; see Section **7**.

The area of each window is calculated by assessor during the survey by measuring its height and width. Additional information to be noted are the type of glazing, the glazing age, the frame type, the thickness of the glazing gap (if one or more present), the location within the dwelling construction, and its orientation.

Multiple glazing can be installed before 2002[7], during/after 2002 (these windows are assumed to have low-emissivity coating), installed after 2022[8], double glazing unknown date, secondary glazing or triple glazing. For multiple glazing the U-value can be known.

The total window area is obtained by the assessor measuring each individual window, and the software aggregating the total. That also applies to park homes.

The location area of each window in the main part of the dwelling and in any alternative wall of each extension are recorded separately, along with:
- single glazed, double glazed before or during/after 2002, secondary glazing or triple glazed;
- U-value if known;
- source of data (for U-value);
- window or roof window;
- orientation

Multiple types of windows are allowed.

If external dimensions were used, all windows were measured and there is a roof window with area greater than the roof area of the building part concerned, change the roof window area to be equal to the roof area. This can occur with a fully glazed roof because the roof window area entered by the assessor does not take account of the reduction in areas that occurs when the dimensions are converted from external to internal.

4.7.2 Sun rooms

For a highly glazed part of the dwelling, such as a sun room, which does not meet the criteria for a conservatory (50% of walls and 75% of roof glazed), glazed parts are treated as windows and the dimensions are measured.

4.8 Roof area

Roof area is the greatest of the floor areas on each level, calculated separately for main dwelling and any extension. In the case of a pitched roof with a sloping ceiling, divide the area so obtained by cos(30°).

4.9 Room in Roof

The following procedure is applied to main dwelling and separately to any extension with roof rooms as applicable.

Note. A roof room cannot be an extension in its own right, roof rooms are defined only when a building part consisting of normal storey(s) has been defined.

Where a roof room is built over a garage attached to the dwelling, treat the roof room as an extension (see section **4.2** for how to deal with this situation).

[7] 2002 in England & Wales, 2003 in Scotland, 2006 in Northern Ireland
[8] 2022 in England/Wales/Northern Ireland, 2023 in Scotland.

If there are roof rooms, with a total floor area of A_{RR_floor} (measured internally), then area A_{RR_floor} is deducted from the roof area of a building part below determined in section **4.8.**

Two assessment options can be used for RR in RdSAP-10:

a) Detailed assessment option for RR:

Where all actual dimensions are measured, and the U-values assigned; see section **4.10**, and **Figure 4** for the details.

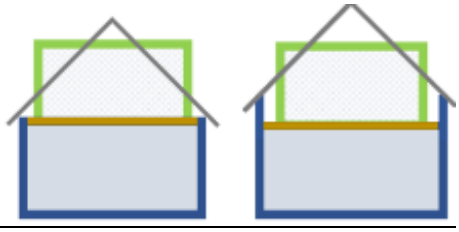
The U-value are from **Table 4 : U-values of gable-end and other walls in RR**.

b) Simplified assessment option for RR:

Slightly less accurate but requiring less measurements.

The simplified assessment option has two scenarios:
1) Room in Roof fully within roof (true Room in Roof), and
2) Room in Roof built into a roof space which has continuous common walls located outside of the RR boundaries.

4.9.1 The approach to Room in Roof fully within roof (True Room in Roof), see also **2.16:**



There is no common wall in the true RR type, therefore 1.8m rule does not apply.

The following steps apply when:

RR is either:
-RR fully within the roof (left diagram above), or
-RR type with accessible areas of continuous common walls which are outside the boundaries of the RR (right diagram above).

a) Assessor measures floor dimensions in m (length L_{RR_floor} and width W_{RR_floor}) and calculates RR floor area A_{RR_floor}

$$A_{RR\_floor} = L_{RR\_floor} \times W_{RR\_floor}$$

b) The height of RR is assumed to be **2.2 m high** (this is lower than normal room height of 2.4m to compensate for the sloping parts); however, this height does not include **0.25m** between RR and the storey below, therefore 0.25m needs to be added, making height of RR 2.2+0.25=2.45m.

In addition, if applicable, assessor measures and specifies length of each gable (L_{gable1} and L_{gable2}) or adjacent wall (A_{RR_party}, $A_{RR\_sheltered}$ or $A_{RR\_connected}$) and software assumes height of gables as 2.45m (this also includes 0.25m between RR and the storey below).

c) The areas of the applicable RR walls are calculated by software as:

$$\Sigma A_{RR\_gable/other} = A_{RR\_gable1} + A_{RR\_gable2} + A_{RR\_party} + A_{RR\_sheltered} + A_{RR\_connected}$$

Where for the gable walls:

$$A_{RR\_gable1} = L_{gable1} \times 2.45m$$
$$A_{RR\_gable2} = L_{gable2} \times 2.45m$$

For other walls (party walls, sheltered walls or walls connected to another part or the dwelling):

$A_{RR\_party} = L_{party} \times 2.45m$

$A_{RR\_sheltered} = L_{sheltered} \times 2.45m$

$A_{RR\_connected} = L_{connected} \times 2.45m$

Note: Heights of these walls are not measured by assessors; they are assumed as 2.45m.

d) The remaining RR area is assessed by using the equation (this includes gable walls):

$$A_{RR} = 12.5\sqrt{A_{RR\_floor} / 1.5}$$

This is treated as timber framed construction and assumes a rectangular room-in-roof area of average height 2.2 m, and accounts for 0.25 m between RR floor and the ceiling of the storey below, i.e. the calculation uses RR height = (2.2 + 0.25) = 2.45 m.

e) The areas of gable walls are deducted from the net RR area is:

$A_{RR\_final} = A_{RR} - \Sigma A_{RR\_gable/other}$

The rest of the calculation is as normal, i.e. software will treat A_{RR_final} as timber framed construction, and gables will be allocated U-values given in **Table 4.**

Table 4 Note: different U-values should be assigned to gable and adjacent walls with different heatloss; therefore, there are four options for gable walls:

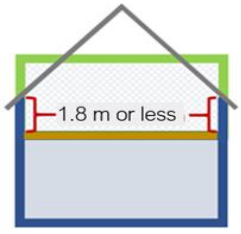
Table 4 : U-values of gable-end and other walls in RR

Description	RR wall type	Assigned U-value
A_{RR_gable}	Exposed gable	U-value as common wall
A_{RR_party}	Party	U-value = 0.25 W/m2K
$A_{RR\_sheltered}$	Sheltered	U-value as external wall with sheltering factor R = 0.5
$A_{RR\_connected}$	Adjacent to heated space	U-value = 0

f) Elements of RR other than gable-end and adjacent walls are assumed by software to be of a timber framed construction with U-values from **Table 17** or **Table 18**

4.9.2 The approach to RR Type with the accessible areas of continuous common walls

(see also section 2.16):



This type of RR is checked for the 1.8 m rule. It is considered as Room in Roof when the height of accessible common walls is less than 1.8 m (otherwise it is a separate storey).

The following applies when:

RR has accessible areas of continuous common walls which are boundaries of the RR; this RR type is as defined in Figure 2 (see section **2.16.2**).

The approach is:

a) Assessor measures floor dimensions (length L_{RR_floor} and width W_{RR_floor}) and calculates RR floor area A_{RR_floor}

$$A_{RR\_floor} = L_{RR\_floor} \times W_{RR\_floor}$$

In addition, the following applicable dimensions are measured:

.

- length of each gable or adjacent wall (L_{gable1}, L_{gable2}, L_{party}, $L_{sheltered\ or}$ $L_{\_connected}$) and their heights (H_{gable1}, H_{gable2}, H_{party}, $H_{sheltered\ or}$ $H_{connected}$) where **heights are measured at the highest point** of each accessible gable or adjacent wall;

- length L_{common_wall} and height H_{common_wall} of each accessible common wall;

a) The total area of each continuous common wall is calculated as:
$A_{RR\_common\_wall} = \Sigma(L_{common\_wall} \times (0.25 + H_{common\_wall})$

b) Software calculates the area of each gable or adjacent wall by using the equation:

$$A_{RR\_gable} = L_{gable} \times (0.25 + H_{gable}) - \left(\frac{(H_{gable} - H_{common\_wall\_1})^2}{2} + \frac{(H_{gable} - H_{common\_wall\_2})^2}{2} \right)$$

Note: 0.25 m added to the measured height of common wall to take account space of 0.25m between RR and the storey below.

A_{RR_gable} can be one of the appropriate values in **Table 4 : U-values of gable-end and other walls in RR**

The same equation is used for calculating areas of other walls, where a gable wall is a party wall (A_{RR_party}), a sheltered wall ($A_{RR\_sheltered}$) or a wall connected to another building part ($A_{RR\_connected}$).

These walls will be assigned to U-values given in Table 4.

Walls other than gable-end walls, adjacent walls and accessible continuous common walls are assumed to be of a timber framed construction with U-values from **Table 17 : U-values applicable to rooms in roof (RR) where insulation thickness is known.**

c) Total RR wall area is calculated by the equation (this includes gables and accessible continuous walls):

$$A_{RR} = 12.5\sqrt{A_{RR\_floor} / 1.5}$$

d) The areas of gable walls are deducted from the calculated total RR area, and the remaining area of RR, A_{RR_final} is then calculated. This area is treated as roof structure.

$$A_{RR\_final} = A_{RR\_wall} - (\Sigma A_{RR\_common\_wall} + \Sigma A_{RR\_gable} + \Sigma A_{RR\_party} + \Sigma A_{RR\_sheltered} + \Sigma A_{RR\_connected}).$$

e) The rest of the calculation is as normal, i.e. software will treat A_{RR_final} as timber framed construction, and other elements (continuous common walls and gables) will be treated by allocating the appropriate U-value.

Note: 0.25m between RR and the storey below is added by software (not by RdSAP Assessor).

4.10 Detailed measurements of roof room

Detailed measurements of roof rooms are required only if evidence exists that the flat ceiling, slope, stud wall (or common wall) or gable wall (see Figure 4) have differing levels of insulation and each of their U-values is known. Refer to RdSAP Conventions for more details.

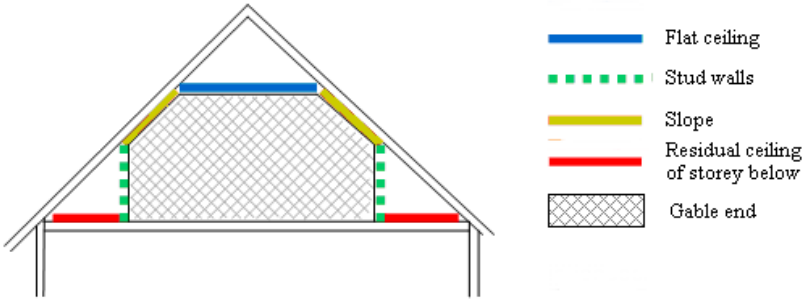


Figure 4**: Different parts of roof rooms**
(instead of stud wall and residual ceiling there can be a common wall)

For detailed measurements of roof rooms there can be up to two of each of:
- flat ceiling
- sloping ceiling
- stud wall (or common wall)
- gable wall

A U-value must be acquired for each non-zero heat loss area.

4.10.1 Default U-values of the roof rooms.

Where the details of insulation are not available, the default U-values are those for the appropriate age band for the construction of the roof rooms (see **Table 18 : Assumed roof U-values when Table 16 or Table 17 do not apply**). The default U-values apply when the roof room insulation is **'as built'** or **'unknown'.**

Where the thickness of insulation of the roof room elements has been determined, the U-value is from **Table 16 : Roof U-values when loft insulation thickness is known** or the insulation thickness concerned and for the insulation type, except for a **vaulted roof** when the insulation of the flat ceiling is marked as 'not applicable' and for the purposes of the calculation $U_{RR} = U_{vr.}$
(U_{RR} means Room Roof U-value and $U_{vr.}$ means U-value of vaulted roof).

The residual area (area of roof less the floor area of room(s)-in-roof) has a U-value from **Table 16 : Roof U-values when loft insulation thickness is known** according to its insulation thickness if at least half the area concerned is accessible, otherwise it is the default for the age band of the original property or extension.

The default U-value can be overwritten if any of the elements of the roof room (ceiling/slope/stud/gable) have known insulation details and the U-values are available or taken from the Tables in this document on a basis of the type and thickness of insulation.

4.11 Heat loss area for houses and bungalows

The lowest floor of a part of a dwelling ('part' means main dwelling or any extension) can be a basement, a ground floor, an exposed floor (external air below e.g. over a passageway) or a semi-exposed floor (unheated space below e.g. over an integral garage) or not a heat loss floor (upper flats/maisonettes or same or another dwelling below).

The area of the lowest occupied floor of the main dwelling is a ground floor.

If it is a heated **basement** it is treated as a lowest occupied floor.

For each building part examine the floor areas on each storey. If the area of any upper floor is greater than that of the floor below, the difference in these areas is an **exposed or semi-exposed floor.** Exposed floors are ground floors or floors above a passage. An example of semi-exposed floor is a floor above an integral garage.

When external dimensions are being used, however, the method of dimensional conversion can result in a small, but spurious, exposed floor area. To avoid that situation, the area of exposed floor on any level cannot be greater than the difference between the area of the current floor and the floor below measured using external dimensions.

This rule is implemented as follows:

1. Calculate the exposed floor area before converting dimensions, call this A_1
2. Convert dimensions
3. Calculate exposed floor area from the internal areas, call this A_2
4. If $A_2 \leq A_1$ the exposed floor area is A_2
5. If $A_2 > A_1$ the exposed floor area is A_1
6. Repeat for all levels if dwelling has more than two storeys and obtain the total exposed floor area.

When dimensions have been measured internally, the exposed floor area is simply the difference in area between the current floor and the floor below.

Generally, semi-exposed floors are treated as if they were fully exposed. This is because semi-exposed floors (e.g. floor above garage) are above slightly ventilated spaces making very small reduction to the U-value. However, U-value calculated according to BR443 can be used if available.

The ground floor area of the main dwelling and that of any extension are treated separately as they can have different U-values.

4.12 Heat loss floor area for flats and maisonettes

There is no heat loss through the floor if there is another flat below. Otherwise the floor area of the flat, or the lower floor of the maisonette, is:

- an exposed floor if there is an open space below;
- a semi-exposed floor if there are unheated premises below it (e.g. an enclosed garage);
- above a partially heated space if there are non-domestic premises below (heated, but at different times);
- a ground floor if there is ground below

Semi-exposed (sheltered) floors are treated as if they were fully exposed, because semi-exposed are above slightly ventilated spaces making very small reduction to the U-value.

4.13 Sheltered walls for flats and maisonettes

If the flat or maisonette is adjacent to an unheated corridor or stairwell, the area of wall between the dwelling and the corridor or stairwell is treated as a sheltered (semi-exposed) wall, see **2.4**.

The area of sheltered wall is the shelter length multiplied by the height of the lowest storey, less the door area (see **4.6** and **4.7**).

In any building part there can be an alternative wall which is indicated as sheltered. In this case the assessor does not provide the area of alternative wall; instead, it is calculated from the shelter length as above (this avoids the door to the unheated corridor being deducted twice).

The length of wall between the dwelling and the unheated corridor or stairwell is included in the exposed perimeter.

When a dwelling (flat or maisonette) has a sheltered wall to an unheated corridor on more than one storey the sheltered length is the total for all storeys with a sheltered wall (example: two storeys with sheltered wall on each storey, length of sheltered wall is 5 m on each storey: enter 10 m for the sheltered length).

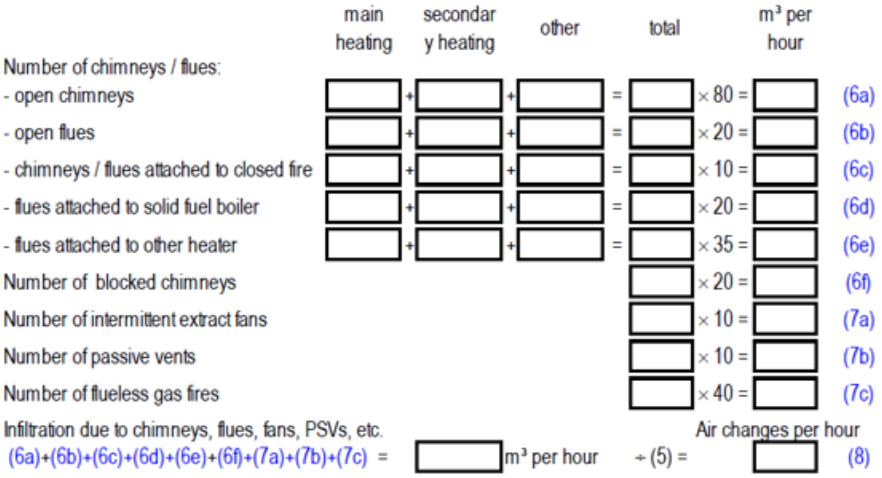
In the case of the wall separating the dwelling from an unheated corridor or stairwell, where this wall is of different construction or insulation to the external walls (e.g. not insulated but external walls are), make it an alternative wall and mark it as sheltered.

5 VENTILATION

5.1 Infiltration (SAP algorithm)

The parameters needed for calculation of the ventilation rate are obtained from **Table 5 : Ventilation parameters**.

Table 5 : Ventilation parameters

Parameter	Value
Infiltration due to chimneys, flues, fans, passive stack vents, etc.	RdSAP calculation is according to SAP10.2 worksheet: 
Chimneys	• Number of open fireplaces for main and for secondary heating, • or “0” if not present
Blocked chimneys	• Number of blocked chimneys, or • “0” if not present
Flues	• Number of open flues (main and secondary heating systems) for main and for secondary heating, or • “0” if not present Flue for solid fuel boiler in unheated space is not counted.
Chimneys/flues attached to closed fire	• Number for main and for secondary heating, • or “0” if not present
Flues attached to solid fuel boiler	• Number for main and for secondary heating, • or “0” if not present
Flues attached to other heater	• Number for main and for secondary heating, • or “0” if not present
Ventilation system	• Natural with intermittent extract fans, unless mechanical ventilation system clearly identified

<table>
<tr><th>Parameter</th><th>Value</th></tr>
<tr><td>Extract fans</td><td>
• Number of extract fans if known

• If number is unknown:
Not park home:
Age bands A to E — all cases — 0
Age bands F to G — all cases — 1
Age bands H to M — up to 2 habitable rooms — 1
3 to 5 habitable rooms — 2
6 to 8 habitable rooms — 3
more than 8 habitable rooms — 4
Park home:
Age band F — all cases — 0
Age bands G onwards — all cases — 2
</td></tr>
<tr><td>Passive stack vents</td><td>
• Number of Passive stack vents if known,
• or “0” if not present
</td></tr>
<tr><td>Flueless gas fire</td><td>
• Number of flueless gas fires if known,
• or “0” if not present
</td></tr>
<tr><td>Infiltration rate through walls, roofs, floors</td><td>
Infiltration rate calculated according to SAP10.2 worksheet:
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)
Number of storeys in the dwelling (n_s) ☐ (9)
Additional infiltration [(9) – 1] × 0.1 = ☐ (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction ☐ (11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal use 0.35
If suspended wooden ground floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 ☐ (12)
If no draught lobby, enter 0.05, else enter 0 ☐ (13)
Percentage of windows and doors draught proofed ☐ (14)
Window infiltration 0.25 - [0.2 × (14) ÷ 100] = ☐ (15)
Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = ☐ (16)
</td></tr>
<tr><td>Number of storeys</td><td>Greater of the number of storeys in the main part of the dwelling and in any extension.</td></tr>
<tr><td>Walls</td><td>
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction; if both present – use prevailing construction; if equal use 0.35
System build: treated as masonry.
If both types of walls present, use the value applicable to the greater wall area after deducting areas of openings; if wall areas are equal use 0.35.
Walls of roof rooms: not included.
Park home: use value for timber frame.
Curtain walls: see section 6.18 below
</td></tr>
<tr><td>Solid and suspended not timber</td><td>
Solid (structural infiltration 0)
Suspended not timber (structural infiltration 0)
</td></tr>
</table>

Parameter	Value
Floor infiltration (suspended timber ground floor only)	Default infiltration when : - Age band of main dwelling **A to E:** a) if floor **U-value is < 0.5**, assume "sealed" and use floor infiltration 0.1 b) if floor insulation is **'retro-fitted'** and no U-value is supplied, assume "sealed" and use 0.1; otherwise "unsealed" and use floor infiltration 0.2. - Age band of main dwelling **F to M**: sealed (the floor infiltration for the whole dwelling is determined by the floor type of the main dwelling) **- Park home:** assume unsealed suspended timber and use floor infiltration 0.2.
Draught lobby	Presence of draught lobby: add infiltration 0.05 if draught lobby is **not** present, or use 0.0 if present. **House, bungalow, or park home**: assume **no** draught lobby if cannot be determined. **Flat or maisonette:** Assume draught lobby if entrance door is facing corridor (heated or unheated) or stairwell.
Infiltration rate applicability	Calculated when pressure test result is not available; however when pressure test result is available it can be used in the calculation.
Pressure test result available	If pressure test result is available (at 50Pa or 4Pa), it is used for calculating effective air change rate. Air permeability value, AP_{50}, ($m^3/h/m^2$) ☐ (17) Air permeability value, AP_4, ($m^3/h/m^2$) ☐ (17a) If based on air permeability value at 50 Pa, then (18) = [(17) ÷ 20] + (8) If based on air permeability value at 4 Pa, then (18) = [0.263 x (17a)$^{0.924}$] + (8) ☐ (18) If no air permeability test data, then (18) = (16) *Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used* Number of sides on which dwelling is sheltered ☐ (19) Shelter factor (20) = 1 - [0.075 × (19)] = ☐ (20) Infiltration rate incorporating shelter factor (21) = (18) × (20) = ☐ (21)
Sheltered sides	0 for detached, 1 for semi-detached or end terraced; 3 for enclosed mid-terraced 2 in other cases (e.g. mid-terraced, including flats)
Number of wet rooms (required for an exhaust air heat pump)	1 to 2 habitable rooms: Kitchen + 1 3 to 4 habitable rooms: Kitchen + 2 5 to 6 habitable rooms: Kitchen + 3 7 to 8 habitable rooms: Kitchen + 4 9 to 10 habitable rooms: Kitchen + 5 11 or more habitable rooms: Kitchen + 6

<table>
<tr><th>Parameter</th><th>Value</th></tr>
<tr><td>Mechanical ventilation</td><td>If details are available, select mechanical ventilation from PCDB, otherwise use default data.
Default data given in Table 4g in SAP10.2 specification:
<table>
<tr><th>Type of mechanical ventilation</th><th>SFP, W/(litre/sec)</th><th>Heat recovery efficiency</th></tr>
<tr><td>Mechanical extract ventilation (centralised or decentralised), or positive input ventilation from outside</td><td>0.8</td><td>-</td></tr>
<tr><td>Balanced whole house mechanical ventilation, without heat recovery</td><td>2.0</td><td>-</td></tr>
<tr><td>Balanced whole house mechanical ventilation, with heat recovery</td><td>2.0</td><td>66%</td></tr>
</table>
Default in-use factors:
For SFP: 2.5
For efficiency of heat recovery: 0.70</td></tr>
</table>

Age bands mentioned in **Table 5** relate to the age of the main dwelling and not to any extension.
The number of rooms is as defined in **10.1**.

Refer to RdSAP Conventions for the chimney/fireplace definitions and count.

5.2 Provision of ventilation

Ventilation can be provided by one of these methods:

1) Natural ventilation
2) Positive input – from loft (treated as natural)
3) Positive input – from outside
4) Mechanical extract – centralised
5) Mechanical extract – decentralised
6) Whole House Mechanical Ventilation – no heat recovery
7) Whole House Mechanical Ventilation – with heat recovery

Items from 2) to 7) in the above list are treated as Mechanical ventilation.

If a mechanical ventilation system present and the details and documentary evidence s are available, use mechanical ventilation from PCDB by specifying brand name and model.

Otherwise use default value for mechanical ventilation in **Table 5 : Ventilation parameters**.

6 CONSTRUCTION TYPES AND INSULATION (U-VALUES)

Where it can be established that a building element has insulation beyond what would normally be assumed for the age band, this can be specified if adequate evidence exists. Refer to RdSAP Conventions for further details.

6.1 Wall options

The thickness of stone and brick walls should be measured wherever possible. While the construction elements will often be indicated as 'as-built' or 'unknown insulation,' RdSAP will assign default insulation on the basis of the age band of the part of the property concerned (main dwelling, extension, room in roof).

Where there is evidence of additional insulation, the assessor has three options:

a. indicate the thickness of insulation, or
b. provide the U-value of the construction element, or
c. select unknown thickness and RdSAP will default.

6.2 Wall types

RdSAP allows the following wall types:

- Stone (granite or whinstone)
- Stone (sandstone or limestone)
- Solid brick
- Cob
- Cavity (unfilled, filled)
- System built.

If the dwelling has a wall type that does not correspond closely with one of the available options, select the nearest equivalent taking account of the U-values in the tables below and include Addendum 1 (**see section 14 : Addendum to EPCs).**

6.2.1 Cavity wall

Where a cavity wall has been identified, it is recorded irrespective of the width of the cavity.
However, insulation level, presence of dry-lining and wall thickness should be recorded.

6.2.2 System Built wall

System built wall is a wall other than masonry or timber-framed.
See RdSAP conventions in relation to system-built dwellings greater than four storeys.

6.2.3 Unknown wall type

Do not use the 'unknown' option for wall insulation inappropriately as this automatically suppresses any insulation recommendation; assume as-built if no evidence of retro-fitted insulation.

'Unknown' should be used only in exceptional circumstances, e.g. when there is conflicting evidence (inspection and/or documentary) of added insulation whose presence cannot be ascertained conclusively. In these cases clarification must be provided in site notes.

Note that "Unknown" wall type will automatically suppress any insulation recommendation.
Refer to RdSAP Conventions.

6.2.4 Wall adjacent to stairwell or corridor

Stairwells and access corridors are not regarded as parts of the dwelling, however wall adjacent to stairwell or access corridor can be treated as sheltered alternative wall (if stairwell or corridor is unheated), or as party wall (if heated).

Refer to RdSAP conventions for definition of heated corridor.

6.2.5 Dwelling adjacent to non-domestic (commercial) premises

If a dwelling or part of a dwelling has commercial premises below record as partially heated space below.

If a dwelling or part of a dwelling has commercial premises above record as another dwelling above.

If a dwelling has commercial premises alongside it, treat as a party wall.

Refer to RdSAP conventions for more details.

6.2.6 Curtain wall

The definition of a curtain wall is given in section **2.5;** see also section **6.18 below** for the details of curtain wall.

6.3 U-value for walls, roofs, floors

U-values of construction elements are determined within software from the constructional type, date of construction and, where applicable, thickness of additional insulation, according to the tables below.

U values are obtained separately for the main part of the dwelling and for any extension. If the insulation status is unknown, the relevant value for 'as built' is used.

A U-value is that of the whole element, including any added insulation.

The U-values of existing elements (walls/roofs/floors, etc.) must be the RdSAP default values (e.g. entered "as built") and must not be overwritten unless specific documentary evidence of the thermal conductivity of individual materials of the building element of the property being assessed is provided and was undertaken in accordance with **BR 443 "Conventions for U-value calculations" (BRE, 2019).**

Documentary evidence applicable to the property being assessed must be provided and recorded if overwriting any default U-value. See RdSAP10 Conventions for the details of documentary evidence.

Otherwise **Table 31 : Data to be collected** indicates the options required for collection of data on site in respect of additional insulation of elements.

These are:
- floor insulation
- cavity filled wall
- internal and/or external wall insulation
- party wall insulation (cavity fill)
- measured thickness of loft insulation
- rafter insulation
- flat roof insulation
- insulation of roof rooms

A U-value is assigned to an insulated loft according to the measured insulation thickness. In other cases the U-value with additional insulation is based on the thickness of insulation of mineral wool type (assume 100 mm if thickness is unknown).

If insulation is **multifoil** or **foam insulation** refer to RdSAP Conventions.

If there is both internal and external wall insulation add the insulation thicknesses together and enter as external.

6.4 Default U-values of external walls

Unless the U-value is available (subject to documentary evidence) use the default wall U-values given in:
Table 6 : Wall U-values – England
Table 7 : Wall U-values – Scotland
Table 8 : Wall U-values – Northern Ireland
Table 9 : Wall U-values – Wales
Table 10 : Wall U-values – Isle of Man

Table 6 : Wall U-values – England

Age band	A	B	C	D	E	F	G	H	I	J	K	L	M
Wall type													
Stone: granite or whinstone	According to **6.6**				1.7 a	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.26
Stone: sandstone or limestone					1.7 a	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.26
Solid brick as built	According to **6.7**				1.7b	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.26
Stone/solid brick with 50 mm external or internal insulation	According to **6.8**				0.55c	0.45*	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
Stone/solid brick with 100 mm external or internal insulation					0.32c	0.28*	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
Stone/solid brick with 150 mm external or internal insulation					0.23c	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
Stone/solid brick with 200 mm external or internal insulation					0.18c	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*
Cob (as built)	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60	0.45	0.35	0.30	0.28	0.26
Cob with 50 mm external or internal insulation	0.40	0.40	0.40	0.40	0.40	0.40	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
Cob with 100 mm external or internal insulation	0.26	0.26	0.26	0.26	0.26	0.26	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
Cob with 150 mm external or internal insulation	0.20	0.20	0.20	0.20	0.20	0.20	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
Cob with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.16	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*
Cavity as built	1.5	1.5	1.5	1.5	1.5	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.26
Unfilled cavity with 50 mm external or internal insulation	0.53	0.53	0.53	0.53	0.53	0.45	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
Unfilled cavity with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.30	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
Unfilled cavity with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
Unfilled cavity with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*
Filled cavity	0.7	0.7	0.7	0.7	0.7	0.40	0.35	0.35	0.45†	0.35†	0.30†	0.28†	0.26†
Filled cavity with 50 mm external or internal insulation	0.37	0.37	0.37	0.37	0.37	0.27	0.25*	0.25*	0.25*	0.25*	0.21*	0.21*	0.20*
Filled cavity with 100 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.20	0.19*	0.19*	0.19*	0.19*	0.17*	0.16*	0.15*
Filled cavity with 150 mm external or internal insulation	0.19	0.19	0.19	0.19	0.19	0.16	0.15*	0.15*	0.15*	0.15*	0.14*	0.14*	0.13*
Filled cavity with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.13	0.13*	0.13*	0.13*	0.13*	0.12*	0.12*	0.11*
Timber frame as built	2.5	1.9	1.9	1.0	0.80	0.45	0.40	0.40	0.40	0.35	0.30	0.28	0.26
Timber frame with internal insulation	0.60	0.55	0.55	0.40	0.40	0.40	0.40†	0.40†	0.40†	0.35†	0.30†	0.28†	0.26†
System build as built	2.0	2.0	2.0	2.0	1.7	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.26
System build with 50 mm external or internal insulation	0.60	0.60	0.60	0.60	0.55	0.45	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
System build with 100 mm external or internal insulation	0.35	0.35	0.35	0.35	0.35	0.32*	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
System build with 150 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
System build with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*

a Or from equations in 6.6 if the calculated U-value is less than 1.7.
b Or from 6.7 if wall thickness is other than 200mm to 280mm
c According to 6.8
* wall may have had internal or external insulation when originally built; this applies only if insulation is known to have been increased subsequently (otherwise 'as built' applies)
† assumed as built
If a wall is known to have additional insulation but the insulation thickness is unknown, use the row in the table for 50 mm insulation

Table 7 : Wall U-values – Scotland

Age band	A	B	C	D	E	F	G	H	I	J	K	L	M
Wall type													
Stone: granite or whinstone as built	According to **6.6**				1.7 a	1.0	0.60	0.45	0.45	0.30	0.25	0.22	0.17
Stone: sandstone or limestone as built					1.5 a	1.0	0.60	0.45	0.45	0.30	0.25	0.22	0.17
Solid brick as built	According to **6.7**				1.7b	1.0	0.60	0.45	0.45	0.30	0.25	0.22	0.17
Stone/solid brick with 50 mm external or internal insulation	According to **6.8**				0.55c	0.45*	0.35*	0.30*	0.30*	0.21*	0.19*	0.17*	0.14*
Stone/solid brick with 100 mm external or internal insulation					0.32c	0.28*	0.24*	0.24*	0.21*	0.19*	0.17*	0.14*	0.12*
Stone/solid brick with 150 mm external or internal insulation					0.23c	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.12*	0.10*
Stone/solid brick with 200 mm external or internal insulation					0.18 c	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.10*	0.09*
Cob as built	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60	0.45	0.30	0.25	0.22	0.17
Cob with 50 mm external or internal insulation	0.40	0.40	0.40	0.40	0.40	0.40	0.35*	0.35*	0.30*	0.21*	0.19*	0.17*	0.14*
Cob with 100 mm external or internal insulation	0.26	0.26	0.26	0.26	0.26	0.26	0.24*	0.24*	0.21*	0.19*	0.17*	0.14*	0.12*
Cob with 150 mm external or internal insulation	0.20	0.20	0.20	0.20	0.20	0.20	0.18*	0.18*	0.17*	0.15*	0.14*	0.12*	0.10*
Cob with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.16	0.15*	0.15*	0.14*	0.13*	0.12*	0.10*	0.09*
Cavity as built	1.5	1.5	1.5	1.5	1.5	1.0	0.60	0.45	0.45	0.30	0.25	0.22	0.17
Unfilled cavity with 50 mm external or internal insulation	0.53	0.53	0.53	0.53	0.53	0.45	0.35*	0.30*	0.30*	0.25*	0.19*	0.17*	0.14*
Unfilled cavity with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.30	0.24*	0.21*	0.21*	0.19*	0.17*	0.14*	0.12*
Unfilled cavity with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21	0.18*	0.17*	0.17*	0.15*	0.14*	0.12*	0.10*
Unfilled cavity with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.10*	0.09*
Filled cavity	0.7	0.7	0.7	0.7	0.7	0.40	0.35	0.45†	0.45†	0.30†	0.25†	0.22†	0.17
Filled cavity with 50 mm external or internal insulation	0.37	0.37	0.37	0.37	0.37	0.27	0.25*	0.25*	0.25*	0.25*	0.25*	0.17*	0.14*
Filled cavity with 100 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.20	0.19*	0.19*	0.19*	0.19*	0.19*	0.14*	0.12*
Filled cavity with 150 mm external or internal insulation	0.19	0.19	0.19	0.19	0.19	0.16	0.15*	0.15*	0.15*	0.15*	0.15*	0.12*	0.10*
Filled cavity with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.13	0.13*	0.13*	0.13*	0.13*	0.12*	0.10*	0.09*
Timber frame as built	2.5	1.9	1.9	1.0	0.80	0.45	0.40	0.40	0.40	0.30	0.25	0.22	0.17
Timber frame with internal insulation	0.60	0.55	0.55	0.40	0.40	0.40	0.40†	0.40†	0.40†	0.30†	0.25†	0.22†	0.17†
System build as built	2.0	2.0	2.0	2.0	1.7	1.0	0.60	0.45	0.45	0.30	0.25	0.22	0.17
System build with 50 mm external or internal insulation	0.60	0.60	0.60	0.60	0.55	0.45	0.35*	0.30*	0.30*	0.21*	0.19*	0.17*	0.14*
System build with 100 mm external or internal insulation	0.35	0.35	0.35	0.35	0.35	0.32*	0.24*	0.24*	0.21*	0.19*	0.17*	0.14*	0.12*
System build with 150 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.12*	0.10*
System build with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.10*	0.09*

a Or from equations in 6.6 if the calculated U-value is less than 1.7.
b Or from 6.7 if wall thickness is other than 200mm to 280mm
c According to 6.8
* wall may have had internal or external insulation when originally built; this applies only if insulation is known to have been increased subsequently (otherwise 'as built' applies)
† assumed as built
If a wall is known to have additional insulation but the insulation thickness is unknown, use the row in the table for 50 mm insulation

Table 8 : Wall U-values – Northern Ireland

Age band	A	B	C	D	E	F	G	H	I	J	K	L	M
Wall type													
Stone: granite or whinstone as built	According to **6.6**				1.7 b	1.0	0.60	0.45	0.45	-	0.30	0.28	0.18
Stone: sandstone or limestone as built					1.7 b	1.0	0.60	0.45	0.45	-	0.30	0.28	0.18
Solid brick as built	According to **6.7**				1.7c	1.0	0.60	0.45	0.45	-	0.30	0.28	0.18
Stone/solid brick with 50 mm external or internal insulation	According to **6.8**				0.55	0.45*	0.35*	0.30*	0.30*	-	0.21*	0.21*	0.15
Stone/solid brick with 100 mm external or internal insulation					0.32	0.28*	0.24*	0.24*	0.21*	-	0.17*	0.16*	0.12
Stone/solid brick with 150 mm external or internal insulation					0.23	0.21*	0.18*	0.18*	0.17*	-	0.14*	0.14*	0.11
Stone/solid brick with 200 mm external or internal insulation					0.18	0.17*	0.15*	0.15*	0.14*	-	0.12*	0.12*	0.09
Cob as built	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60	0.45	-	0.30	0.28	0.18
Cob with 50 mm external or internal insulation	0.40	0.40	0.40	0.40	0.40	0.40	0.35*	0.35*	0.30*	-	0.21*	0.21*	0.15*
Cob with 100 mm external or internal insulation	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	-	0.21*	0.16*	0.12*
Cob with 150 mm external or internal insulation	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	-	0.20	0.14*	0.11*
Cob with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.16	0.15*	0.15*	0.14*	-	0.12*	0.12*	0.09*
Cavity as built	1.5	1.5	1.5	1.5	1.5	1.0	0.60	0.45	0.45	-	0.30	0.28	0.18
Unfilled cavity with 50 mm external or internal insulation	0.53	0.53	0.53	0.53	0.53	0.45	0.35*	0.35*	0.30*	-	0.21*	0.21*	0.15*
Unfilled cavity with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.30	0.24*	0.24*	0.21*	-	0.17*	0.16*	0.12*
Unfilled cavity with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21	0.18*	0.18*	0.17*	-	0.14*	0.14*	0.11*
Unfilled cavity with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	-	0.12*	0.12*	0.09*
Filled cavity	0.7	0.7	0.7	0.7	0.7	0.40	0.35	0.45†	0.45†	-	0.30†	0.28†	0.18†
Filled cavity with 50 mm external or internal insulation	0.37	0.37	0.37	0.37	0.37	0.27	0.25*	0.25*	0.25*	-	0.25*	0.21*	0.15*
Filled cavity with 100 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.20	0.19*	0.19*	0.19*	-	0.19*	0.16*	0.12*
Filled cavity with 150 mm external or internal insulation	0.19	0.19	0.19	0.19	0.19	0.16	0.15*	0.15*	0.15*	-	0.15*	0.14*	0.11*
Filled cavity with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.13	0.13*	0.13*	0.13*	-	0.12*	0.12*	0.09*
Timber frame as built	2.5	1.9	1.9	1.0	0.80	0.45	0.40	0.40	0.40	-	0.30	0.28	0.18
Timber frame with internal insulation	0.60	0.55	0.55	0.40	0.40	0.40	0.40†	0.40†	0.40†	-	0.30†	0.28†	0.18†
System build as built	2.0	2.0	2.0	2.0	1.7	1.0	0.60	0.45	0.45	-	0.30	0.28	0.18
System build with 50 mm external or internal insulation	0.60	0.60	0.60	0.60	0.55	0.45	0.35*	0.30*	0.30*	-	0.21*	0.21*	0.15*
System build with 100 mm external or internal insulation	0.35	0.35	0.35	0.35	0.35	0.32*	0.24*	0.24*	0.21*	-	0.17*	0.16*	0.12*
System build with 150 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.21*	0.18*	0.18*	0.17*	-	0.14*	0.14*	0.11*
System build with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	-	0.12*	0.12*	0.09*

a Or from equations in 6.6 if the calculated U-value is less than 1.7.
b Or from 6.7 if wall thickness is other than 200mm to 280mm
c According to 6.8
* wall may have had internal or external insulation when originally built; this applies only if insulation is known to have been increased subsequently (otherwise 'as built' applies)
† assumed as built
If a wall is known to have additional insulation but the insulation thickness is unknown, use the row in the table for 50 mm insulation

Table 9 : Wall U-values – Wales

Age band	A	B	C	D	E	F	G	H	I	J	K	L	M
Wall type													
Stone: granite or whinstone	According to **6.6**				1.7 a	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.18/0.21[#]
Stone: sandstone or limestone					1.7 a	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.18/0.21[#]
Solid brick as built	According to **6.7**				1.7b	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.18/0.21[#]
Stone/solid brick with 50 mm external or internal insulation	According to **6.8**				0.55c	0.45*	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
Stone/solid brick with 100 mm external or internal insulation					0.32c	0.28*	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
Stone/solid brick with 150 mm external or internal insulation					0.23c	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
Stone/solid brick with 200 mm external or internal insulation					0.18c	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*
Cob (as built)	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60	0.45	0.35	0.30	0.28	0.18/0.21[#]
Cob with 50 mm external or internal insulation	0.40	0.40	0.40	0.40	0.40	0.40	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
Cob with 100 mm external or internal insulation	0.26	0.26	0.26	0.26	0.26	0.26	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
Cob with 150 mm external or internal insulation	0.20	0.20	0.20	0.20	0.20	0.20	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
Cob with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.16	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*
Cavity as built	1.5	1.5	1.5	1.5	1.5	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.18/0.21[#]
Unfilled cavity with 50 mm external or internal insulation	0.53	0.53	0.53	0.53	0.53	0.45	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
Unfilled cavity with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.30	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
Unfilled cavity with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
Unfilled cavity with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*
Filled cavity	0.7	0.7	0.7	0.7	0.7	0.40	0.35	0.35	0.45[†]	0.35[†]	0.30[†]	0.28[†]	0.18[†]
Filled cavity with 50 mm external or internal insulation	0.37	0.37	0.37	0.37	0.37	0.27	0.25*	0.25*	0.25*	0.25*	0.21*	0.21*	0.20*
Filled cavity with 100 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.20	0.19*	0.19*	0.19*	0.19*	0.17*	0.16*	0.15*
Filled cavity with 150 mm external or internal insulation	0.19	0.19	0.19	0.19	0.19	0.16	0.15*	0.15*	0.15*	0.15*	0.14*	0.14*	0.13*
Filled cavity with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.13	0.13*	0.13*	0.13*	0.13*	0.12*	0.12*	0.11*
Timber frame as built	2.5	1.9	1.9	1.0	0.80	0.45	0.40	0.40	0.40	0.35	0.30	0.28	0.18/0.21[#]
Timber frame with internal insulation	0.60	0.55	0.55	0.40	0.40	0.40	0.40[†]	0.40[†]	0.40[†]	0.35[†]	0.30[†]	0.28[†]	0.18/0.21[#†]
System build as built	2.0	2.0	2.0	2.0	1.7	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.18/0.21[#]
System build with 50 mm external or internal insulation	0.60	0.60	0.60	0.60	0.55	0.45	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
System build with 100 mm external or internal insulation	0.35	0.35	0.35	0.35	0.35	0.32*	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
System build with 150 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
System build with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*

a Or from equations in 6.6 if the calculated U-value is less than 1.7.
b Or from 6.7 if wall thickness is other than 200mm to 280mm
c According to 6.8
* wall may have had internal or external insulation when originally built; this applies only if insulation is known to have been increased subsequently (otherwise 'as built' applies)
† assumed as built
If a wall is known to have additional insulation but the insulation thickness is unknown, use the row in the table for 50 mm insulation.
[#] U-value=0.18W/m^{2}K applicable for houses; U-value=0.21W/m^{2}K applicable for flats

Table 10 : Wall U-values – Isle of Man

Age band	A	B	C	D	E	F	G	H	I	J	K	L	M
Wall type													
Stone: granite or whinstone	According to **6.6**				1.7 a	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.26
Stone: sandstone or limestone					1.7 a	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.26
Solid brick as built	According to **6.7**				1.7b	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.26
Stone/solid brick with 50 mm external or internal insulation	According to **6.8**				0.55c	0.45*	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
Stone/solid brick with 100 mm external or internal insulation					0.32c	0.28*	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
Stone/solid brick with 150 mm external or internal insulation					0.23c	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
Stone/solid brick with 200 mm external or internal insulation					0.18c	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*
Cob (as built)	0.80	0.80	0.80	0.80	0.80	0.80	0.60	0.60	0.45	0.35	0.30	0.28	0.26
Cob with 50 mm external or internal insulation	0.40	0.40	0.40	0.40	0.40	0.40	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
Cob with 100 mm external or internal insulation	0.26	0.26	0.26	0.26	0.26	0.26	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
Cob with 150 mm external or internal insulation	0.20	0.20	0.20	0.20	0.20	0.20	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
Cob with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.16	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*
Cavity as built	1.5	1.5	1.5	1.5	1.5	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.26
Unfilled cavity with 50 mm external or internal insulation	0.53	0.53	0.53	0.53	0.53	0.45	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
Unfilled cavity with 100 mm external or internal insulation	0.32	0.32	0.32	0.32	0.32	0.30	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
Unfilled cavity with 150 mm external or internal insulation	0.23	0.23	0.23	0.23	0.23	0.21	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
Unfilled cavity with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*
Filled cavity	0.7	0.7	0.7	0.7	0.7	0.40	0.35	0.35	0.45†	0.35†	0.30†	0.28†	0.26†
Filled cavity with 50 mm external or internal insulation	0.37	0.37	0.37	0.37	0.37	0.27	0.25*	0.25*	0.25*	0.25*	0.21*	0.21*	0.20*
Filled cavity with 100 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.20	0.19*	0.19*	0.19*	0.19*	0.17*	0.16*	0.15*
Filled cavity with 150 mm external or internal insulation	0.19	0.19	0.19	0.19	0.19	0.16	0.15*	0.15*	0.15*	0.15*	0.14*	0.14*	0.13*
Filled cavity with 200 mm external or internal insulation	0.16	0.16	0.16	0.16	0.16	0.13	0.13*	0.13*	0.13*	0.13*	0.12*	0.12*	0.11*
Timber frame as built	2.5	1.9	1.9	1.0	0.80	0.45	0.40	0.40	0.40	0.35	0.30	0.28	0.26
Timber frame with internal insulation	0.60	0.55	0.55	0.40	0.40	0.40	0.40†	0.40†	0.40†	0.35†	0.30†	0.28†	0.26†
System build as built	2.0	2.0	2.0	2.0	1.7	1.0	0.60	0.60	0.45	0.35	0.30	0.28	0.26
System build with 50 mm external or internal insulation	0.60	0.60	0.60	0.60	0.55	0.45	0.35*	0.35*	0.30*	0.25*	0.21*	0.21*	0.20*
System build with 100 mm external or internal insulation	0.35	0.35	0.35	0.35	0.35	0.32*	0.24*	0.24*	0.21*	0.19*	0.17*	0.16*	0.15*
System build with 150 mm external or internal insulation	0.25	0.25	0.25	0.25	0.25	0.21*	0.18*	0.18*	0.17*	0.15*	0.14*	0.14*	0.13*
System build with 200 mm external or internal insulation	0.18	0.18	0.18	0.18	0.18	0.17*	0.15*	0.15*	0.14*	0.13*	0.12*	0.12*	0.11*

a Or from equations in 6.6 if the calculated U-value is less than 1.7.
b Or from 6.7 if wall thickness is other than 200mm to 280mm
c According to 6.8
* wall may have had internal or external insulation when originally built; this applies only if insulation is known to have been increased subsequently (otherwise 'as built' applies)
† assumed as built
If a wall is known to have additional insulation but the insulation thickness is unknown, use the row in the table for 50 mm insulation

6.5 U-values for Park home walls

Table 11 : Default U-values for park home walls

Age band	F	G	I	K	~~L~~	~~M~~
Park home as built	1.7	1.2	0.7	0.6	~~0.6~~	~~0.6~~
Park home with additional insulation	Entered U-value (see section **2.19.1**)					

6.6 U-values of uninsulated stone walls, age bands A to E

Table 12 : Default U-values of stone walls

Stone wall type	Equation
Sandstone or limestone	$U = 54.876 \times W^{-0.561}$
Granite or whinstone:	$U = 45.315 \times W^{-0.513}$

Where: W is wall thickness, mm

Apply the adjustment according to **Table 14 : Insulation thickness and corresponding resistance** if wall is insulated or dry-lined including lath and plaster.

6.7 U-values for uninsulated brick walls, age bands A to E

Table 13 : Default U-values of brick walls

Wall thickness, mm	U-value, W/m2K
Up to 200 mm	2.5
200 to 280 mm	1.7
280 to 420 mm	1.4
More than 420mm	1.1

Apply the adjustment according to **Table 14 : Insulation thickness and corresponding resistance** if wall is insulated or/and dry-lined including lath and plaster.

6.8 U-value for insulated walls in age bands A to E

This applies to walls in age bands A to E with insulation, dry-lining or lath and plaster:

1. Obtain the U-value (U_0) of the wall without insulation or dry-lining from the corresponding table of wall U-values (e.g. one of Tables 6 to 10). Call this U_0.

2. The U-value of the insulated wall is

$$U = \frac{1}{\frac{1}{U_0} + R_{insulation}}$$

Where:

U_o is a U-value of the building element without insulation, W/m^{2}K (e.g. Tables 6, 7. 8. 9 or 10)

$R_{insulation}$ is the additional thermal resistance introduced by the insulation or internal finish obtained from **Table 14 : Insulation thickness and corresponding resistance**.

Table 14 : Insulation thickness and corresponding resistance

Insulation thickness T, mm	$R_{insulation}$ (m²K/W)		
	λ =0.04 W/m·K	λ =0.03 W/m·K (optional)	λ =0.025 W/m·K
10mm	0.5	0.58	0.65
25mm	0.875	1.08	1.25
50 mm	1.5	1.92	2.25
75mm	2.125	2.75	3.25
100 mm	2.75	3.58	4.25
125mm	3.375	4.42	5.25
150 mm	4	5.25	6.25
175mm	4.625	6.08	7.25
200 mm	5.25	6.92	8.25

λ =0.04 W/m·K is typical for mineral wool, rock wool, fibre glass or EPS (expanded polystyrene);

λ =0.03 W/m·K (optional) typical for XPS (extruded polystyrene),

λ =0.025 W/m·K is typical for PUR (polyurethane foam), PIR (polyisocyanurate), phenolic foam.

For drylining including laths and plaster use $R_{insulation}$ = 0.17m²K/W.

Thickness of render is included in the thickness of uninsulated wall.

If thickness of insulation is in between of the values given in this table, the resistance value can be interpolated by using equations:

R= 0.04*T+0.25 when λ =0.025 W/m·K

R=0.0333*T+0.248 when λ =0.03 W/m·K

R=0.025*T+0.25 when λ =0.04 W/m·K

Where T is thickness of insulation in mm

6.9 U-values of sheltered walls (adjacent to unheated corridor or stairwell)

For sheltered walls of flats and maisonettes (between the dwelling and an unheated corridor or stairwell), the U-value for the applicable wall area is adjusted as described in SAP10.2 specification Section 3.3

$$U = \frac{1}{\frac{1}{U_0} + R_u}$$

Where:

U_o is a U-value of the building element without insulation, W/m2K (e.g. from Tables S6, S7 or S8) or for insulated walls calculated according to sections **6.5** to **6.8**.

R_u is the additional thermal resistance,

Use R_u = 0.5 m²K/W for corridors and **R_u = 2.1 m²K/W** for stairwell (the values are from the SAP10.2 specification).

6.10 U-values of party walls and walls adjacent to heated corridor and stairwell

The U-value of party walls is taken from Table 15.

Table 15 : U-values of party walls

Party wall type	Party wall U-value
Solid masonry / timber frame / system built	0.0
Cavity masonry unfilled	0.5
Cavity masonry filled	0.2
Unable to determine, house or bungalow	0.25
Unable to determine, flat or maisonette*	0.0

*Note. In the case of flats and maisonettes it is assumed that the construction is such as to avoid a thermal bypass.

6.11 U-values of roofs

6.11.1 Roof insulation present at both joists and rafters

In the case of roofs, the boundary between the heated space and unheated roof space is usually the finished ceiling of the upper level of the dwelling. The heatloss calculation is based on the U-value at the ceiling level.

If **joist and rafter insulation are both present** record joist insulation only. This is because roof U-value greatly depends on the air changes per hour in the unheated loft space and therefore the presence of insulation at rafters does not affect the U-value at joists, unless roof space is fully airtight (e.g. ventilation rate is less than 0.5 air changes per hour). As we do not measure the ventilation rate in the loft space, RdSAP assumes that the loft space is ventilated.

6.11.2 Roof U-values when loft insulation thickness at joists is known.

The U-value assumed for a pitched roof with an insulated ceiling or the insulation at rafter level should, where possible, be based on the observed thickness of the loft insulation according to Table 16.

Table 16 : Roof U-values when loft insulation thickness is known

Insulation thickness (mm)	Assumed roof U-value (W/m²K) at the ceiling level.		
	Insulation at joists at ceiling level and flat roof (1)	Insulation at rafters but U-value is attributed to the ceiling area (2)	Insulation at joists (thatched roof only) (3)
None	2.3	2.3	0.35
12	1.5	1.75	0.32
25	1.0	1.30	0.30
50	0.68	0.88	0.25
75	0.50	0.67	0.22
100	0.40	0.54	0.20
125	0.35	0.45	0.18
150	0.30	0.39	0.17
175	0.25	0.32	0.15
200	0.21	0.29	0.14
225	0.19	0.25	0.13
250	0.17	0.23	0.12

270	0.16	0.21	0.12
300	0.14	0.19	0.11
350	0.12	0.16	0.10
>= 400	0.11	0.14	0.09

Note: The U-values in **Table 16 :** take account of timber joists. The insulation is taken as being between joists only up to 150 mm, and between and over joists thereafter. It also takes into the account sheltering effect of unheated roof space.

The U-values in Table 16 are for mineral wool or expanded polystyrene insulation.

In other cases, unless provided by the assessor the U-value is taken from **Table 18**.
For a pitched roof with no access, use the column **(1)** for **'at joists"** in **Table 18**.

6.11.3 Roof Room insulation where thickness of insulation is known.

The U-value assumed for a Room in Roof where thickness of insulation is known should, where possible, be based on the observed thickness of the insulation and the corresponding U-values according to Table 17.

Table 17 : U-values applicable to rooms in roof (RR) where insulation thickness is known.

Insulation thickness (mm)	Insulated slope – sloping ceiling U-value (1)		Insulated slope - flat ceiling U-value (2)		Stud wall u-value For Room in Roof (3)	
	Mineral wool or EPS slab (1a)	PUR or PIR optional (1b)	Mineral wool or EPS slab (2a)	PUR or PIR Optional (2b)	Mineral wool or EPS slab (3a)	PUR or PIR optional (3b)
none	2.3				2.3	
12	1.5	1.25	1.75	1.5	0.95	0.85
25	1	0.8	1.25	1	0.7	0.6
50	0.68	0.52	0.88	0.69	0.52	0.45
75	0.5	0.38	0.67	0.51	0.43	0.35
100	0.4	0.3	0.54	0.41	0.36	0.29
125	0.35	0.25	0.45	0.34	0.31	0.24
150	0.3	0.21	0.39	0.29	0.27	0.21
175	0.25	0.17	0.32	0.23	0.24	0.19
200	0.21	0.15	0.29	0.2	0.22	0.17
225	0.19	0.13	0.25	0.18	0.2	0.15
250	0.17	0.11	0.23	0.15	0.18	0.14
270	0.16	0.1	0.21	0.14	0.17	0.13
300	0.14	0.09	0.19	0.13	0.16	0.12
350	0.12	0.08	0.16	0.11	0.14	0.11
>400	0.11	0.07	0.14	0.09	0.12	0.1

Key: EPS – expanded polystyrene slab; PUR – polyurethane rigid insulation; PIR – polyisocyanurate rigid foam

In other cases, unless provided by the assessor the U-value is taken from **Table 18.**

6.11.4 Assumed U-values when thickness of insulation cannot be determined.

U-values in **Table 18** are used when thickness of insulation cannot be determined.

If retrofit insulation present of unknown thickness use 50 mm.

Table 18 : Assumed roof U-values when Table 16 or Table 17 do not apply

Age band	Assumed Roof U-value (W/m²K) [a]						
	Pitched, slates or tiles, insulation between joists or unknown (1)	Pitched, slates or tiles, insulation at rafters (2)	Flat roof [b] (3)	Room-in-roof, all elements (4)	Thatched roof [c] (5)	Thatched roof, room-in-roof (6)	Park home (7)
A, B, C, D	0.40 (100 mm) [1] [4]	2.3 [1]	2.3 [1]	2.3 [1]	0.35	0.25	-
E	0.40 (100 mm) [1] [4]	1.5 [1]	1.5 [1]	1.5 [1]	0.35	0.25	-
F	0.40 (100 mm) [1] [4]	0.68 [1]	0.68 [1]	0.80 [1]	0.35	0.25	1.7
G	0.40 (100 mm) [1]	0.40 [1]	0.40 [1]	0.50 [1]	0.35	0.25	0.6
H	0.30 (150 mm) [1]	0.35 [1]	0.35 [1]	0.35 [1]	0.35	0.25	-
I	0.26 (170 mm) [1]	0.35 [1]	0.35 [1]	0.35 [1]	0.35	0.25	0.35
J	0.16 (270 mm) [1]	0.20 [1]	0.25 [1]	0.30 [1]	0.30	0.25	-
K	0.16 (270 mm) [1]	0.20 [1]	0.25 [1] [2]	0.25 [1] [2]	0.25 [2]	0.25 [2]	0.30
L	0.16 [3] (270 mm) [1]	0.18 [1]	0.18 [1]	0.18 [1]	0.18	0.18	-
M	0.15 (300mm) [1]	0.15 [1]	0.15 [1]	0.15 [1]	0.15	0.15	0.15

[a] If the roof insulation is "none" use U = 2.3 (all roof types, except for thatched roofs); it takes into the account sheltering effect of unheated roof space.

[b] Applies also to roof with sloping ceiling and "unheated space above the building part". See also **2.14 .**

[c] For thatched roofs if there is also retro-fitted insulation between the rafters reduce the U-value to

$$U = \frac{1}{\frac{1}{U_{table}} + R_{ins}}$$ where R_{ins} is 0.7 m²K/W for 50 mm, 1.4 m²K/W for 100 mm and 2.1 m²K/W for 150 mm.

[1] The value from the table applies for unknown and as built.

[2] 0.20 W/m²K in Scotland

[3] 0.15 W/m²K in Scotland

[4] Most lofts are insulated to at least 100 mm insulation

In the case of roof rooms, the insulation thickness on the flat part of the ceiling should be measured where possible and the U-value taken from column (2) in **Table 17**.

The U-value of the remaining parts of the roof rooms, i.e. walls and sloping ceilings, is taken from **Table 18** according to the age band of the roof rooms, unless evidence is available as to the insulation of these parts in which case column (1) in **Table 17** applies.

There is no heat loss through the roof of a building part that has the same dwelling above or another dwelling above.

Note: These U-values take account of joists. They may differ from Elemental U-values in regulations applicable at the time of construction, where the Elemental U-values in regulations (up to age band H) were set on the basis of ignoring joists in U-value calculations.

6.12 U-values of floors next to the ground

Unless provided by the assessor the floor U-value is calculated according to BS EN ISO 13370 using its area (A) and exposed perimeter (P) and rounded to two decimal places. Floor U-values are obtained separately for the main dwelling and for any extension, using the applicable area, exposed perimeter and wall thickness.
The following parameters are used:

– wall thickness (w) in metres as provided in the RdSAP data set or from **Table 3 : Wall thickness (mm)** if thickness unknown
– soil type clay (thermal conductivity λ_g = 1.5 W/m·K)
– R_{si} = 0.17 m²K/W
– R_{se} = 0.04 m²K/W
– floor construction as specified by assessor, or from **Table 19** if unknown
– all-over floor insulation of thickness as provided by the assessor or from **Table 19** if unknown
– thermal conductivity of floor insulation 0.035 W/m·K
(so that $R_f = 0.001*d_{ins}/0.035$ where d_{ins} if the insulation thickness in mm)

A non-separated conservatory has an uninsulated solid ground floor and wall thickness 300 mm.

A park home has a suspended timber floor.

For solid ground floors

1. $d_t = w + \lambda_g \times (R_{si} + R_f + R_{se})$
2. $B = 2 \times A/P$
3. if $d_t < B$, $U = 2 \times \lambda_g \times \ln(\pi \times B/d_t + 1)/(\pi \times B + d_t)$
4. if $d_t >= B$, $U = \lambda_g / (0.457 \times B + d_t)$

For suspended ground floors:

– thermal resistance of floor deck R_f = 0.2 m²K/W if uninsulated,
or R_f = thermal resistance of insulation + 0.2 if insulated
– height above external ground level h = 0.3 m
– average wind speed at 10 m height v = 5 m/s
– wind shielding factor f_w = 0.05
– ventilation openings per m exposed perimeter ε = 0.003 m²/m
– U-value of walls to underfloor space U_w = 1.5 W/m²K

1. $d_g = w + \lambda_g \times (R_{si} + R_{se})$
2. $B = 2 \times A/P$
3. $U_g = 2 \times \lambda_g \times \ln(\pi \times B/d_g + 1)/(\pi \times B + d_g)$
4. $U_x = (2 \times h \times U_w/B) + (1450 \times \varepsilon \times v \times f_w/B)$
5. $U = 1 / (2 \times R_{si} + R_f + 1/(U_g + U_x))$

Table 19 : Basis for floor U-value calculation for ground floors when insulation thickness is unknown

Age band	Floor construction (1)	All-over floor insulation (2)			
		England & Wales	Scotland	Northern Ireland	Park home (3)
A, B	suspended timber (4)	none	none	none	-
C to F	solid	none	none	none	none
G	solid	none	none	none	25 mm
H	solid	none	25 mm	25 mm	-
I	solid	25 mm	50 mm	50 mm	50 mm
J	solid	75 mm	75 mm	-	-
K	solid	100 mm	100 mm	100 mm	70 mm
L	solid	100 mm	120 mm	100 mm	-
M	solid	140 mm	180 mm	140 mm	100mm
(1) Where floor construction is unknown					

(2) For floors which have retrofitted insulation, use the greater of 50 mm and the thickness according to the age band.
(3) Suspended timber in all cases.
(4) Solid ground floor if underfloor heating.

6.13 U-values of exposed and semi-exposed upper floors

U-values of exposed and semi-exposed upper floors may be available to the assessor.

Otherwise, to simplify data collection no distinction is made in terms of U-value between an exposed floor (to outside air below) and a semi-exposed floor (to an enclosed but unheated space below) and the U-values in **Table 20** are used.

Table 20 : Exposed/Semi-exposed floor U-values

Age band	U-value (W/m²K)			
	Insulation unknown or as built	Insulated 50 mm	Insulated 100 mm	Insulated 150 mm
A to G	1.20	0.50 (1)	0.30	0.22
H or I	0.51	0.50 (1)	0.30	0.22
J	0.25	0.25	0.25	0.22
K	0.22	0.22	0.22	0.22
L	0.22 (2)	0.22 (2)	0.22 (2)	0.22 (2)
M	0.18 (3)	0.18 (3)	0.18 (3)	0.18 (3)

(1) Use these values if known to be insulated but insulation thickness not known
(2) 0.18 W/m²K in Scotland
(3) 0.15 W/m²K in Scotland and Wales

6.14 U-value of floor above a partially heated space

The U-value of a floor above partially heated premises is taken as 0.7 W/m²K. This applies typically for a flat above non-domestic premises that are not heated to the same extent or duration as the flat.

6.15 Allowance for thermal bridging

The thermal bridging factor, y, as defined in Appendix K is taken from **Table 21 : Thermal bridging**.

Table 21 : Thermal bridging

	Thermal bridging factor y (W/m²K)	
Age band	Not Park home	Park home
A to I	0.15	0.15
J	0.11	0.15
K, L, M	0.08	0.15

Thermal bridging factor “y” is determined according to the age band of the main dwelling and applied to the all the exposed area including main dwelling, extensions, and non-separated conservatory.

6.16 Thermal Mass

The thermal mass parameter is taken as:

Table 22 : Thermal mass parameter

Construction type of main building	Thermal mass parameter
Timber frame, cob and park home (the three types regardless of presence of internal insulation) or masonry including stone, solid brick, cavity walls and system built (all four types **with internal insulation)**	100 kJ/m²K
Masonry including stone, solid brick, cavity walls and system built **(all four types without internal insulation)**	250 kJ/m²K

6.17 Basement U-values

For basement walls and floors use values in **Table 23 : Basement U-values**

Table 23 : Basement U-values

Age band	U-value (W/m²K)	
	Basement Wall	**Basement Floor**
A to E	0.7	0.50
F	0.7	0.50
G to H	0.6	0.5
I	0.45	0.5
J	0.35	0.25
K	0.3	0.22
L	0.28	0.22
M	0.26	0.18

If there is a **floor above a basement** it is treated as if it were a ground floor for heat loss purposes.

6.18 Curtain wall - U-value and other parameters

See section **2.5** for the definition of a curtain wall.

If documentary evidence is available, use calculated U-value of the whole curtain wall.
Otherwise for the purpose of RdSAP, U= 2.0 W/m²K for pre-2023 curtain walls,
And for post-2023 (2024 in Scotland) U-values as for windows given in Notes below **Table** 24.

For the whole wall curtain walls use Frame Factor=1.

Software should have a provision for specifying curtain wall.

7 CONSERVATORY

7.1 Non-separated conservatory

The floor area and volume of a non-separated conservatory are added to the total floor area and volume of the dwelling. Its roof area is taken as its floor area divided by cos(20°), and wall area is taken as the product of its exposed perimeter and its height. Its height is estimated from the equivalent number of storey heights of the dwelling to the nearest half storey (based on average internal height within the conservatory). The conservatory walls and roof are taken as fully glazed (and this glazed area applied in addition to measured window areas). Glazed walls are taken as windows, glazed roof as rooflight, see window U-values in **Table 24 : Window characteristics**.

The number of storey heights are translated into an actual height according to:
- 1 storey: ground floor room height
- 1½ storey: ground floor room height + 0.25 + 0.5*(first floor room height)
- 2 storey: ground floor room height + 0.25 + first floor room height

etc.

7.2 Separated conservatory.

A separated conservatory with or without fixed heaters is disregarded.

8 SOLAR GAINS

Solar gains are calculated for average overshading (SAP10.2 Table 6d). When all windows are measured the collected data includes the orientation of each window.

9 WINDOWS AND DOORS

A window is an opening in an external wall or roof of a building, fitted with glass or similar material, usually in a frame, that admits light.
A door may be treated as a window if it is considered to be highly glazed. Examples of highly glazed doors are patio doors, fully glazed doors, or French doors.
If in doubt, measure it and treat as a window if glazing area is 60% or more.

9.1 Draught proofing

All external doors and openable windows per building part should be examined for the presence of draughtproofing.

Refer to RdSAP Conventions if the state of draughtproofing cannot be determined.

If the state of the draught proofing cannot be determined then take triple, double or secondary glazed as being draughtproofed, and single glazed windows and doors as not draughtproofed.

Include glazing in a non-separated conservatory.

Insulated doors are assumed to be draught proofed, uninsulated doors are assumed to not be draught proofed.

The percentage draught proofed is calculated as [(number of draughtproofed openable windows & doors) divided by (total number of openable windows & doors)] x 100.

9.2 Window U-values and g-values

Actual U-values, g-values and frame factors (FF) can be used if known, subject to a documentary evidence.

Default U-values and g-values for windows are in **Table 24 : Window characteristics**; the values can be overwritten only if documentary evidence is provided, which can be either a Window Energy Rating certificate (as defined by BFRC), modelled values or published manufacturer's data.

The U-value is for a whole window, not a centre pane; it includes the glass AND the frame.

Refer to RdSAP Conventions for definition of "glazing age" and "glazing gap".

Table 24 : Window characteristics

Glazing	Installed	Glazing gap between panes of glass	U-value (PVC or wooden frame)	U-value (metal frame)	U-value** (roof window)	g-value
Single	Any period	-	4.8	5.7	5.3	0.85
Double glazed*	England/Wales: before 2002, Scotland: before 2003 N. Ireland: before 2006	6 mm	3.1	3.7	3.4	0.76
		12 mm	2.8	3.4	3.1	
		16 mm or more	2.7	3.3	3.0	
Triple glazed	England/Wales: before 2002, Scotland: before 2003 N. Ireland: before 2006	6 mm	2.4	2.9	2.6	0.68
		12 mm	2.1	2.6	2.3	
		16 mm or more	2.0	2.5	2.2	
Double or triple glazed	England/Wales: 2002 or later, Scotland: 2003 or later N. Ireland: 2006 or later	any	2.0	2.2	2.3	0.72
Double or triple glazed	England/Wales: 2022 or later Scotland: 2023 or later NI: 2022 or later	any	1.4	-	1.6	0.72
Secondary glazing	Any period	16 mm or more Normal emissivity	2.9	-	-	0.85
		16 mm or more Low emissivity	2.2			
Any glazing-known data	Any period	Any	As provided			

* Use this row for conservatories and for other double or triple glazing whose installation date is unknown.
** Roof pitch 45° (unless horizontal), wooden or PVC.

Frame factor is 0.7 for wooden or PVC frame; 0.8 for metal frame (not applied if data source is BFRC)

For **curtains** and **blinds** no additional adjustment is required as curtains and blinds already accounted in formula (2) §3.2 in SAP10.2 by adding resistance R=0.04 m^2K/W , however:

- If a window is fitted with **uninsulated shutters** use R=0.13 m^2K/W in formula (2) §3.2 in SAP10.2
- If a window is fitted with **insulated shutters** use R=0.16 m^2K/W in formula (2) §3.2 in SAP10.2

Table 25 applies to a non-separated conservatory.

Table 25 : Default U-values for non-separated conservatory

Glazing	Age band	Frame (FF)	U-value of window	U-value of roof window	g-value
Single	Any	Wood/PVC (FF=0.7)	4.8	5.3	0.85
Double (6 mm gap)	Any	Wood/PVC (FF=0.7)	3.1	3.4	0.76
Triple (6 mm gaps)	Any	Wood/PVC (FF=0.7)	2.4	2.6	0.68
U-values are adjusted for curtains (section 3.2 of the SAP 10.2 specification).					

The orientation of windows in a conservatory is not recorded, thus solar gains are calculated using the default solar flux (East/West orientation, with 20° pitch for roof windows) in all cases.

9.3 Door U-values

The RdSAP data set contains the total number of external doors and the number of those doors that are insulated. The U-value of insulated doors is part of the data set; the U-value of other external doors is taken from **Table 26 : Default U-values for doors**.

Table 26 : Default U-values for doors

Door opens to	**Age band**	**Door U-value, W/m²K**
Outside	A to J	U-value =3.0 W/(m²·K)
	K	U-value =2.0 W/(m²·K)
	L	E/W and N.I: U-value =1.8 Scotland: U-value =1.6 W/(m²·K)
	M	1.4 W/(m²·K)
Unheated corridor or stairwell	any	U-value =1.4 W/(m²·K)
Heated corridor or stairwell	any	(omitted from data collection)

A multiple door should be recorded as such, e.g. a double door should be counted as 2 doors (or measured).

A door is counted as insulated only if documentary evidence is provided, which must include U-value or manufacturer reference enabling the assessor to ascertain the U-value from the manufacturer.

If there is more than one insulated door and they have different U-values, use the average U-value.

An external door is a door that forms part of the heat loss perimeter of the dwelling (including being covered by a separated conservatory)

If there is more than one insulated door and they have different U-values, enter the average U-value.

See RdSAP Conventions for treatment of highly glazed doors.

10 ROOM COUNT AND LIVING AREA

10.1 Room count (habitable room count)

The room count is equal to the number of habitable rooms[9].

10.1.1 Habitable room count

Habitable rooms include any living room, sitting room, dining room, kitchen/diner, bedroom, study and similar; and also a non-separated conservatory.

Excluded from the room count are: any room used solely as a kitchen, utility room, bathroom, cloakroom, en-suite bathroom/shower room/toilet or similar; any hallway, stairs or landing; and also any room without access to natural daylight.

For a kitchen to be a kitchen/diner it must have space for a table and 4 chairs.

A lounge/dining room where the door was temporarily removed (i.e. architrave and hinges still there) is counted as two habitable rooms.

A lounge/dining room with the door permanently removed (hinge holes filled, etc.) is one habitable room.

A non-separated conservatory adds to the habitable room count if it has an internal quality door between it and the dwelling.

If a conservatory is open to the rest of the dwelling it is NOT counted as a separate room.

If a conservatory has an external quality door between it and the dwelling, then the conservatory is thermally separated from the dwelling and ignored for purposes of RdSAP.

Refer to RdSAP Conventions applicable at the time of assessment for more details.

10.1.2 Heated habitable room count

Includes all habitable rooms heated by either main heating system(s) or fixed secondary heating Bedrooms with only open fireplaces are disregarded from the heated habitable room count when identifying the heating systems (main and secondary, refer to SAP10.2 Appendix A section A2.2).

10.2 Living area

The default living area fraction is determined from the number of habitable rooms.

Table 27 : Living area fraction.

Number of rooms:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Living area fraction:	0.75	0.50	0.30	0.25	0.21	0.18	0.16	0.14
Number of rooms:	**9**	**10**	**11**	**12**	**13**	**14**	**15+**	
Living area fraction:	0.13	0.12	0.11	0.10	0.10	0.09	0.09	

The living area is then the fraction multiplied by the total floor area.

Table 27 gives default living area fractions. Alternatively, living area fraction can be calculated by dividing measured living area by measured total floor area.

[9] In Scotland, usually referred to as ‘apartments’.

11 SPACE AND WATER HEATING (REFER TO SAP10.2 APPENDIX A)

11.1 Main space heating system(s)

The main heating system is that which heats the largest proportion of dwelling. Main heating system not usually based on individual room heaters (unless only room heaters are present in the dwelling), and often provides hot water as well as space heating.

Main heating systems are either identified via the Product Characteristics Database or are categorised on the basis of the generic types in Tables 4a and 4b in SAP10.2.

In the case of gas or oil boilers, micro-CHP systems and heat pumps, the database is to be used whenever possible. There is a significant difference between the database efficiency values and the defaults in Table 4a/4b in many cases.

In the case of micro-CHP system or a heat pump, if the **Plant Size Ratio** is out of range (this is described in Appendix N in SAP10.2 specification and incorporated in SAP and RdSAP software) the RdSAP software reports the situation advising the assessor to select:

- in the case of micro-CHP, a condensing boiler;
- in the case of a heat pump, the appropriate one from Table 4a in SAP10.2.

Otherwise space heating systems are those marked "rd" in Tables 4a and 4b in SAP10.2.

The following are to be assumed as not fan-assisted:

- gas boiler pre 1998 with balanced or
- open flue oil boiler
- gas warm air, balanced or open flue

Where no space heating system is present, the calculation is done for portable electric heaters (with no controls) in all habitable rooms. The control type for this case (as is needed for SAP10.2 Table 9) is 2, the same as for portable electric heaters with no controls.

For treatment of unheated habitable rooms see SAP10.2 Appendix A.

Where one system is serving both radiators and underfloor, specify the same heat source as main heating 1 and main heating 2 following the **rules for "two main heating systems" in RdSAP convention.**

11.2 Two main heating systems

RdSAP allows for two main heating systems.

There is an option for two main systems to cover the situation of different systems heating different parts of the dwelling.

If main system 1 heats all habitable rooms, there is no main system 2 unless it serves DHW only (see section **11.5**).

Main systems 1 and 2 cannot be room heaters except in the case of the dwelling's heating consisting solely of room heaters.

A second main system is not to be confused with a secondary heater. See **RdSAP Conventions** for rules on secondary heaters.

11.3 Space heating controls

Space heating controls are those marked "rd" in Table 4e in SAP10.2. Some control features whose effect is small are omitted.

11.4 Secondary heating

The secondary heating system is a room heater type.

In the case of micro-CHP (only) where SAP 10.2 Table N9 indicates a non-zero secondary heating requirement and no secondary heater has been specified, RdSAP should include secondary heating by portable electric heaters for the purposes of the calculation.

A fixed heater in non-habitable rooms is still counted as a secondary heater.

Refer to RdSAP conventions for more details.

11.4.1 Fuels for solid fuel fires

If the appliance can burn only one fuel, specify that fuel (includes exempted appliances burning wood in Smoke Control Areas).
Otherwise*:* Refer to RdSAP conventions for more details.

11.5 Water heating

The actual size of hot-water cylinder should be used if it can be obtained from the label on the cylinder.

If the actual size is not determined, the size of a hot-water cylinder is taken as according to **Table 28**.

Table 28 : Cylinder size

Descriptor	**Indicative size range**	**Size to be used in SAP calculation ***
Inaccessible		if off-peak electric dual immersion: 210 litres if from solid fuel boiler: 160 litres otherwise: 110 litres
Normal	up to 130 litres	110 litres
Medium	131 – 170 litres	160 litres
Large	> 170 litres	210 litres
* Actual size to be used if present in the PCDB data set (and in conjunction with Domestic Hot Water solar panel data where solar store volume is required)		

If water is heated by a dual immersion and the electricity supply is a single meter include Addendum 6.

An electric immersion is assumed dual in the following cases:
- cylinder is inaccessible and electricity tariff is dual;
- the DHW is heated by an electric boiler index (191) in SAP10.2 Table 4a and the electricity tariff is “dual”.

11.5.1 Separate boiler or heat pump for DHW

If there is a separate boiler or heat pump providing DHW only, specify the two main heating systems as follows:
- main system 1 is the one providing space heating (100% of heat is from main system 1);
- main system 2 is the one providing DHW (0% of heat from main system 2);

If both main heating systems supply space heating only, a generic DHW-only boiler can be selected from the water heating options.

11.6 Back boilers

Where water heating is from a back boiler or room heater with boiler, and the boiler provides water heating only, the appropriate fire or room heater is identified in the data collection process, and the water heating is identified as from main system or from secondary system.

Where the back boiler provides space heating:

- if gas, the back boiler is selected as main heating, the associated fire is selected as the secondary heating, and the water heating is from main system.
- if oil or solid fuel, the combination of room heater and boiler is selected as main heating and provides the water heating as well.

In the case of a gas fire with back boiler, the efficiency of the fire is from the room heater section of Table 4a according to the type of fire and the efficiency of the back boiler is 65% (from water heating section of Table 4a).

In the case of oil or solid fuel, the efficiency from the room heater section of Table 4a is applied to both the fire/room heater and the back boiler.

11.7 No water heating system

Where no water heating system is present, the calculation is done for an electric immersion heater. If the electric meter is dual the immersion heater is also dual, but is a single immersion otherwise (including unknown meter). The calculation is done for a cylinder defined by the first row of **Table 28 : Cylinder size** and the first row of **Table 29 : Heating and hot water parameters**.

11.8 Solar water heating

Calculation according to SAP 10.2.
Refer to RdSAP Conventions for additional information.

11.9 Flue gas heat recovery

Calculation according to SAP 10.2 Appendix G.
Refer to RdSAP Convention for additional information.

11.10 Waste water heat recovery

Calculation according to SAP 10.2 Appendix G.
Refer to RdSAP Convention for additional information.

11.11 Space and water heating assumptions

Parameters in **Table 29 : Heating and hot water parameters** are supplementing data in **Table 31 : Data to be collected**

Table 29 : Heating and hot water parameters

Parameter	Value
Hot water cylinder insulation if not accessible	Age band of main property A to F: 12 mm loose jacket Age band of main property G, H: 25 mm foam Age band of main property I to M: 38 mm foam
Cylinder thermostat if no access	No cylinder thermostat (but see also §9.4.9 in SAP10.2, A cylinder thermostat should be assumed to be present when DHW is from heat network (HN), an immersion heater, a thermal store, combi boiler or CPSU.
Cylinder heat exchanger area (required for some database heat pumps)	1.0 m² However, if data from database, from PCDB then all details are from PCDB
Insulation of primary pipework	Age bands A to J: none Age band K. L, M: full
Space heating circulation pump for wet systems	Within heated space
Oil pump for oil boilers	Not in heated space

Parameter	**Value**
Gas boilers pre-1998, balanced or open flue	Not fan-assisted
Oil boilers from SAP table	Not fan-assisted
CPSU	In airing cupboard Gas: if data from Table 4b, store volume 80 litres, store loss rate 2.72 kWh/day Gas: if data from database use store volume and insulation thickness from database Electric: store volume 300 litres, store loss rate 3.16 kWh/day, store temperature 90°C
Gas warm air system, balanced or open flue (not the fan-assisted types)	Not fan assisted
Solid fuel boiler or room heater	Not HETAS approved
Underfloor heating	If dwelling has a ground floor, then according to the floor construction (see **Table 19** if unknown): - solid, main property age band A to E: concrete slab - solid, main property age band F to M: in screed - suspended timber: in timber floor - suspended, not timber: in screed Otherwise (i.e. upper floor flats), take floor as suspended timber if the wall is timber frame and as solid for any other wall type, and apply the rules above.
Emitter temperature for condensing boilers and heat pumps	If unknown in RdSAP dataset: - if heating by radiators, > 45°C - underfloor heating, <= 35°C
Design water use target not more than 125 litres per person per day	No
Hot water separately timed	No programmer, pre-1998 boiler: - No Programmer, pre-1998 boiler: - Yes Post-1998 boiler: - Yes
Hot water cylinder in heated space	Yes
Boiler interlock	Assumed present if there is a room thermostat and (for stored hot water systems heated by the boiler) a cylinder thermostat. Otherwise not interlocked.
Summer immersion where DHW is provided by a solid fuel open fire or closed room heater	Yes; single immersion unless already has dual immersion
Supplementary immersion heater for DHW from heat pump	Yes if generic heat pump supplying space and water heating (from Table 4a in SAP10.2). Not applicable if heat pump from database since supplementary heating is incorporated in the water heating efficiency in the database record. Assume dual immersion if electricity tariff is dual, otherwise single immersion.
Electricity tariff	See section **13**

Parameter	**Value**
Solar panel	If solar panel present, the parameters for the calculation not provided in the RdSAP data set are: - panel aperture area 3 m² - flat panel, $\eta_0 = 0.80$, $a_1 = 4.0$, $a_2 = 0.01$ - facing South, pitch 30°, modest overshading - if regular boiler: combined cylinder, solar part one-third of total rounded to nearest litre (if separate pre-heat cylinder, assess total cylinder size (**Table 28**) on the basis of both cylinders) - if water heating by: - combi boiler - CPSU - heat pump (including hot water only) - micro-CHP with integral DHW vessel - instantaneous water heater - or community heating assume a 75-litre pre-heat cylinder. - pump for solar-heated water is electric (75 kWh/year) - showers are both electric and non-electric
Storage waste water heat recovery WWHR system	Dedicated storage volume: - if combined, one third of the total cylinder size rounded to the nearest litre - if separate, the mean of the high and low dedicated volumes in the data record, rounded to the nearest litre.
Heat Network (HN) supplying - space and water, or - space heating only	For HN with data in the PCDB, the network data are used for plant efficiency, distribution loss and pumping energy. Otherwise: - system based on boilers with efficiency 80% or heat pump with efficiency 300% - see Table 12c in SAP10.2 - if CHP (waste heat or geothermal treat as CHP): fraction of heat from CHP = 0.35 CHP overall efficiency 75% heat to power ratio = 2.0 boiler efficiency 80%
Heat Network (HN) supplying - water heating only	For HN with data in the PCDB, the network data are used for plant efficiency, distribution loss and pumping energy. Otherwise: - system based on boilers with efficiency 80% or heat pump with efficiency 300% - flat-rate charging or if CHP fraction of heat from CHP = 1.0 CHP overall efficiency 75% heat to power ratio = 2.0
HN – charging method	As per SAP10.2 Table 4e Group 3: Heat networks

12 ADDITIONAL ITEMS

12.1 Photovoltaics

The calculation is as follows:

a) If the kWp (or DNC) is known, calculate the annual contribution according to M1 in Appendix M. Up to three separate PV arrays are allowed for, each with their own kWp, tilt orientation and overshading as given in SAP10.2 Table H2, so that RdSAP10 uses the same overshading for PV and solar thermal.
b) If the kWp (or DNC) is not known use the following:
   - PV area is roof area for heat loss (before amendment for any room-in-roof), times percent of roof area covered by PVs, and if pitched roof divided by cos(35°). If there is an extension, the roof area is adjusted by the cosine factor only for those parts having a pitched roof.
   - kWp is 0.12 × PV area.
   - if not provided in the RdSAP data set then facing South, pitch 30°, modest overshading

Basis of "0.12": mainstream solar panels generate an average of around 120 Wp (0.12kWp) per square meter. Hence for a 1 kWp system you will need around 8m2 of roof size.

Calculation example if kWp or DNC of PV battery is not known:
Estimated ceiling area is $10m^2$
Divide $10m^2$ by cos(35) to estimate the required area of pitched roof; $10/0.819=12.2\ m^2$.
kWp=12.2*1.2=1.46 kWp

Refer to RdSAP Conventions for more details.

12.2 PV diverters and PV batteries

If PV diverters are present, the calculation procedure is given in SAP 10.2 section G4.

Assessor needs to collect information on:
1) Number of Batteries;
2) Capacity of each battery:
   - Use default capacity of one battery = 5kW if actual capacity not available, or
   - Actual capacity

12.3 Wind turbine

If present and details not provided in the RdSAP data set, calculate for 1 turbine with 2 m rotor diameter and 2 m hub height.

12.4 Small scale hydro generators

If present and details are available, the calculation is according to SAP10.2 specification, where the calculation can be either for a year or for each month.

12.5 Shutters and blinds

Shutter is a product, where the curtain is made of a rigid material, installed to provide or modify characteristics such as thermal and visual properties of an existing glazed surface (e.g. window, door) to which it is applied.

The approach applies to all shutters and external venetian blinds whatever their use and nature of the materials used:

$$U_{window\_and\_shutter} = \frac{1}{1/U_{window} + \Delta R}$$

Where:

U_{window} – U-value of a whole window (including window frame) without a shutter, W/m2K
$U_{window\_and\_shutetr}$ – U-value of a whole window without a shutter, W/m2K
ΔR – additional resistance, m^2K/W

Refer to **Table 24 : Window characteristics** for ΔR associated with shutters and blinds.

12.6 Special features (Appendix Q technologies)

The procedures described in Appendix Q are also applicable to RdSAP assessments. Only Appendix Q items marked "for the use in RdSAP" should be used.

12.7 Technical Notes

The procedures described in Technical Notes are also applicable to RdSAP assessments. RdSAP software should therefore allow using Technical Notes marked "for the RdSAP use."

12.8 Terrain

Terrain type should be based on the abundance of obstacles in the curtilage of the dwelling, not necessarily the characteristics of the surrounding area.

For example, a site containing a number of dwellings but away from a village/town should be classed as suburban as the number of dwellings would likely make the use of a wind turbine unviable.

13 ELECTRICITY TARIFF

The electricity meter is recorded as single, dual (two separate readings), dual 18-hour, dual 24-hour or unknown (if inaccessible). Dual 24-hour is possible in Scotland and some parts of northern Northumberland.

Off-peak tariff is needed for the intended operation of:
- electric storage heaters (401 to 409)
- underfloor heating (421 or 422, but not 424)
- electric dry core or water storage boiler (193, 195)
- electric CPSU (192)
- dual electric immersion

If it is a single meter when any of these are present enter heating as panel heaters and/or immersion as single, and include Addendum 6.

If the electricity meter is unknown, treat as single meter except where:
- main heating or water heating are intended to run off an off-peak tariff (per systems listed in text box above) or
- main heating is ground source or water source heat pump.

If that results in a dual meter, assign tariff per rules 1. to 4. below.

If the electricity meter is single, the tariff is standard electric tariff and if the meter is dual 18-hour/24-hour it is 18-hour/24-hour tariff. Otherwise the choice between 7-hour and 10-hour is determined as follows.

1. If the main heating system (or main system if there are two) is an electric CPSU (192) it is 10-hour tariff.
2. Otherwise, if the main heating system (or either main system if there are two) is:
   - electric storage heaters (401 to 409), or
   - electric dry core or water storage boiler (193 or 195), or
   - electric underfloor heating (421 or 422)

   it is 7-hour tariff.
3. If that has not resolved it then if the main heating system (or either main system if there are two) is:
   - direct-acting electric boiler (191), or
   - heat pump (211 to 224, 521 to 524, or database), or
   - electric room heaters (unless assumed because there is no heating system).

   it is 10-hour tariff.
4. If none of the above applies it is 7-hour tariff. This includes assumed electric heaters because there is no heating system.

A dual meter is possible even if off-peak is not used for heating or DHW.

If dual, assign electricity uses to tariffs according to 12.4.3.

14 ADDENDUM TO EPCS

Where a feature, e.g. wall type or heating system, is not part of the reduced data set, a near equivalent should be selected. For the circumstances indicated below, an explanation can be provided on the EPC by way of an addendum.

Table 30 : Addendum

Reference Number	Circumstances	Addendum text on EPC
1	Wall type does not correspond to options available in RdSAP	The dwelling has a type of wall that is not included in the available options. The nearest equivalent type was used for the assessment.
4	Dwelling has a swimming pool	The energy assessment for the dwelling does not include energy used to heat the swimming pool.
5	Dwelling has micro-CHP	The performance characteristics of the micro-CHP system in this dwelling are not known and default values were used for the assessment.
6	Off-peak appliance(s) with single meter	A dual rate appliance(s) is present with a single-rate supply. A single-rate appliance has been used for the assessment. Changing the electricity tariff to an off-peak (dual rate) supply is likely to reduce fuel costs and improve the energy rating.
8	PVs or wind turbine present on the property (England, Wales or Scotland)	The assessment does not include any feed-in tariffs that may be applicable to this property but may include a benefit for the export of excess generation to the Grid.
9	Two main heating systems and heating system upgrade is recommended	As there is more than one heating system, you should seek professional advice on the most cost-effective option for upgrading the systems.
10	Dual electricity meter selected but there is also an electricity meter for standard tariff	The assessment has been done on the basis of an off-peak electricity tariff. However some heating or hot water appliances may be on the standard domestic tariff.
11	Single electricity meter selected but there is also an electricity meter for an off-peak tariff	The assessment has been done on the basis of the standard domestic electricity tariff. However some heating or hot water appliances may be on an off-peak tariff.
12	Dwelling is using a biomass fuel that is not in the RdSAP fuel options	The dwelling uses a type of fuel that is not included in the available options. The nearest equivalent fuel type was used for the assessment.
13	Dwelling has a special energy saving feature	The dwelling has a special energy saving feature which is recognised in the assessment, but its impact on the savings shown for other improvement measures is ignored.
14	Conservation area	Conservation area
15	PV recommended	When considering the PV installation consider installing PV battery and a PV diverter for water heating
16	PV-independent battery storage present	The assessment does not include PV-independent battery storage

Reference Number	Circumstances	Addendum text on EPC
17	"Phase-changing" heat storage present	The assessment does not include "Phase-changing" heat storage
18	Party wall insulation	Party wall is a property of two homes. If acoustic issues are important seek professional advice before insulating party wall. Insulating party wall on one side may cause condensation risk to adjoining property.

The list of addenda shown above is current at the date of this document; items will be modified or added as appropriate. An addendum may be added as a temporary measure; if an addendum is used frequently the reduced data set will be extended in a future revision so as to avoid the need for it.

Software displays the current list of possible addenda (showing the 'circumstances' for each one); the assessor can select one or more to be included on the EPC.

15 CLIMATE DATA

For ratings (SAP rating and EI rating), the calculations are done using the UK average climate data as follows:

External temperature: row for UK average in SAP10.2 Table U1.
Wind speed: row for UK average in SAP 10.2 Table U2.
Solar radiation on horizontal surfaces: row for UK average in SAP 10.2 Table U3.
Solar radiation on vertical surfaces (for calculation of solar gains) and solar radiation on inclined surfaces (for solar panels and PVs): from the radiation on the horizontal converted by the procedures in SAP10.2 section U3.2.

For costs and savings, energy demand, total emissions and primary energy, the calculations are done using the climate data for the location of the property, as follows:

External temperature, wind speed, solar radiation on horizontal surfaces: data provided for each postcode district.
Solar radiation on vertical surfaces (for calculation of solar gains) and solar radiation on inclined surfaces (for solar panels and PVs): from the radiation on the horizontal for the property's postcode converted by the procedures in SAP10.2 section U3.2.

16 ROUNDING OF DATA

For consistency of application, after expanding the RdSAP data into SAP data using the rules in this Appendix, the data are rounded before being passed to the SAP calculator. The rounding rules are:

U-values: 2 d.p.
All element areas (gross) including window areas and conservatory wall area: 2 d.p.
All internal floor areas and living area: 2 d.p.
Storey heights and conservatory height: 2 d.p.
Draught strip percent and multiple glazing percent: integer
Solar part of combined cylinder: integer
kWp for photovoltaics, etc.: 2 d.p.

17 IMPROVEMENT MEASURES

The effect of improvement measures is assessed by amending the data for the existing dwelling according to the improvement measure being considered.

When a number of measures are being considered, the effect of any one of them on the SAP and Environmental Impact ratings depends, in general, on the order in which they are introduced.
A standard list of improvement measures and how their effect on energy performance is to be assessed is provided in Section **21**.

Recommendations should be supressed by RdSAP Assessor only if there is documentary evidence showing that a specific recommendation is not appropriate. A listed building or a property in a conservation area is not sufficient grounds in its own right to suppress a recommendation. If a recommendation is removed this must be recorded with reasons in site notes. Further guidance on specific recommendations can be sought from an appropriate professional organisation, for example heating engineers, building control officers, product manufacturers, trade associations, etc.

18 DATA TO BE COLLECTED

Table 31 : Data to be collected

Code	Item	Data	Comment
FOR THE DWELLING AS A WHOLE			
1-1	Country	One of: - England - Wales - Scotland - Northern Ireland - Isle of Man	
1-2	Region	One of those in SAP 10.2 Table U1 For Isle of Man see section **19** of this document	Derived from the postcode of the property (Note: for Isle of Man use Region 22, Isle of Man for all postcodes) See section **19 Additional climate Data for Isle of** Man
1-3	Transaction type	One of: - marketed sale - non-marketed sale - rental - grant-scheme (ECO, RHI, etc.) - non-grant scheme (e.g MEES) - stock condition survey/EESSH - re-mortgaging - none of the above	Non-marketed sale includes right-to-buy Refer to RdSAP Conventions for additional details.
1-4	Tenure	One of - owner-occupied - rented (social) - rented (private) - unknown	Private rented includes institutions (e.g. university); Refer to RdSAP Conventions for additional details.
1-5	Dwelling type	One of - house - bungalow - flat - maisonette - park home	
1-6	Built form and detachment	Classification according to section **2.1** of this document.	Detachment does not need to be recorded for flats/maisonettes, provided that internal dimensions are being used.
1-7	Number of rooms	Number of habitable rooms and Number of heated habitable rooms	Total number of habitable rooms as defined in section **10.1**, inclusive of main property and any extension. A heated habitable room is one with a fixed heat emitter in the room.

Code	Item	Data	Comment
			Refer to Section A3.2 in Appendix A3 (in SAP10.2). Note: this is used to define which heating is main and which is a secondary in inadequately heated dwellings.
1-8	Dimension type	Measured internally or externally	Applies to areas and perimeters. Room heights always measured internally within the room. See section **4.**
1-9	Conservatory	One of - no conservatory - separated, no fixed heaters - separated, fixed heaters - not separated	For the definition of separated conservatory see section 3.3.3 in SAP10.2. Separated conservatory – use the approach given in section **7.2.**
1-10	Non-separated conservatory only	Floor area Glazed perimeter Double glazed (yes/no) Height (number of half storeys of main dwelling)	Non-separated conservatory – use the approach given in section **7.1**
1-11	Flats and maisonettes only	Heat loss corridor/stairwell, one of: - no corridor/stairwell - heated corridor/stairwell - unheated corridor --unheated stairwell	
1-12		If unheated corridor/stairwell, length of sheltered wall adjacent to corridor/stairwell	This is the length of wall between flat and corridor/stairwell. If a flat or maisonette is sheltered on more than one storey this is the total of the sheltered lengths on each storey.
1-13		Floor level relative to the lowest level of the building (0 for ground floor).	This is the lowest floor level if property has more than one storey. If there is a basement, the basement is level 0 and the other floors from 1 upwards.
1-14		Property position, one of: - ground floor - mid floor - top floor	This is used for the description of the dwelling type on the EPC (e.g. 'Top-floor flat')
1-15	Number of extensions (assuming that there are one or more extensions)	Between 1 and 4	

Code	Item	Data	Comment
1-16	Is dwelling export-capable	Yes or No	The savings associated with generated electricity depends on whether it is used directly within the dwelling or exported. Savings depend on factor β (from 0 to 1) which indicates proportion of electricity used in the dwelling. See Section M in SAP10.2 specification.
1-17	Presence of smart meter	Yes or No	Does not affect the calculation; used for statistical reasons only.
1-18	Presence of smart meter for gas	Yes or No	Does not affect the calculation; used for statistical reasons only.
	FOR EACH BUILDING PART A building part is main dwelling, extension 1, extension 2, extension 3 or extension 4		
2-1	Age band	According to **Table 1 : Age bands**	Note differences for England, Wales, Scotland , NI, and Isle of Man
2-2	Below the building part	Below the building part there is: a) ground floor b) partially/intermittently heated space (commercial premises) c) unheated space d) external air e) same dwelling f) another dwelling	a) Ground floor: use §**6.12** b) A partially heated space below applies when a building part is above non-domestic premises. Refer to § **6.14** c) An unheated space below applies when it is above a space not used for habitation. Refer to **Table 20**, and **Table 19** External air is treated as "exposed", Refer to **Table 20** "Same dwelling": U=0 "Another dwelling": U=0 If a building part is above more than one type, it is classified according to the largest floor area concerned.

Code	Item	Data	Comment
2-3	Above the building part	Above the building part there is: a) pitched roof (slates or tiles), access to loft b) pitched roof (slates or tiles), no access c) pitched roof, sloping ceiling d) pitched roof (thatched) e) flat roof f) non-residential/other unheated space g) same dwelling above h) another dwelling above	See section **6** a) **Table 16** or U-value b) **Table 18** c) **Table 18** d) **Table 18** e) **Table 18** f) value from **Table 18** column (3) and R=0.5 m²K/W as given in section **2.14** g) U=0 h) U=0 For a park home select pitched or flat roof type as appropriate.
2-4	Dimensions	For each storey: - Area - Average room height - Exposed perimeter (from lowest occupied floor up to lowest occupied + 6) - Party wall length on each storey	For each building part. If measured externally, **Table 2** is used to convert floor areas and perimeters to internal dimensions. Floor area and exposed perimeter used for calculating floor U-value.
		Floor	
3-1	Floor construction	One of: - unknown - solid - basement floor - suspended timber - suspended, not timber	For lowest floor of the building part. Not if another dwelling or other premises below. Details used for ventilation algorithm and for U-value according to **6.12**
3-2	Floor insulation	One of: - unknown - as built - retro-fitted	Not if another dwelling or other premises below. There must be evidence for retro-fitted insulation. **Table 19 : Basis for floor U-value calculation for ground floors when insulation thickness is unknown**

Code	Item	Data	Comment
3-3	Floor insulation thickness	One of: - unknown - 25 mm - 50 mm - 75 mm - 100 mm - 125 mm - 150 mm -175 mm -200 mm	Only if floor insulation is retro-fitted. Applies to ground floors and exposed upper floors. Assessor specifies thickness of floor insulation (in mm), and software calculates U-value according to § **6.12;** or **Table 19** is used when insulation thickness is unknown.
3-4	Known floor U-value	U-value in W/m²	'U-value' calculated on a basis of insulation thickness according to § **6.12** and known U-value are mutually exclusive alternatives.
	Walls		
4-1	Wall type	External wall Alternative wall 1 Alternative wall 2	for each building part
4-2	Wall construction of each wall type	One of: - stone (granite or whinstone) - stone (sandstone or limestone) - solid brick - cob - cavity - timber frame - park home wall - system build (i.e. any other) - basement wall - curtain wall	"park home wall" is the only option for a park home. Measurement of basement walls will be subject to RdSAP Conventions.
4-3	Wall thickness of each wall type	Wall thickness in mm (or unknown if it cannot be measured).	Where thickness varies for the same construction use the average of the measured values. For curtain wall thickness of wall is not required as it can be included only via specifying U-value.
4-4	Wall insulation type of each wall type	One of: - as built - external - filled cavity - internal - cavity plus external - cavity plus internal - unknown	External, cavity or internal insulation to be indicated only if added subsequent to original construction and evidence exists. If it has only the insulation that was part of the original construction it is 'as built.'

Code	Item	Data	Comment
4-5	Known wall insulation thickness for each stone or brick wall (Applies to U-value for insulated walls in age bands A to E where equations are used to calculate U-value of uninsulated wall)	One of: - unknown - 10 mm - 25 mm - 50 mm - 75 mm - 100 mm - 125 mm - 150 mm - 175 mm - 200 mm - other measured thickness, mm	Only if wall insulation is external, internal, or cavity (filled or unfilled) plus external or internal. **Table 14 : Insulation thickness and corresponding resistance**
4-6	Thermal conductivity of insulation λ in W/m²K	One of: λ =0.04 W/m·K λ =0.03 W/m·K λ =0.025 W/m·K	Only if documentary evidence is available If no documentary evidence of thermal property of insulation is available, assume λ =0.04 W/m·K
4-7	Wall U-value of each wall type	U-value in W/m²K where known; for each wall type.	'Insulation thickness' and 'U-value' are mutually exclusive alternatives. Sources of data are defined in RdSAP Conventions
4-8	Wall dry-lined or lath and plaster	yes/no	Only for uninsulated stone, solid brick or cavity walls in age bands A to E.
4-9	If present, Alternative wall 1 and Alternative wall 2 (for any building part with an alternative wall)	All the above items for walls, plus - net area of alternative wall 1 - is it a sheltered wall adjacent to corridor/stairwell (yes/no) - net area of alternative wall 2 - is it a sheltered wall adjacent to corridor/stairwell (yes/no)	Sheltered wall applies only to the building part of a flat or maisonette that is adjacent to an unheated corridor or stairwell. If sheltered, its area is calculated from the shelter length and not specified separately. Also see code 1-12.
4-10	Party wall construction	One of: - solid masonry, timber frame or system built - masonry cavity unfilled - masonry cavity filled - not applicable - unable to determine	Except for detached properties there must be at least one building part with a party wall. 'not applicable' applies to a detached property and to building parts of other properties not adjoining a party wall.

Code	Item	Data	Comment
4-12	Party wall insulation	One of: - Not filled - Filled	Only if documentary evidences are available. §**6.10** gives U-values of party walls.
	Roof		
5-1	Roof insulation (if not same or another dwelling above)	One of: - none - at joists - at rafters - flat roof insulation - sloping ceiling insulation - unknown	'None' does not apply to a flat roof or to a pitched roof with sloping ceiling. There must be evidence for joist, rafter, flat roof or sloping ceiling insulation, otherwise it is 'unknown.' 'At rafters' can apply to a thatched roof.
5-2	Roof insulation thickness (loft space **at ceiling level**). Pitched roof with insulation at joists, applies to roof or parts of roof without roof room.	One of: 12, 25, 50, 75, 100, 125, 150, 175, 200, 225, 250, 270, 300, 350, 400+ mm	Only for roof insulation at joists and where can be accessed. If none or unknown this is recorded via the preceding item. **Table 16** includes U-values for different thickness of insulation for insulation at ceiling level, insulation is at rafters, but U-value is attributed to the ceiling area and when insulation is at ceiling level for thatched roofs. Use the appropriate column in **Table 16**.
5-3	Rafter insulation thickness	One of: - unknown - as built - thickness one of 12, 25, 50, 75, 100, 125, 150, 175, 200, 225, 250, 270, 300, 350, 400+ mm	Only if roof insulation is 'at rafters' following the roof slope. If insulation present at joists and rafter level, rafter insulation is disregarded. Insulated slope: use column (1) "Unknown or as built" in **Table 18**

Code	Item	Data	Comment
5-4	Flat roof insulation thickness	One of: - unknown - as built If known, one of: 12, 25, 50, 75, 100, 125, 150, 175, 200, 225, 250, 270, 300, 350, 400+ mm	Only if roof insulation is 'flat roof insulation' If unknown: **Table 18 : Assumed roof U-values when Table 16 or Table 17 do not apply** If as built: **Table 18 : Assumed roof U-values when Table 16 or Table 17 do not apply** If known: **Table 16 : Roof U-values when loft insulation thickness is known**
5-5	Sloping ceiling insulation thickness	One of: - unknown - as built If known, one of: 12, 25, 50, 75, 100, 125, 150, 175, 200, 225, 250, 270, 300, 350, 400+ mm	Only if roof insulation is 'sloping ceiling insulation' Unknown as built - **Table 18** If known, - use column (1a) or (1b) in **Table 17**
5-6	Roof U-value	Value in W/m²K	'Insulation thickness' (loft, rafter, flat roof or sloping ceiling) and 'U-value' are mutually exclusive alternatives
5-7	Roof room age band	According to **Table 1**	The age band of the roof rooms can be different to that of the rest of the building part.
5-8	Roof room areas and U-value details **(when all elements are measured)**	Area* and U-value for: - flat ceiling - sloping ceiling - stud wall - gable wall (up to 2 of each of these) -continuous common wall	**Only where these details are measured**; if so, they supersede roof room insulation and roof room insulation thickness of RR type1 and RR type 2. *Area is calculated from length and height of each element.
5-9	Roof room type	One of: RR Type 1 (True RR) RR Type 2 (with the accessible areas of continuous common walls)	RR type 1 and RR type 2 defined in section **2.16**
5-10	Roof room dimensions for RR type 1 (True RR)	Area of RR derived from floor dimension (length and width); Length of Gable 1; Length of Gable 2 (if applicable). Length of party wall (if applicable) Length of sheltered wall (if applicable) Length of connected wall (if applicable)	See section **4.9.1** U-values of RR walls – see **Table 4 : U-values of gable-end and other walls in RR**

Code	Item	Data	Comment
5-10	Roof room details for RR type 2 (with the accessible areas of continuous common walls)	Area of RR derived from floor dimension (length and height); <u>Gable 1:</u> Length of Gable 1; Height of Gable 1; <u>Gable (if applicable) 2:</u> Length of Gable 2; Height of Gable 2; <u>Common walls:</u> Length of common wall 1; Height of common wall 1; Length of common wall 2 (if present) Height of common wall 2 (if present)	See section **4.9.2** Gable end wall can be one of walls in **Table 4 : U-values of gable-end and other walls in RR**
5-11	Roof room insulation thickness and type (each part/component of roof of roof room)	Insulation thickness, one of: - Unknown - As-built - Known insulation thickness (mm) One of: 0, 12, 25, 50, 75, 100, 125, 150, 175, 200, 225, 250, 270, 300, 350, 400+ mm, Insulation type, one of: - Mineral wool or EPS - PUR or PIR	For unknown or as built use values from **Table 18** If known insulation thickness use **Table 17** with the details of insulation (mineral wool/EPS or PUR/PIR)
5.12	Known U-value	- U-value (W/m2K)	'Insulation thickness' and 'U-value' are mutually exclusive alternatives. Known U-values would require documentary evidence
	OPENINGS (WINDOWS AND DOORS)		
6-1	Number of external doors	Total number of external doors and Number of insulated external doors with known U-value(s)	Doors to a heated access corridor are not included in the door count. Number of insulated external doors required if their U-value is known.
6-2	Door U-value	Two options possible; a) Default U-value in W/m²K b) Known U-value in W/m²K	a) Default U-values given in **Table 26 : Default U-values for doors** b) Known U-value is subject to documentary evidence Average door U-value can be used if doors have different known U-values

Code	Item	Data	Comment
6-3	Windows dimensions and orientation (not including any separated conservatory)	Dimensions of each window (including frame): • Height (m) • Width (m) Orientation one of S, SE, E ,NE, N, NW ,W, SW, or horizontal	Area of each window (**in m^2**) is calculated by software from height (in **m**) and width (in **m**) of each window. Windows are assigned to the relevant wall type (e.g. windows in external walls assigned to external wall; windows in alternative wall 1 are assigned to Alternative wall 1, etc.). Glazed parts of sun rooms are treated as windows and the dimensions are measured.
6-4	Window data sources	Options possible for acquiring U-values and g-values: a) Default data b) Known data (from BFRC) c) Known data (from Manufacturer)	Default data is in **Table 24 : Window characteristics**. Known data can be from BFRC, From Manufacturer, or modelled/calculated. If data from BFRC, Frame factor is nit requires as it is already accounted. If data from BFRC or Manufacturer, documentary evidence required.
6-5	Where window source is Default data for each measured door, window or roof window **in each building part and Room in Roof**	Type, one of: • Window (vertical) • Roof window (inclined) • Doors Window frame type, one of: • Wooden or PVC frame • Metal frame Glazing type, one of: • Single/Double/Triple • secondary - normal emissivity • secondary - low emissivity Glazing gap, one of: • 6mm / 12mm / 16mm or more Window age/installation age where known U-value not available: • Any period • England/Wales before 2002 • Scotland – before 2003 • N. Ireland-before 2006 • England/Wales 2022 or later • Scotland – 2023 or later • N. Ireland - 2022 or later	Area of windows is subtracted from wall areas (whether it is main wall or alternative wall). Window age not required for single-glaze or secondary glazing. Use window data for choosing default U-value and g-value from **Table 24 : Window characteristics**

Code	Item	Data	Comment
6-6	Known Window U-value **For each window in each building part and Room in Roof**	U-value in W/m²K	Only when glazing type is with known U-values and g-values, otherwise use code 6-5.
6-7	Known glazing g-value **For each window in each building part and Room in Roof**	Value to 2 d.p.	
6-8	Draught proofing **For each window in each building part and Room in Roof**	Yes/No	Assessor specifies whether each is draught-proofed or not and the software calculates the percentage.
6-9	Presence of permanently fixed shutters **For each window in each building part and Room in Roof**	Yes/no	See notes to **Table 24 : Window characteristics**
6-10	Are shutters insulated? **For each window in each building part and Room in Roof**	Yes/no	
6-11	For each window / roof window	**Location** of each window / roof window (in which building part): • In main wall • In alternative wall 1 • In alternative wall 2 **If RR present:** In roof of RR (for RR type 1 or 2) In Gable-1 of RR (RR type 1 and 2) In Gable-2 of RR (RR type 1 and 2) In common wall of RR (in RR type 2)	For windows in Room in Roof see codes 6.12 to 6.15 For Gable-1 and Gable-2 of RR are exposed gables (i.e. gables adjacent to external environment, they are: A_{RR_gable1} and/or A_{RR_gable2} in section **4.9 Room in Roof**
		Heating	
7-1	Fireplaces	Number of open fireplaces	According to **Table 5**
7-2	Fuel	Fuel for main heating	(as SAP 10.2)
7-3	Main heating system (option to say 'none')	Product Brand Name, model, and model qualifier (or/and index number) whenever possible for boilers, micro-CHP, heat pumps, warm air systems, storage heaters, otherwise system (marked "rd") from Table 4a or 4b	If none, the calculation is done for portable electric heaters with no controls. If product can be identified, its characteristics are obtained via the database. Storage heaters (high heat retention types only): index number of each heater

Code	Item	Data	Comment
7-4		Flue type, one of - open - room-sealed	Applies to boilers, micro-CHP and warm-air systems. For fires and room heaters use normal flue type indicated in Table 4a
		For gas boilers 1998 or later, the ignition type, one of - auto-ignition - permanent pilot light	Not if from database
		For gas boilers 1998 or later, whether fan-flued	Not if from database
		For gas and oil boilers, for heat pumps to water and for electric CPSUs, the heat emitter type, one of - radiators - underfloor - fan coil units	If underfloor downstairs and radiators upstairs, select radiators Fan coil units only for heat pumps
		For wet systems, central heating pump age, one of: - 2012 or earlier - 2013 or later - unknown	Unknown if the pump cannot be located.
		For heat pumps, MCS installation (yes/no)	Yes only if documentary evidence available.
		Design flow temperature of heat generator, one of: - unknown - over 45°C - <= 45°C and over 35°C - <= 35°C	Applicable to heat pumps and condensing boilers. Unknown unless documentary evidence is available giving the design flow temperature. Option "<= 45°C and over 35°C" not available for heat pumps from SAP Tables.
7-5	Second main heating system (where applicable)	Details of system as above. plus the percentage of heated floor area served by the second system. System 1 is that heating the living area.	Estimate percentage to nearest 10%. If there is a boiler providing DHW only, assign it as the 2nd main system with a space heating percentage of zero.

Code	Item	Data	Comment
7-6	Community heating (CH) / District Heat Network (HN)	Index number of community heat network if known and included in PCDB. Otherwise fuel used by HN and heat generator type, one of: - boilers - CHP and boilers - heat pump These can included via PCDB: - waste heat - heat recovered from power stations - heat recovered from geothermal or other natural processes	Community heating system is a system that supplies heat from a central source to more than one dwelling. District Heat Network supplies heat from a central source to consumers via a network of underground pipes carrying hot water. SAP does not distinguish these two systems. If fuel cannot be ascertained, assume mains gas Software: See **Table 29 : Heating and hot water parameters** for assumptions
7-7	Main heating controls	Item from SAP10.2 Table 4e according to main system type Compensating controller Yes/No If "Yes," controller from PCDB	For both main systems if there are two As SAP10.2 Appendix D; see (D2.2)
7-8	Secondary heating system	Fuel for secondary heating, and system from room heater section of Table 4a	'None' if no secondary heating system
7-9	Water heating	Either - from main heating system, or - from 2nd main system, or - from secondary system, or - any other water heater marked "rd" in hot-water-only section of Table 4a, or - no DHW system present	If no system, the calculation is done for an electric immersion, see text below **Table 28 : Cylinder size**. Fuel also needed if not from main system.

Code	Item	Data	Comment
7-10		Cylinder size, one of: - no cylinder - no access - normal (up to 130 litres) - medium (131-170 litres) - large (> 170 litres) - exact cylinder volume if known	Separate thermal store (hot-water only or integrated) treated as if it were a cylinder Software: If "exact cylinder volume" used then software implementation is based on SAP10.2 Tables 2, 2a and 2b.
7-11		Cylinder insulation type (unless no access), one of - none - loose jacket - factory-applied	Software: Specified only when cylinder loss is derived from the cylinder insulation thickness
7-12		**Cylinder measured loss in kWh/day**	Mutually exclusive Software: implementation is based on Table 2 in SAP 10.2 Specification for cylinder loss factors associated with cylinder thickness.
7-13		Cylinder insulation thickness, one of: 0, 12, 25, 38, 50, 80, 120, 160 mm	
7-14		If immersion, whether single or dual	
7-15		Cylinder thermostat (unless no access): yes/no	
7-16	Space cooling system present	yes/no	
7-18	Number of showers	number	Calculation is as in Appendix J of SAP10.2 See also code 9-1 for showers and baths with WWHR
7-19	Number of mixer showers	number	
7-20	Number of baths	number	
Solar water heating			
8-1	Solar water heating	Solar panel (yes/no)	

Code	Item	Data	Comment
8-2	Solar water heating details known	**yes/no.** If yes, then details: - tilt: one of horizontal, 30°, 45°, 60°, vertical - orientation (if not horizontal): one of S, SE, E ,NE, N, NW ,W, SW - overshading: very little, modest, significant or heavy - solar water pump: electrically powered, solar powered or unknown - type(s) of showers in the property, one of - non-electric only - electric only * - both electric and non-electric - no shower	Only if solar panel present Software: If details not known, then default parameters used; they are defined in **Table 29 : Heating and hot water parameters** * where the water is heated as the shower runs. If the shower is supplied from a hot-water cylinder it is classified as non-electric even though the cylinder is electrically heated.
8-3	Solar collector details known	**yes/no.** If yes then details: - collector aperture area - collector type (evacuated tube, flat plate or unglazed) - collector zero loss efficiency - collector linear heat loss coefficient - collector 2nd order heat loss coefficient	Only if solar panel present and solar water heating details known.
8-4	Solar store details known	**yes/no.** If yes, then details: - combined solar store (yes/no) - total hot water store volume - dedicated solar volume	Only if solar panel present and solar water heating details known and solar collector details known
8-5	Flue gas heat recovery	**yes/no.** If yes then: - PCDB product index number	Only if located in the database Software defines the following: A FGHRS is an option only if: -main heating is from a boiler fired by mains gas, LPG or oil, and -the boiler is a condensing type, and -the fuel to which the FGHRS data apply is the same as the boiler fuel, and -the boiler type is one of those to which the FGHRS data apply. It is not relevant if the above conditions do not apply.

Code	Item	Data	Comment
8-6	PV for flue gas heat recovery	Details of the PV: - kWp - tilt: one of horizontal, 30°, 45°, 60°, vertical - orientation (if not horizontal): one of S, SE, E ,NE, N, NW, W, SW - overshading: very little, modest, significant or heavy	Only for systems with a PV powered immersion (Software: see SAP 10.2 section G1.6)
		WWHR	
9-1	Baths and showers	Number of baths with WWHR Number of showers with WWHR and type of each shower (from Table J4).	These items are always collected, to enable a recommendation for waste water heat recovery to be made See also code 7-18 to 7-20
9-2	Waste water heat recovery	If **instantaneous** type present: - number of systems (1 or 2) - system 1 product index number - which showers are connected to system 1 - system 2 product index number - which showers are connected to system 2 If **storage** type WWHR present: - disregard as it will be not possible to identify the details required for the calculation according to Appendix 3 of SAP 10.2 at the time of survey.	Calculation is according to SAP10.2 Appendix G2.
		Ventilation	

Code	Item	Data	Comment
10-1	Mechanical ventilation	yes/no, and if yes what type **Type of ventilation system** 1) Natural ventilation 2) Positive input – from loft (as natural) 3) Positive input – from outside 4) Mechanical extract – centralised 5) Mechanical extract – decentralised 6) MV – no heat recovery 7) MV – heat recovery **If from PCDB, additional data required** Wet rooms: Kitchen + N Duct insulation: Yes/No	If type of ventilation cannot be identified, assume natural ventilation. Applies to whole house ventilation system only, otherwise assume natural ventilation. Intermittent extract fans (kitchen and bathrooms) are not a mechanical ventilation system for SAP calculations, but continuously running extract fans in wet rooms are treated as mechanical extract ventilation. Mechanical ventilation systems use continually running fans.
10-2	Electricity meter	Dual/single/10-hour/18-hour/ 24-hour/unknown	See section **13**
10-3	Mains gas available	yes/no	Yes means that there is a gas meter or a gas-burning appliance (e.g. cooker) in the dwelling. A closed-off gas pipe does not count. Can be relevant to improvement recommendations.
		PV and renewables	
11-1	Photovoltaic array	**yes/no** and if yes then either: a) % of external roof area with PVs, or b) details of the PV: - kWp - pitch: one of horizontal, 30°, 45°, 60°, vertical - orientation (if not horizontal): one of S, SE, E ,NE, N, NW ,W, SW - overshading: very little, modest, significant or heavy In either case, whether the PVs are connected to the dwelling's electricity meter	To be used when the information on kWp or DNC is available. In this case up to 3 PV arrays can be specified (See also PV diverters and batteries)

Code	Item	Data	Comment
11-2	PV Diverter for water heating	**yes/no**	When PV is used for water heating. If Yes, calculation is according to SAP 10.2 section G4 (Appendix G). Software: This requires beta-factor calculated in Appendix M1 in SAP10.2 specification.
11-3	PV batteries	Yes/No	If more than one battery
11-4	Number of batteries	1 to 4 (maximum 4)	Only if Photovoltaic array(s) present with battery storage **default capacity of one battery = 5kWh** If unknown or unable to determine, assume 5kWh If known capacity is 10 kWh, specify 2 batteries.
11-5	Wind turbine details known	yes/no. If yes, then details: - number of turbines - rotor diameter - height above ridge	Only if wind turbine present.
11-6	Hydro	Dwelling connected to Hydro. -Yes/No	Only if documentary evidence is available.
11-7	kWh supplied per year supplied by hydro	kWh/year	Calculation - according to SAP10.2 specification.
11-8	Terrain	One of: - Dense urban - Low rise urban or suburban - Rural	Terrain is required for the wind turbine calculation. Used to choose correction factors given in Table M2 of SAP10.2 specification. Also to generate wind turbine recommendation where appropriate
Miscellaneous			

Code	Item	Data	Comment
12-1	Lighting	RdSAP assessor counts: 1) Total number of bulbs (count bulbs, not fittings) 2) Number of LEDs, number of CFLs and number of incandescent bulbs 3) If it is not possible to determine the exact number of LEDs and CFLs, input the total number of LEL bulbs	Use RdSAP10-specific defaults: - LEDs 100 Lm/W (9W); - CFLs 55 Lm/W (19W); - incandescent 11.2 Lm/W (60W). **If number of LED and CFL is not known, use default:** - **LEL: 80 Lm/W (15W)** RdSAP software should use these defaults for star ratings (see separate document giving the basis of star ratings).
12-2	Swimming pool	A swimming pool is not included in the data set.	Count the room containing the swimming pool as a habitable room and add Addendum 4, see **Table 30 : Addendum**
12-3	Special feature (Appendix Q technology)	Appendix Q technology type, brand name and model name. Energy saving, CO2 saving and/or calculated air change rate taken from RdSAP Appendix Q spreadsheet.	From RdSAP Appendix Q identification label (if present) or Technologies whose characteristics have been independently assessed and included in Appendix Q (www.ncm-pcdb.org.uk)

19 ADDITIONAL CLIMATE DATA FOR ISLE OF MAN

For the purpose of RdSAP10 a new region (Region 22 – Isle of Man) has been added to the existing Tables U1, U2, U3 and U4 in the SAP 10.2 specification.

The details for Mean External Temperature and Wind Speed were provided by IoM.

Mean global solar irradiance (W/m²) on a horizontal plane was assumed as for region 8.

Isle of Man has several postcode areas (IM1 to IM9), these should be used from the postcode data in the spreadsheet.

(SAP10.2)Table U1: Mean external temperature (°C) with added data for Isle of Man

These data are for typical height above sea level representative of the region (see Table U4).

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0 **UK average**	**4.3**	**4.9**	**6.5**	**8.9**	**11.7**	**14.6**	**16.6**	**16.4**	**14.1**	**10.6**	**7.1**	**4.2**
1 Thames	5.1	5.6	7.4	9.9	13.0	16.0	17.9	17.8	15.2	11.6	8.0	5.1
2 South East England	5.0	5.4	7.1	9.5	12.6	15.4	17.4	17.5	15.0	11.7	8.1	5.2
3 Southern England	5.4	5.7	7.3	9.6	12.6	15.4	17.3	17.3	15.0	11.8	8.4	5.5
4 South West England	6.1	6.4	7.5	9.3	11.9	14.5	16.2	16.3	14.6	11.8	9.0	6.4
5 Severn Wales / Severn England	4.9	5.3	7.0	9.3	12.2	15.0	16.7	16.7	14.4	11.1	7.8	4.9
6 Midlands	4.3	4.8	6.6	9.0	11.8	14.8	16.6	16.5	14.0	10.5	7.1	4.2
7 West Pennines Wales / West Pennines England	4.7	5.2	6.7	9.1	12.0	14.7	16.4	16.3	14.1	10.7	7.5	4.6
8 North West England / South West Scotland	3.9	4.3	5.6	7.9	10.7	13.2	14.9	14.8	12.8	9.7	6.6	3.7
9 Borders Scotland / Borders England	4.0	4.5	5.8	7.9	10.4	13.3	15.2	15.1	13.1	9.7	6.6	3.7
10 North East England	4.0	4.6	6.1	8.3	10.9	13.8	15.8	15.6	13.5	10.1	6.7	3.8
11 East Pennines	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2
12 East Anglia	4.7	5.2	7.0	9.5	12.5	15.4	17.6	17.6	15.0	11.4	7.7	4.7
13 Wales	5.0	5.3	6.5	8.5	11.2	13.7	15.3	15.3	13.5	10.7	7.8	5.2
14 West Scotland	4.0	4.4	5.6	7.9	10.4	13.0	14.5	14.4	12.5	9.3	6.5	3.8
15 East Scotland	3.6	4.0	5.4	7.7	10.1	12.9	14.6	14.5	12.5	9.2	6.1	3.2
16 North East Scotland	3.3	3.6	5.0	7.1	9.3	12.2	14.0	13.9	12.0	8.8	5.7	2.9
17 Highland	3.1	3.2	4.4	6.6	8.9	11.4	13.2	13.1	11.3	8.2	5.4	2.7
18 Western Isles	5.2	5.0	5.8	7.6	9.7	11.8	13.4	13.6	12.1	9.6	7.3	5.2
19 Orkney	4.4	4.2	5.0	7.0	8.9	11.2	13.1	13.2	11.7	9.1	6.6	4.3
20 Shetland	4.6	4.1	4.7	6.5	8.3	10.5	12.4	12.8	11.4	8.8	6.5	4.6
21 Northern Ireland	4.8	5.2	6.4	8.4	10.9	13.5	15.0	14.9	13.1	10.0	7.2	4.7
22 Isle of Man	4.4	4.0	4.5	5.8	8.1	10.6	12.5	12.6	11.3	9.2	6.8	5.0

(SAP10.2) Table U2: Wind speed (m/s) for calculation of infiltration rate

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0 **UK average**	**5.1**	**5.0**	**4.9**	**4.4**	**4.3**	**3.8**	**3.8**	**3.7**	**4.0**	**4.3**	**4.5**	**4.7**
1 Thames	4.2	4.0	4.0	3.7	3.7	3.3	3.4	3.2	3.3	3.5	3.5	3.8
2 South East England	4.8	4.5	4.4	3.9	3.9	3.6	3.7	3.5	3.7	4.0	4.1	4.4
3 Southern England	5.1	4.7	4.6	4.3	4.3	4.0	4.0	3.9	4.0	4.5	4.4	4.7
4 South West England	6.0	5.6	5.6	5.0	5.0	4.4	4.4	4.3	4.7	5.4	5.5	5.9
5 Severn Wales / Severn England	4.9	4.6	4.7	4.3	4.3	3.8	3.8	3.7	3.8	4.3	4.3	4.6
6 Midlands	4.5	4.5	4.4	3.9	3.8	3.4	3.3	3.3	3.5	3.8	3.9	4.1
7 West Pennines Wales / West Pennines England	4.8	4.7	4.6	4.2	4.1	3.7	3.7	3.7	3.7	4.2	4.3	4.5
8 North West England / South West Scotland	5.2	5.2	5.0	4.4	4.3	3.9	3.7	3.7	4.1	4.6	4.8	4.7
9 Borders Scotland / Borders England	5.2	5.2	5.0	4.4	4.1	3.8	3.5	3.5	3.9	4.2	4.6	4.7
10 North East England	5.3	5.2	5.0	4.3	4.2	3.9	3.6	3.6	4.1	4.3	4.6	4.8
11 East Pennines	5.1	5.0	4.9	4.4	4.3	3.8	3.8	3.7	4.0	4.3	4.5	4.7
12 East Anglia	4.9	4.8	4.7	4.2	4.2	3.7	3.8	3.8	4.0	4.2	4.3	4.5
13 Wales	6.5	6.2	5.9	5.2	5.1	4.7	4.5	4.5	5.0	5.7	6.0	6.0
14 West Scotland	6.2	6.2	5.9	5.2	4.9	4.7	4.3	4.3	4.9	5.4	5.7	5.4
15 East Scotland	5.7	5.8	5.7	5.0	4.8	4.6	4.1	4.1	4.7	5.0	5.2	5.0
16 North East Scotland	5.7	5.8	5.7	5.0	4.6	4.4	4.0	4.1	4.6	5.2	5.3	5.1
17 Highland	6.5	6.8	6.4	5.7	5.1	5.1	4.6	4.5	5.3	5.8	6.1	5.7
18 Western Isles	8.3	8.4	7.9	6.6	6.1	6.1	5.6	5.6	6.3	7.3	7.7	7.5
19 Orkney	7.9	8.3	7.9	7.1	6.2	6.1	5.5	5.6	6.4	7.3	7.8	7.3
20 Shetland	9.5	9.4	8.7	7.5	6.6	6.4	5.7	6.0	7.2	8.5	8.9	8.5
21 Northern Ireland	5.4	5.3	5.0	4.7	4.5	4.1	3.9	3.7	4.2	4.6	5.0	5.0
22 Isle of Man	8.0	7.5	6.8	5.9	5.6	5.0	4.8	5.1	5.8	6.9	7.5	7.8

(SAP 10.2) Table U3: Mean global solar irradiance (W/m²) on a horizontal plane, and solar declination

Region	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0 **UK average**	**26**	**54**	**96**	**150**	**192**	**200**	**189**	**157**	**115**	**66**	**33**	**21**
1 Thames	30	56	98	157	195	217	203	173	127	73	39	24
2 South East England	32	59	104	170	208	231	216	182	133	77	41	25
3 Southern England	35	62	109	172	209	235	217	185	138	80	44	27
4 South West England	36	63	111	174	210	233	204	182	136	78	44	28
5 Severn Wales / Severn England	32	59	105	167	201	226	206	175	130	74	40	25
6 Midlands	28	55	97	153	191	208	194	163	121	69	35	23
7 West Pennines Wales / West Pennines England	24	51	95	152	191	203	186	152	115	65	31	20
8 North West England / South West Scotland	23	51	95	157	200	203	194	156	113	62	30	19
9 Borders Scotland / Borders England	23	50	92	151	200	196	187	153	111	61	30	18
10 North East England	25	51	95	152	196	198	190	156	115	64	32	20
11 East Pennines	26	54	96	150	192	200	189	157	115	66	33	21
12 East Anglia	30	58	101	165	203	220	206	173	128	74	39	24
13 Wales	29	57	104	164	205	220	199	167	120	68	35	22
14 West Scotland	19	46	88	148	196	193	185	150	101	55	25	15
15 East Scotland	21	46	89	146	198	191	183	150	106	57	27	15
16 North East Scotland	19	45	89	143	194	188	177	144	101	54	25	14
17 Highland	17	43	85	145	189	185	170	139	98	51	22	12
18 Western Isles	16	41	87	155	205	206	185	148	101	51	21	11
19 Orkney	14	39	84	143	205	201	178	145	100	50	19	9
20 Shetland	12	34	79	135	196	190	168	144	90	46	16	7
21 Northern Ireland	24	52	96	155	201	198	183	150	107	61	30	18
22 Isle of Man	23	51	95	157	200	203	194	156	113	62	30	19
Solar declination (°)												
All regions	-20.7	-12.8	-1.8	9.8	18.8	23.1	21.2	13.7	2.9	-8.7	-18.4	-23.0

(SAP10.2) Table U4: Representative latitude and height above mean sea level

Region	Representative Latitude (°N)	Representative height above sea level (m)
0 **UK average**	**53.5**	**79**
1 Thames	51.6	53
2 South East England	51.1	55
3 Southern England	50.9	50
4 South West England	50.5	85
5 Severn Wales / Severn England	51.5	99
6 Midlands	52.6	116
7 West Pennines Wales / West Pennines England	53.5	71
8 North West England / South West Scotland	54.6	119
9 Borders Scotland / Borders England	55.2	101
10 North East England	54.4	78
11 East Pennines	53.5	79
12 East Anglia	52.1	29
13 Wales	52.6	138
14 West Scotland	55.9	113
15 East Scotland	56.2	117
16 North East Scotland	57.3	123
17 Highland	57.5	218
18 Western Isles	57.7	59
19 Orkney	59.0	53
20 Shetland	60.1	50
21 Northern Ireland	54.6	72
22 Isle of Man	54.2	47

Table U6 from SAP10.2 with Isle of Man added

The region indicated in Table U6 applies to all postcodes in the postcode area except those for which specific postcode districts are given. For example BD16 is in region 11 and BD23 is in region 10.

Table U6: Postcodes

Postcode	Region	Postcode	Region	Postcode	Region	Postcode	Region
AB	16	G	14	N	1	SL	1
AL	1	GL	5E	NE	9E	SM	1
B	6	GU	1	NG	11	SN	5E
BA	5E	GU11-12	3	NN	6	SN7	1
BB	7E	GU14	3	NP	5W	SO	3
BD	11	GU28-29	2	NP8	13	SP	5E
BD23-24	10	GU30-35	3	NR	12	SP6-11	3
BH	3	GU46	3	NW	1	SR	9E
BL	7E	GU51-52	3	OL	7E	SR7-8	10
BN	2	HA	1	OX	1	SS	12
BR	2	HD	11	PA	14	ST	6
BS	5E	HG	10	PE	12	SW	1
BT	21	HP	1	PE9-12	11	SY	6
CA	8E	HR	6	PE20-25	11	SY14	7E
CB	12	HS	18	PH	15	SY15-25	13
CF	5W	HU	11	PH19-25	17	TA	5E
CH	7E	HX	11	PH26	16	TD	9S
CH5-8	7W	IG	12	PH30-44	17	TD12	9E
CM	12	IP	12	PH49	14	TD15	9E
CM21-23	1	IV	17	PH50	14	TF	6
CO	12	IV30-32	16	PL	4	TN	2
CR	1	IV36	16	PO	3	TQ	4
CT	2	KA	14	PO18-22	2	TR	4
CV	6	KT	1	PR	7E	TS	10
CW	7E	KW	17	RG	1	TW	1
DA	2	KW15-17	19	RG21-29	3	UB	1
DD	15	KY	15	RH	1	W	1
DE	6	L	7E	RH10-20	2	WA	7E
DG	8S	LA	7E	RM	12	WC	1
DH	10	LA7-23	8E	S	11	WD	1
DH4-5	9E	LD	13	S18	6	WF	11
DL	10	LE	6	S32-33	6	WN	7E
DN	11	LL	7W	S40-45	6	WR	6
DT	3	LL23-27	13	SA	5W	WS	6
DY	6	LL30-78	13	SA14-20	13	WV	6
E	1	LN	11	SA31-48	13	YO	10
EC	1	LS	11	SA61-73	13	YO15-16	11
EH	15	LS24	10	SE	1	YO25	11
EH43-46	9S	LU	1	SG	1	ZE	20
EN	1	M	7E	SK	7E		
EN9	12	ME	2	SK13	6	IM	22
EX	4	MK	1	SK17	6		
FK	14	ML	14	SK22-23	6		
FY	7E						

20 RDSAP10-SPECIFIC METRICS

20.1 RdSAP10-specific SAP rating equations (referred to as EER)

Fuel prices are the same as in Table 12 of the SAP 2012 specification but replicated in Table 32 for completeness of information.

The SAP rating for RdSAP 10 is to be calculated using Table 32 unit costs (not Table 12) for section 10a and 10b.

The SAP rating is related to the total energy cost by the equations:

ECF = deflator × total cost / (TFA + 45)

if ECF ≥ 3.5, RdSAP 10 = 117 – 121 × $\log_{10}$(ECF)
if ECF < 3.5, RdSAP 10 = 100 – 13.95 × ECF

where the total cost is calculated at (255) or (355) in the SAP10.2 worksheet and TFA is the total floor area of the dwelling at (4) (see SAP10.2 specification).

20.2 Carbon Dioxide emissions and Primary Energy in RdSAP10

Both CO_2 factors and Primary Energy factors are the same as in Table 12 of SAP10.2 specification but replicated in Table 32 for completeness of information.

Refer to section 14 in SAP10.2 specification for the calculation of carbon-based Environmental Impact Rating (EIR) and Primary Energy (PE).

The Environmental Impact Rating (EI rating) is related to the annual CO_2 emissions by:

CF = (CO2 emissions) / (TFA + 45)

if CF >= 28.3, RdSAP 10 EI rating = 200 – 95 × $\log_{10}$ (CF)
if CF < 28.3, RdSAP 10 EI rating = 100 – 1.34 × CF

where the CO_2 emissions are calculated at (272) or (383) and TFA is the total floor area of the dwelling at (4).

The EI rating scale has been set so that EI 100 is achieved at zero net emissions. It can rise above 100 if the dwelling is a net exporter of energy. The EI rating is essentially independent of floor area.

The EI rating is rounded to the nearest integer. If the result of the calculation is less than 1 the rating should be quoted as 1. Environmental impact rating bands are defined by the EI rating according to Table 14 of SAP 10.2.

The primary energy consumption of the dwelling is calculated in the same way as CO_2 emissions, using the primary energy factors in Table 32 in place of the CO_2 emission factors. However, this result is not used to create a rating.

Table 32 : RdSAP10-specific fuel prices, emission factors and primary energy factors
(This table is equivalent to Table 12 in SAP10.2 specification)

Fuel	Standing charge, £ [a]	Unit price p/kWh	Emissions kg CO_{2e} per kWh [b]	Primary energy factor	Fuel code
Gas fuels:					
mains gas	120	3.48	0.210	1.130	1
bulk LPG	70	7.60	0.241	1.141	2
bottled LPG (for main heating system)		10.30	0.241	1.141	3
bottled LPG (for secondary heating)	120	3.48	0.241	1.133	5
LPG subject to Special Condition 11F [c]	70	7.60	0.241	1.163	9
biogas (including anaerobic digestion)			0.024	1.286	7
Liquid fuels:					
heating oil		5.44	0.298	1.180	4
bio-liquid HVO from used cooking oil [d]		7.64	0.036	1.180	71
bio-liquid FAME from animal/vegetable oils [e]		7.64	0.018	1.180	73
B30K [f]		6.10	0.214	1.136	75
bioethanol from any biomass source		47.0	0.105	1.472	76
Solid fuels: [g]					
house coal		3.67	0.395	1.064	11
anthracite		3.64	0.395	1.064	15
manufactured smokeless fuel		4.61	0.366	1.261	12
wood logs		4.23	0.028	1.046	20
wood pellets (in bags for secondary heating)		5.81	0.053	1.325	22
wood pellets (bulk supply for main heating)		5.26	0.053	1.325	23
wood chips		3.07	0.023	1.046	21
dual fuel appliance (mineral and wood)		3.99	0.087	1.049	10
Electricity: [a]					
standard tariff	54	13.19	0.136 [s]	1.501 [t]	30
7-hour tariff (high rate) [h]	24	15.29	0.136 [s]	1.501 [t]	32
7-hour tariff (low rate) [h]		5.50	0.136 [s]	1.501 [t]	31
10-hour tariff (high rate) [h]	23	14.68	0.136 [s]	1.501 [t]	34
10-hour tariff (low rate) [h]		7.50	0.136 [s]	1.501 [t]	33
18-hour tariff (high rate) [h]	40	13.67	0.136 [s]	1.501 [t]	38
18-hour tariff (low rate) [h]		7.41	0.136 [s]	1.501 [t]	40
24-hour heating tariff	70	6.61	0.136 [s]	1.501 [t]	35
electricity sold to grid, PV		13.19 [i]	0.136 [s]	0.501 [t]	60
electricity sold to grid, other			0.136 [s]	0.501 [t]	36
electricity, any tariff [j]			0.136 [s]	1.501 [t]	39
Heat networks: [k]	120 [l]				
heat from boilers – mains gas		4.24	0.210	1.130	51
heat from boilers – LPG		4.24	0.241	1.141	52
heat from boilers – oil (assumes 'gas oil')		4.24	0.335	1.180	53
heat from boilers that can use mineral oil or biodiesel		4.24		1.180	56
heat from boilers using HVO from used cooking oil		4.24		1.180	57
heat from boilers FAME from animal/vegetable oils [e]		4.24		1.180	58
heat from boilers – B30D [f]		4.24	0.269	1.090	55
heat from boilers – coal		4.24	0.375	1.064	54
heat from electric heat pump		4.24	0.136 [s]	1.501 [t]	41
heat recovered from waste combustion		4.24	0.015 [p]	0.063	42
heat from boilers – biomass		4.24	0.029	1.037	43
heat from boilers – biogas (landfill or sewage gas)		4.24	0.024	1.286	44
heat recovered from power station		2.97	0.015 [p]	0.063	45
high grade heat recovered from process (Appendix C4.3)		2.97	0.011	0.051	
low grade heat recovered from process (Appendix C4.4)		2.97	0.136 [s][v]	1.501 [t][v]	
heat recovered from geothermal or other natural processes		2.97		0.051	46
heat from CHP		2.97	as above[q]	as above[q]	48

Fuel	Standing charge, £ [a]	Unit price p/kWh	Emissions kg CO_{2e} per kWh [b]	Primary energy factor	Fuel code
electricity generated by CHP		N/A	See Table 12f		
electricity for pumping in distribution network		N/A	0.136 [s]	1.501 [t]	50
Fuel from PCDB [u]	Data for each field comes from PCDB table				99
Energy Cost Deflator [r] = 0.42					

Notes to Table (wording of the notes copied from notes to Table 12 in SAP10.2):

(a) The standing charge given for electric off-peak tariffs is the extra amount, over and above the amount for the standard domestic tariff.
For calculations including regulated energy uses only (e.g. regulation compliance, energy ratings):
- *The standing charge for electricity standard tariff is omitted;*
- *The standing charge for off-peak electricity is added to space and water heating costs where either main heating or hot water uses off-peak electricity;*
- *The standing charge for gas fuels is added to space and water heating costs where the gas fuel is used for space heating (main or secondary) or for water heating.*

For calculations inclusive of unregulated energy uses (e.g. occupancy assessment):
- *The standing charge for electricity standard tariff is included in all cases;*
- *The standing charge for off-peak electricity is included in addition if an off-peak tariff applies;*
- *The standing charge for gas fuels is included where the gas fuel is used for any calculated energy use.*

The unit price used for 'electricity exported to grid' is the 2020 wholesale electricity price taken from Annex M of 'Projections of greenhouse gas emissions and energy demand from 2016 to 2035', existing policies scenario. (It is not based on the export rate used for the Feed in Tariff or similar incentive schemes.)

(b) These are CO_2 equivalent figures which include the global warming impact of CH_4 and N_2O as well as CO_2. Figures for specific heat networks may be included in the Product Characteristics Database.

(c) https://epr.ofgem.gov.uk/Content/Documents/National%20Grid%20Gas%20Plc%20-%20Special%20Conditions%20Consolidated%20-%20Current%20Version.pdf (see pages 284-287).

(d) For appliances that specifically use bio-liquid HVO to BS EN 15940 certified as wholly derived from waste/used cooking oil

(e) For appliances that specifically use bio-liquid FAME to BS EN 14214 certified as wholly derived from waste animal fats/used cooking oil

(f) For appliances that specifically use a blend of 30% bio-liquid FAME (e) and 70% kerosene (B30K) or 70% gas oil (B30D)

(g) The specific fuel should be assumed for those appliances that can only burn the particular fuel (including Exempted Appliances within Smoke Control Areas).
Where a main heating appliance is classed as dual fuel (i.e mineral and wood), the data for dual fuel should be used, except where the dwelling is in a Smoke Control Area, when the data for solid mineral fuel should be used.
Wood should be specified as fuel for a main heating system only if there is adequate provision (at least 1.5 m³) for storage of the fuel.
Outside Smoke Control Areas an open fire should be considered as dual fuel, and a closed room heater without boiler if capable of burning wood as burning wood logs.

(h) With certain appliances using an off-peak tariff, some of the consumption is at the low rate and some at the high rate. The high-rate fractions to be used are given in Table 12a in SAP10.2, the remainder being provided at the low rate.

(i) Deducted from costs, emissions or primary energy

(j) This code is used to define the fuel for any electric system. Other codes for electricity are to provide cost data, depending on the applicable electricity tariff.

(k) Cost is per unit of heat generated (i.e. before distribution losses); emission and primary factors are per unit of fuel used by the heat generator.

(l) Include half this value if only DHW is provided by a heat network

(m) Based on the mix of petroleum products used to generated heat in the UK (predominantly diesel).

(n) Value for non-domestic coal

(o) Based on the mix of biomass sources used to generate heat in the UK.

(p) Takes account of the reduction in electricity generation that occurs where heat is produced at a high enough temperature to supply a heat network.

(q) Use factor for heat network with boilers according to fuel used.

(r) An energy cost deflator term is applied before the rating is calculated. It will vary with the weighted average price of heating fuels in future so that the SAP rating is not affected by the general rate of fuel price inflation. However, individual SAP ratings are affected by relative changes in the price of particular heating fuels.

(s) CO_2 factors for grid electricity vary by month. The average figure given in this table is therefore not used directly. Instead the monthly factors given in Table 12d in SAP10.2 should be used in the SAP worksheet.

(t) PE factors for grid electricity vary by month. The average figure given in this table is therefore not used directly. Instead the monthly factors given in Table 12e in SAP10.2 should be used in the SAP worksheet.

(u) This allows the possibility of adding new fuels between major updates of SAP. Supplementary guidance may be issued when new fuels are added explaining how they are used in SAP calculations.

(v) Figure assigned to energy used by heat pump to boost temperature.

The emissions factors are "CO_2 equivalent" values, which include CH_4 and N_2O in addition to CO_2.
The emission factors and primary energy factors for electricity in Table 12 are a 5-year projection for 2020-2025.

21 IMPROVEMENT MEASURES FOR ENERGY PERFORMANCE CERTIFICATES (FORMER APPENDIX T)

Appendix T defines the circumstances under which recommendations for improvements are made on EPC. RdSAP software tests for the relevance of improvement measures, and applies them where relevant, in the order shown in this table.

Several heating measures apply when mains gas is not available (J,K,R,I). When mains gas is available, they are substituted by a fuel switch recommendation (item T).

A recommendation is made only if it increases the SAP rating by at least 1 (one) SAP point, or 0.5 SAP point in the case of C (cylinder insulation), D (draughtproofing) and E (LEL).

Several measures are marked as "Alternative measures"; these may not be shown on EPCs subject to the EPC design adopted by the EPC Register.

In the case of new dwellings only items E, N, U and V2 are considered (this applies to all countries for new dwellings).

Table 33 : Improvement measures

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:	Rec No
A	Loft insulation **at ceiling level** Note. This is assumed to include insulation of the loft hatch.	Pitched roof (slates or tiles), accessible loft, insulation at ceiling level, not thatched roof. Note: This does not include insulation of a room-in-roof	Loft insulation ≤ 150 mm or U-value from **Table 16** or **Table 18** or entered by assessor ≥ 0.35 W/m^{2}K	270 mm insulation or U-value 0.16 W/m^{2}K. See Note 2. For park home insulated loft 220 mm insulation or U-value 0.20 W/m^{2}K	5
A2	Flat roof insulation	Flat roof, known insulation or Pitched roof with sloping ceiling, known insulation	Flat roof insulation <125mm or U-value from **Table 16** or **Table 18** or entered by assessor >0.35 W/m^{2}K	270 mm insulation or U-value 0.16 W/m^{2}K. NI: 0.18 W/m^{2}K. For park home insulated flat roof U-value 0.20 W/m^{2}K	45
A3	Roof room insulation	Roof rooms, not thatched roof, as built age band <= H or insulated with U > 0.35 W/m^{2}K	Any part of roof rooms with U-value from **Table 16** or **Table 17** or entered by assessor >0.35 W/m^{2}K	270 mm insulation or U-value 0.16 W/m^{2}K. NI: 0.18 W/m^{2}K. **See Note 13.**	46
B	Cavity wall insulation on its own	Unfilled cavity wall (assessed as "as built" and not "unknown"); Wall is suitable for cavity insulation; See Note 3	Wall U-value entered by assessor or assumed from RdSAP tables > 0.7 W/m^{2}K.	England, Wales, Scotland, NI, IoM: Cavity filled wall. Improved U-value = 0.55 W/m^{2}K	6

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:	Rec No
Q	Solid wall insulation (internal)	Solid wall or park home wall, assessed as "as built" and not "unknown"	(Q-1) Wall U-value (as entered by assessor or assumed from RdSAP tables) > 0.7 W/m^{2}K	**Internal** wall insulation with: U-value 0.30 W/m^{2}K For a park home insulated wall has U-value 0.30 W/m^{2}K See Note 7	7
	Solid wall insulation (external)	Solid wall or park home wall, assessed as "as built" and not "unknown"	(Q-2) Wall U-value (as entered by assessor or assumed from RdSAP tables) > 0.7 W/m^{2}K	**External** wall insulation with: U-value 0.30 W/m^{2}K For a park home insulated wall has U-value 0.30 W/m^{2}K See Note 7	65
Q2	External insulation with cavity wall insulation **(Alternative measure).**	Cavity walls and there is already a recommendation to insulate cavity (measure B) Or cavity already insulated	(Q2-1) Cavity fill recommendation B Or Cavity wall U-value <0.55 W/m^{2}K (which means insulated cavity)	For the walls which are already recommended for cavity fill: U-value 0.30 W/m^{2}K	55
	Internal insulation with cavity wall insulation **(Alternative measure).**	Cavity walls and there is already a recommendation to insulate cavity (measure B) Or cavity already insulated	(Q2-2) Cavity fill recommendation B Or Cavity wall U-value <0.55 W/m^{2}K (which means insulated cavity)	For the walls which are already recommended for cavity fill: U-value 0.30 W/m^{2}K	66
W1	Floor insulation (suspended floor)	Below the building part there is: - ground, or - external air, or - unheated space and floor is suspended	no insulation, or U > 0.7 W/m^{2}K	Insulated floor with U-value: U = 0.25W/m^{2}K For a park home insulated floor has U-value 0.30 W/m^{2}K	57
W2	Floor insulation (solid ground floor)	Below the building part there is - ground and floor is solid	no insulation, or U > 0.7 W/m^{2}K	Insulated floor with U-value: U = 0.25W/m^{2}K	58
C	Hot water cylinder insulation	Cylinder present and accessible.	(C-1) No cylinder insulation	Minimum 80 mm jacket	1
			(C-2) Factory-applied insulation <= 25 mm	Add 80 mm jacket. See Note 1a.	3
			(C-3) Jacket < 80 mm	Add additional jacket. See Note 1b	2

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:	Rec No
D	Draught proofing of windows and external doors	Existing dwelling has single-glazed windows or external doors which are not draught-proofed	Less than 100% draught proofing of windows and doors	100% draught proofing	10
E	Low energy lights	New or existing dwelling	LEL < 100% of fixed outlets	LEL in all fixed outlets with efficacy 75 lumens/Watt (LEL includes LED and CFL bulbs)	35
F	Cylinder thermostat	Cylinder present and accessible	No cylinder thermostat (Note: cylinder thermostat is assumed for electric immersion)	Cylinder thermostat	4
G	Heating controls for wet central heating system	Main heating by boiler with radiators	(G-1) No controls	Room thermostat*, programmer and TRVs ***See Note 17**	11
			(G-2) Programmer only	do.	12
			(G-3) Room thermostat only	do.	15
			(G-4) Room thermostat and TRVs	do.	66 (new)
			(G-5) Programmer, single room thermostat (no TRVs)	do.	13
			(G-6) TRVs (no room thermostat or BEM), with or without programmer	do.	14
			(G1-1) Programmer and at least two room thermostat	Time and temperature zone control	16
		Main heating by boiler with underfloor heating	(G1-2) Less than time and temperature zone control	Time and temperature zone control	16
		Main heating by heat pump with radiators or underfloor heating	(G1-3) Less than time and temperature zone control	Time and temperature zone control	16
G2	Water heating controls	Water heating present	No separate water controls	Separate time and temperature control for water heating	**70**
H	Heating controls for warm air system	Main heating by mains gas or LPG warm air, or by heat pump	(H-1) No control	Programmer/time switch and room thermostat or Programmable room thermostat	17
			(H-2) Programmer only	do.	18

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:	Rec No
J	Biomass boiler	House or bungalow. Independent solid fuel boiler (not biomass or dual fuel)	Mains gas not available and if SAP rating with measure J is better than SAP rating with measure Z1 or Z2	Manual feed biomass boiler in heated space (wood logs) with radiators. **See Note 8.**	22
J2	Biomass boiler **(Alternative measure)**	House or bungalow Heating other than by solid fuel or community	Heating system recommendation already given	Efficient wood logs boiler. **See Note 8**	54
K	Biomass room heater with boiler	House or bungalow Solid fuel open fire with or without boiler (not biomass or dual fuel)	(K-1) Mains gas not available and if SAP rating with measure K-1 is better than SAP rating with measure Z1 or Z2	Wood pellet stove with radiators, summer immersion heater. **See Note 8.**	23
		House or bungalow Solid fuel room heater with or without boiler (not biomass or dual fuel)	(K-2) Mains gas not available and if SAP rating with measure K-2 is better than SAP rating with measure Z1 or Z2	Wood pellet stove with radiators, summer immersion heater. **See Note 8.**	39
Z1	Air or ground source heat pump with radiators	House or bungalow (not flat or maisonette); for flats and maisonettes heat pump is not recommended. Heating other than by: - heat pump or - community - wet underfloor system	Dwelling is fairly insulated, e.g. measures A to Q2 are **NOT** triggered. **and** **compare** SAP rating from implementing Z1 with the SAP rating from the heating system recommendation (this will be one of R,S,T or L2); **recommend** Z1 as a measure when SAP rating assessed with Z1 is equal or better than with heating measures (i.e. one R,S,T or L2). Otherwise recommend R,S,T or L2	Air or ground source heat pump and radiators. **(Z1-1)** Heating system recommendation ASHP **(Z1-2)** Heating system recommendation GSHP **See note 9**	51 75

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:	Rec No
Z2	Air or ground source heat pump with underfloor heating	House or bungalow (not flat or maisonette); for flats and maisonettes heat pump is not recommended. Heating other than by: - heat pump or - community and wet underfloor system and Z1 not applicable	Dwelling is fairly insulated, e.g. measures A to Q2 are **NOT** triggered and **compare** SAP rating from implementing Z2 with the SAP rating from the heating system recommendation (this will be one of R,S,T or L2); **recommend** Z2 as a measure when SAP rating assessed with Z2 is equal or better than with heating measures (i.e. one R,S,T or L2). Otherwise recommend R,S,T or L2	Air or ground source heat pump and radiators. **(Z2-1)** Heating system recommendation ASHP **(Z2-2)** Heating system recommendation GSHP **See note 9**	52 76
Z3	Micro-CHP **(Alternative measure)**	Heating other than by micro-CHP or community and mains gas available	Heating system recommendation already given	Heating by micro-CHP. **See Note 10**	53
I	Upgrade boiler, **same fuel**	Main heating by mains gas boiler (including range cooker boiler) or CPSU or main heating by LPG or oil boiler (including range cooker boiler) and mains gas not available Note. Not applicable to liquid biofuels.	(I-1) Boiler, not condensing**,** **hot water cylinder in dwelling**	Condensing regular boiler, same fuel as original. **See Note 4**	20
			(I-2) Boiler, not condensing**,** **no hot water cylinder in dwelling**	Condensing combi boiler, same fuel as original. **See Note 4**	20
			(I-3) CPSU, not condensing	Condensing combi boiler. **See Note 5**	36
			(I-4) Range cooker boiler, hot water cylinder in dwelling	Condensing regular boiler, same fuel as original. **See Note 4**	37
			(I-5) Range cooker boiler, no hot water cylinder in dwelling	Condensing combi boiler, same fuel as original. **See Note 4**	38

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:	Rec No
R	Condensing **oil** boiler	Main heating by oil warm air	(R-1) Mains gas not available, hot water cylinder in dwelling and if SAP rating with measure R-1 is better than SAP rating with measure Z1 or Z2	Condensing **regular** oil boiler, radiators. **See Note 4**	28
			(R-2) Mains gas not available, no hot water cylinder in dwelling and if SAP rating with measure R-2 is better than SAP rating with measure Z1 or Z2	Condensing **combi** oil boiler, radiators. **See Note 4**	28
	Change heating to gas condensing boiler **(no fuel switch)**	Main heating by mains gas fires	(S-1) Hot water cylinder in dwelling	Condensing **regular** mains gas boiler, radiators. **See Note 4**	40
			(S-2) No hot water cylinder in dwelling	Condensing **combi** mains gas boiler, radiators. **See Note 4**	40

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:	Rec No
T	Change heating to gas condensing boiler (fuel switch)	Main heating by: - solid mineral fuel boiler - LPG boiler (non-condensing) - oil boiler (non-condensing) - LPG fires - oil warm air - solid mineral fuel room heaters - oil room heaters Also if no space heating system present	(T-1) Mains gas available, hot water cylinder in dwelling	Condensing regular mains gas boiler, radiators. See Note 4	29
			(T-2) Mains gas available, no hot water cylinder in dwelling	Condensing combi mains gas boiler, radiators. See Note 4	29
		Main heating by: - electric storage heating - electric off-peak underfloor heating	(T-3) Mains gas available, hot water cylinder in dwelling	Condensing regular mains gas boiler, radiators. Change electricity meter to single. See Note 4	27
			(T-4) Mains gas available, no hot water cylinder in dwelling	Condensing combi mains gas boiler, radiators. Change electricity meter to single. See Note 4	27
		Main heating by LPG CPSU	(T-5) Mains gas available	Mains gas condensing CPSU	42
T2	Flue gas heat recovery	New or replacement gas boiler recommended (I, S or T)	Replacement boiler provides DHW	Add FGHRS	50

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:	Rec No
L2	New or replacement storage heaters	Main heating by storage heaters, Old (large volume) or Slimline	(L2-1) Mains gas not available, and hot-water heating by cylinder with single immersion, or from solid-fuel secondary heater and if SAP rating with measure L2-1 is better than SAP rating with measure Z1 or Z2	High heat retention storage heaters (409) and controls (2404), and dual immersion water heating, large cylinder with 50 mm factory-applied insulation. **See Note 14.**	59
			(L2-2) Mains gas not available, and any other hot water system and if SAP rating with measure L2-2 is better than SAP rating with measure Z1 or Z2	High heat retention storage heaters (409) and controls (2404). **See Note 14.**	60
		Main heating by: - electric room heaters - electric ceiling heating Also if no space heating system present	(L2-3) Mains gas not available, and hot-water heating by cylinder with single immersion or from solid-fuel secondary heater or no hot water system present and if SAP rating with measure L2-3 is better than SAP rating with measure Z1 or Z2	High heat retention storage heaters (409) and controls (2404), 7-hour off-peak tariff and dual immersion water heating, large cylinder with 50 mm factory-applied insulation. **See Note 14.** Secondary electric heaters (693) if no existing secondary.	61
			(L2-4) Mains gas not available, and any other hot water system and if SAP rating with measure L2-4 is better than SAP rating with measure Z1 or Z2	High heat retention storage heaters (409) and controls (2404), 7-hour off-peak tariff. **See Note 14.** Secondary electric heaters (693) if no existing secondary	62
M	Replacement warm-air unit	Main heating by mains gas	(M-1) Non-condensing	New condensing warm-air unit, same fuel as original. **See Note 15.**	26
		Main heating by LPG warm air	(M-2) Age before 1998	New (non-condensing) warm-air unit, same fuel as original, on-off control, fan-assisted flue	26

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:	Rec No
N	Solar water heating	RdSAP assessment, house or bungalow, not thatched roof on main dwelling	(N-1) No solar panel	Solar panel with parameters per **Table 29 : Heating and hot water parameters** in RdSAP10 specification. Increase a normal or unknown size cylinder to medium (see * below).	19
		SAP assessment, house or bungalow	(N-2) No solar panel	Solar panel, 3 m² aperture area, evacuated tube with η=0.70, a_1=1.80, a_2 = 0.005, facing South, pitch 30°, modest overshading. Combined DHW cylinder at least 190 litres (see * below), solar part 75 litres; or if combi boiler, CPSU or instantaneous water heater, a separate solar pre-heat cylinder of 75 litres.	19
		All cases:		* Cylinder change <u>not</u> applicable to water heating by: - combi boiler - CPSU - heat pump (including hot water only) - micro-CHP with integral DHW vessel - instantaneous water heater - community heating. In these cases add a separate solar cylinder of 75 litres Cylinder has cylinder thermostat and 50 mm factory-applied insulation.	
Y	Waste water heat recovery	Dwelling has a mixer shower and no WWHRS Recommendation applicable only if hot water if from a cylinder or a combi boiler.	WWHRS not present	Add WWHRS for each shower. **See Note 16.**	49
O	Double glazed windows (replace single-glazed windows with double-glazed)	Single glazed windows present	Less than 80% of windows with multiple glazing	All single glazed windows replaced by double glazing with U = 1.4 W/m²K (vertical windows) or U = 1.6 (roof windows) and g = 0.63. **See Note 12.**	8

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:	Rec No
O3	Glazing replacement	Double glazing with PVC frames and 12 mm gap installed before 2002 (E&W) or 2003 (Scotland) or 2006 (Northern Ireland)	At least 80% of windows are of that type	Replace double glazing units with new glazing giving whole-window values of U = 1.4 and g = 0.63.	56
P	Secondary glazing	Single glazing present but assessor de-selected measure O. See Note 6	Less than 80% of windows with multiple glazing	apply secondary glazing to single glazed windows with U = 2.9 W/m^{2}K (vertical windows) or U = 3.2 W/m^{2}K (roof windows) and g = 0.76. Otherwise, windows with single glazing changed to double glazing with U = 1.4 W/m^{2}K (vertical windows) or U = 1.6 W/m^{2}K (roof windows) and g = 0.63. See Note 12.	9
X	Insulated doors	House, bungalow, or park home, or (Flat or maisonette) and (no corridor or more than one door) i.e. door directly to outside	Door(s) directly to outside not insulated	Change doors directly to outside to insulated doors with U = 1.4 W/m^{2}K	48
U	Photovoltaics	House or bungalow, not thatched roof	No photovoltaics	Photovoltaics, 2.5 kWp, facing South, pitch 30°, modest overshading, connected to dwelling's electricity meter. Add Addenda item 15, see **Table 30 : Addendum**	34
V2	Wind turbine	House or bungalow in rural location	No wind turbine	Wind turbine on mast, blade diameter 4.0 m, hub height 10 m above ridge	44
Y2	PV diverter	Dwelling has PV No PV battery storage present No solar water heating present	Hot water tank present	Add PV diverter	73
Y1	PV battery	Dwelling has PV	PV but no battery storage	One battery 5 kWh	72

Note 1 : Improvement A. Loft insulation is considered separately for main roof and extensions 1, 2, 3, 4 as applicable and applied to all accessible roofs with insulation <= 150 mm.

Note 1a : Improvement C, Cylinder insulation, existing is factory applied <= 25 mm: SAP Table 2 is constructed on the basis that 80 mm jacket is equivalent to 25 mm factory-applied insulation. Therefore an additional 80 mm jacket can be implemented by increasing the existing insulation thickness by an additional 25 mm, to the nearest RdSAP thickness option for cylinders. Thus 12 mm improves to 38 mm, and 25 mm improves to 50 mm.

Note 1b : Improvement C, Cylinder insulation, existing is jacket < 80 mm: 12 or 25 mm improves to 80 mm, and 38 or 50 mm improves to 120 mm.

Note 3 : Cavity wall insulation. Cavity wall insulation is considered separately for main wall, extensions 1, 2, 3, 4 and alternative walls as applicable and applied to all fillable walls. When cavity fill is recommended the data collection includes whether there might be issues of cavity less than 50 mm, high exposure or difficulties of access. If any of those apply an addendum is included on the EPC saying that the issues should be investigated to establish the best treatment for the walls, e.g. dwelling should be assessed for exposure to driving rain.

Note 3a: Insulation of party walls can be considered for semi-detached or terraced houses or bungalows. When party wall insulation is recommended, an Addendum on the EPC shall advise on the need for any statutory approvals (planning approval, Listed Building Consent, Party Wall Notices or approval under the Building Regulations) for the proposed improvement work.

Note 4 : Improvements I, R, S, T. Use database boiler as follows:

Replacement boiler fuel and type	**Boiler database index**	**Replacement boiler fuel and type**	**Description**
mains gas regular	690001	mains gas regular	Regular, condensing 88.9%
mains gas combi (not storage combi)	690002	mains gas combi	Instant combi, condensing 88.9%
mains gas storage combi	690003	mains gas storage combi	Storage combi, condensing 89.4%
LPG regular	690004	LPG regular	Regular, condensing 91.1%
LPG combi	690005	LPG combi	Instant combi, condensing 90%
oil regular	690006	oil regular	Regular, condensing 92%
oil combi	690007	oil combi	Instant combi, condensing 90.1%

The table below is shown here for information and will be deleted at the final stage.

Controls are:
- for radiator systems:
  - programmer,
  - room thermostat and TRVs (or time and temperature zone control if already present),
  - if interlocked, separate timing of space and water heating (if regular boiler);

- if a gas-fired combi boiler is installed at least one of the following should be installed: (these are options a to d from ADL-2021 paragraph 6.2)
  a. FGHR
  b. Weather compensation
  c. Load compensation
  d. Smart thermostat with automatization and optimisation

for underfloor systems:

- time and temperature zone control.

Also:

- emitter temperature unknown;
- cylinder insulation and stat: 50 mm factory-applied insulation and cylinder thermostat.
- cylinder size:
    - for measure I, leave cylinder size as it is;
    - in the case of measures R, S and T, if regular boiler, cylinder of at least normal size (no solar panel) or medium size (solar panel present).

When there are two boilers, if main system 1 is being upgraded to a new boiler the new boiler does the water heating, unless main system 2 is also being upgraded to a new boiler (improvement I for both boilers) and the water heating was from main system 2 – in that case water heating stays with main system 2.

In the case of improvement I, if only system 2 is being upgraded leave water heating source, cylinder (size, insulation, stat) and secondary heating system unchanged.

- if a gas-fired range cooker: a replacement includes two independently controlled burners (one for cooking and one for the boiler)
- If gas-fired warm air system: time and temperature control .

Note 5 : Replacement CPSU. Replacement is database condensing combi boiler 690003 (mains gas) or 690005 (LPG).
Controls are programmer, room thermostat and TRVs, interlocked system.
(690003 is a primary storage combi boiler. At present there are no condensing CPSUs available.)

Note 6 : Secondary glazing. If any of the windows are single glazed, a recommendation should be made for double glazing of all single-glazed windows. If the assessor cancels this recommendation, a recommendation is made for secondary glazing for the single-glazed windows. The secondary glazing option should appear only in these circumstances.

Note 7 : Improvement Q. Solid wall insulation is considered for main wall, extensions 1, 2, 3 and 4 and alternative wall as applicable and applied to all applicable walls. Implemented by changing the wall insulation to external wall insulation but leaving the building dimensions (in the reduced data set) unchanged.

Note 8 : Improvements J, J2, K. Database boiler 691001 (wood logs) or 691002 (wood pellets). Heating controls are programmer, room thermostat and TRVs. Upgrade hot water cylinder to medium size with 50 mm factory-applied insulation and cylinderstat, separate timing of water heating.

This table is for information and will be deleted at the final stage.

Replacement boiler fuel and type	Boiler database index	Description
Wood logs	691001	Independent boiler 82% efficient
Wood pellets	691002	Closed room heater 82% efficient
Wood pellets	691003	Independent boiler 83% efficient

Note 9 : Improvements Z1, Z2. Use database heat pump as follows using the design heat loss of the dwelling allowing for any insulation measures already included:

Ground source HP:

Emitter	Design heat loss kW	Illustrative HP kW	Boiler database index	efficiency
Radiators	<5kW	4.6	693001	374.5
Radiators	5-8kW	7.6	693002	374.5

Radiators	>8kW	9.8	693003	374.5
Fan coils	<5kW	4.9	693007	411
Fan coils	5-8kW	8.0	693008	411
Fan coils	>8kW	10.4	693009	411
Underfloor	< 6kW	5.3	693004	414
Underfloor	6 – 10kW	8.5	693005	414
Underfloor	> 10kW	10.9	693006	414

Air source HP:

Emitter	**Design heat loss kW**	**Illustrative HP kW**	**Boiler database index**	**efficiency**
Radiators	<3kW	2	693010	328.2
Radiators	3-8kW	5.4	693011	328.2
Radiators	>8kW	14	693012	328.2
Fan coils	<3kW	2.8	693013	359.1
Fan coils	3-8kW	5.7	693014	359.1
Fan coils	>8kW	14	693015	359.1
Underfloor	< 4kW	3	693016	359.7
Underfloor	4 – 8kW	6.1	693017	359.7
Underfloor	> 8kW	14	693018	359.7

Software selects HP on a basis of Design Heat Loss (DHL), calculated as dwelling's heat loss coefficient multiplied by a temperature difference of 24.2K; refer to SAP10.2 Specification Appendix N for further details on DHL.

Note: Z1-1 (ASHP) and Z1-2 (GSHP) have different installation costs.

Note 10 : Improvement Z3. Database micro-CHP 692001 (mains gas). If the PSR is out of range cancel the recommendation. Heating controls are programmer and room thermostat. If DHW is not from main system, change it to main system. If no existing DHW cylinder add one of normal size (110 litres) with 50 mm factory insulation; Upgrade an existing hot water cylinder to at least normal size (no solar panel) or medium size (solar panel present) with 50 mm factory-applied insulation and cylinderstat.

Note 11: Alternative measures (Q2, J2, Z1, Z2, Z3). These are to be included in the XML (except for park homes) so that they can be mentioned on the EPC, subject to the selection conditions shown in the table for the measure and their attaining a cost saving (using current prices) of at least £10.

In the case of the heating alternatives (J2, Z1, Z2, Z3):
- implement each applicable alternative recommendation (in the case of heat pumps as an air source heat pump)
- if total costs are reduced by at least £10 mark it as a possible alternative recommendation
- remove amended heating system and proceed to next one

- finally check the effect of the heating upgrade for the main recommendation list, retain alternatives that meet the above criterion if the main heating upgrade is recommended; if not discard the alternatives as well

Note 12 : Improvements O, P. If there is already some **single** glazing, the double glazing or secondary glazing improvement is implemented by changing single glazed windows changed to above specification and other windows left as they are. If Assessor cancels double/glazing recommendation, the recommendation becomes "secondary glazing".

Note 13: Improvements for roof rooms. Any roof room element with a U-value 'known' to be > 0.35 should be improved to 0.16. 'Known' means i) U-value entered by the assessor, ii) U-value deduced from the insulation thickness entered by the assessor, or iii) an as built U-value taken from RdSAP Tables. Any roof room element with an 'unknown' U-value should not be improved. 'Unknown' means i) the presence of insulation is unknown, or ii) an element is known to have insulation, but the insulation thickness is unknown.

Therefore, based on the insulation status the following logic applies:

a. Roof room insulation type or insulation thickness = unknown: No improvement recommendation.
b. Roof room insulation = as built: Change all elements of roof rooms with U-value > 0.35 (from RdSAP Tables) to U = 0.16

e. Roof room details (area and U-values) provided: Recommend improvement if any elements with U-value > 0.35 to U = o.16

Note 14 : Improvement L2. New storage heater is 697101.

Note 15 : Improvement M. Warm air system is 697001 (space only) or 697002 (space and water). If the existing cylinder is indicated as "no access" in the RdSAP data its size is re-assessed according to **Table 28 : Cylinder size**. If the heating system being replaced was not providing water heating, the water heating arrangements remain as they are.

Note 16 : Improvement Y. Recommendation applicable only if hot water if from a cylinder or a combi boiler. If one shower it is System A. If more than one shower the first shower has System A and others System B, with System A is assigned to a room with shower and no bath if there is one. For System A use 695001, for System B use 695002.

Note 17: Improvement G: Two thermostats if TFA is large than 150m2.
Boiler controls are considered to be part of boiler installation.

Heating upgrades

An improvement to a heating system by adoption of any of the following measures:

I, J, K, L2, M, R, S, T, Z1, Z2

is taken as extending the main heating system to the whole dwelling where that is not the case in the existing dwelling. Thus when implementing any of the above measures, the number of heated habitable rooms is to be set equal to the number of habitable rooms. This rule affects the results where there are unheated habitable rooms and no identified secondary heater. If there is an identified secondary heater, the secondary heater remains throughout the sequence of calculations of improvement measures. Also, in the case of measure T upgrading storage heaters to a condensing gas boiler if the secondary heating has been given as portable electric heaters the secondary heating becomes none after the upgrade.

In the case of measure T, if the existing heating is storage heaters or off-peak underfloor electric heating (401, 402, 404, 408, 421, 422) change the electric meter to single.

Heating upgrades when there are two main systems

In the case of measure I (upgrade boiler, CPSU or range cooker, same fuel) where both systems each use the same fuel, apply the improvement to both boilers as applicable (i.e. boiler is non-condensing) as a single step. If the result attains the SAP increase criterion make the recommendation on the EPC using the improvement text applicable to main system 1 if both boilers are being upgraded.

In the case of any other combination of main heating systems, apply the improvement to system 1 only. This includes measure I where that is relevant to main system 1 but not main system 2, as well as consideration of measures J, K, M, R, S, T, J2, Z1, Z2.

Heating control upgrades when there are two main systems
Apply the improvement to the controls on system 1 only, except apply improved controls to both boilers if both replaced.

Central heating pump age for improvement measures
Where the heating is upgraded to a system which needs a central heating pump (J, J2, K, Z3, I, R, S, T), if the existing dwelling has a one this is retained (pump age is unchanged). If the existing dwelling has no central heating pump then a new one is added (pump age is 2013 or later).

Definitions of the Recommendation Status

For testing purposes only each improvement mentioned in the list can be indicated as being one of the following: Only those with status "Recommended" or "Alternative" appear on the EPC.

Status	**Meaning**	**Example**
Not considered	Measure not considered in this case	Insulation measure for new dwelling
Not applicable	Inapplicable in this case	Loft insulation for ground or mid-floor flat
Existing Unknown	Existing condition not known	Cylinder insulation when cylinder inaccessible
Already installed	Dwelling already has measure to at least that recommended in the above Table of measures	Originally clear cavity walls but cavity has been filled
Equivalent already installed	Dwelling already has equivalent measure to at least that recommended in the above Table of measures	Cavity wall is unfilled but has internal or external insulation to give U <= 0.6
Error	Incompatible data	Solid wall marked as having cavity fill
Recommended	Included in the quantified recommendations on the EPC	Increase insulation of hot-water cylinder
Alternative	Recommended as an alternative measure	Heat pump
Superseded	A measure further down the list applies instead	Upgrade oil boiler to condensing oil boiler, but mains gas is available so instead recommendation is for condensing gas boiler
SAP increase too small	SAP improvement is less than the applicable threshold for the measure	100% low energy lights raises SAP by 0.3 points.
Cost saving too small	Total energy cost reduction is less than £10 when recalculated using current fuel prices	Increase in SAP rating is 0.51 points, but total energy cost increases (because of differential price changes since the values in SAP Table 32 were set)
Recommendation cancelled	Assessor deselected the recommendation	PVs when roof significantly over-shaded

Software implementation recommendations:

All remaining improvement measures are to be written to the XML so that they are included on the EPC. (Note: for an existing dwelling the user is able to de-select measures. That is not the case for new-build EPCs and the option to de-select measures should not be available in the case of new-build.)

The effect of each improvement measure is determined by implementing the measures in turn and calculating the results. The order of implementing the measures is to be as set out below. Implementing measures is done by amending the input data, e.g. to increase the percentage of low-energy lights to 100%, and the calculation is re-done.
The results for each measure consist of:
- the incremental cost saving in £/year from implementation of the measure
- the cumulative SAP band and SAP rating (i.e. after implementing all measures so far)
- ditto environmental impact

The total running costs, CO2 emissions and primary energy are calculated after implementing all applicable measures. They are totalled separately for space heating, water heating and lighting. The electricity for pumps and fans together with any additional standing charge is included with the space heating, except for electricity for a solar water heating pump and for electric keep-hot by a keep-hot combi boiler which are included with the water heating.

The fuel prices to be used for the calculation of incremental savings and total running costs are those in Table 191 of the Product Characteristics Data File (pcdf2012.dat).
(Note: The prices in Table 191 are used only for calculation of costs and savings on EPCs. Any SAP rating, whether initial, after incremental improvements or final, must in all cases be based on the prices given in Table 32. Thus software must maintain two sets of fuel prices, one set for calculation of SAP ratings and one set for calculation of running costs and savings.)