SAP Calculations Explained

A SAP rating is the calculation that is required in order to produce a Predicted Energy Assessment (PEA) and an On Construction Energy Performance Certificate (EPC). Building Regulations require that a SAP calculation and a PEA is submitted for new dwellings prior to the commencement of work.

A SAP calculation indicates a score from 1 to 100+ for the annual energy cost based on:

- The elements of structure;
- The heating and hot water system;
- The internal lighting;
- The renewable technologies used in the home.

The higher the score the lower the running costs, with 100 representing zero energy cost. Dwellings with a rating in excess of 100 are net exporters of energy.

SAP calculations allow comparison to be made of the energy running costs of dwellings anywhere in the UK and are based upon a notional standard occupancy that overcomes variations associated with physical location and the differing ways in which people utilise their homes. SAP ignore appliances' use of energy (actual running costs can be 25% higher).

A SAP calculation for a new dwelling is a desktop exercise, the client or their designer submits drawings, plans and specifications of the development to the assessor. It is recommended that the SAP calculation is undertaken early in the design process, this will help to prevent any costly re-design of the dwelling.

This should be submitted to Building Control a minimum of 5 days before commencement on site.

SAP calculations usually involve 3 main stages:

1. **As Designed stage**

From the suitably scaled or fully dimensioned plans and drawings provided by the agent, the accredited assessor prepares summary information which includes the total floor area of the dwelling; the floor area of the warmer living area; the areas of the heat loss floors, heat loss walls and heat loss roofs; dimensions of external windows and doors; storey heights, etc.

From the specification provided, the assessor calculates the performance of the thermal elements. These are expressed as 'U' values (the rate at which heat passes through the fabric of the building), the higher the 'U' value the greater the rate of heat loss. The assessor then inputs this data into the SAP calculation. Data is entered relating to:

- Type of dwelling;
- Floors;
- Walls;
- Roofs;
- Openings (windows, doors, roof lights);
- Ventilation;
- Main and secondary space heating;
- Hot water generation;
- Renewable technologies, including photovoltaic panels and solar water heating;
- Energy efficient lighting.

The software determines whether the proposed dwelling will comply with the requirements of the Building Regulations with regards to the conservation of fuel and power. The assessor is able to use the software to model different variations of the design if the initial specification doesn't show compliance. The assessor can then advise the designer of the shortfalls and recommend solutions as required.

The client, designer and the assessor agree the final version of the design. This may involve amendments to the initial design in order to achieve SAP compliance. Data from the final design is input into the computer program.

From this the assessor produces reports that the client or designer need to submit to Building Control, this will include a Predicted Energy Assessment (this provides a rating of energy performance based upon the specified design and is required to market the property).

2. Build stage

Any changes on site can have a huge impact on the SAP so we suggest these are checked prior to any changes in the software, or the as designed followed precisely including any thermal bridge details.

SAP 2012 uses an air test figure of 5 $m^3/h \cdot m^2$ at 50 Pa in the model house, so this is what you are being measured against. If you propose to reduce the number of air tests on a site then another of the same house type can use this but you have to add a figure of 2; this can make it very difficult to pass with new technologies added to the specification. Most house builders now test all plots.

The assessor will edit the SAP calculation to reflect the results of the air pressure test and any variations to the specification. The software is used to check that the completed dwelling still meets the requirements of the Building Regulations with regards to the conservation of fuel and power. If it does not, the assessor recommends remedial action.

For new build dwellings the assessor checks to ensure that the dwelling is registered on the Government's central database register of national property addresses. If it is not, the assessor arranges for the address record to be created.

The assessor will require written confirmation that the as built dwelling has followed the as designed dwelling exactly; including for example, thermal bridge details, party wall details or a list of any changes made. Any changes at this stage can mean a fail and costly remedies, as at this stage renewables are often the only way out, hence our advice is to follow the design fully, or check first!

3. As Built stage

The assessor finalises the SAP calculation and creates the Energy Performance Certificate (this provides a rating of energy performance based upon the dwelling **as built**). The EPC is required for a new dwelling prior to being sold or let.

In addition there are other documents that are required by Building Control such as the SAP worksheet report and the SAP data input report.

The assessor provides the client with the EPC.

General

Since SAP calculations are based upon a desktop exercise, and not a site survey, it is critical that the correct information is submitted. The following is a minimum suggested list of the information sources and data items required.

Information required to do a SAP/EPC (Don't panic, we are happy to offer advice on these details if you are unsure).

1. Site address and postcode;
2. Site plan to include orientation of the dwelling(s);
3. Plans of each storey, normally to a recognised scale or fully dimensioned;
4. Elevations drawings for each elevation to a recognised scale or fully dimensioned;
5. Sectional drawings of the dwelling to a recognised scale or fully dimensioned;
6. A written specification which must include the following:

    a) Details of the principal heating and hot water system to include make and model of boiler, details of heating emitters, hot water cylinder size (if applicable) and the system controls;
    b) Details of any secondary heating system present;
    c) Details of ventilation systems;
    d) Details of the internal and external lighting;
    e) Details of the construction of all different floors to the property to include type and thicknesses of insulation and any other building products used;
    f) Details of the construction of all different external walls to the property to include type and thicknesses of insulation and other building products used;
    g) Details of the construction of all different roofs to the property to include type and thicknesses of insulation and other building products used;
    h) Details of thermal bridge details proposed;
    i) Details of the doors and windows to include sizes, type of frame, type of glazing, thickness of glazing, any low-e films. If a lower than the Building Regulations U value is specified, a manufacturer certificate such as BFRC rating is required; http://www.bfrc.org/Consumer/search.aspx online search facility for doors and windows with BFRC ratings;
    j) Details of any renewable technologies utilised such as ground source heat pumps, solar water heating, waste water heat recovery or photovoltaic.

As an alternative to specification on plans for walls, floors and other elements, a U Value calculation from the insulation manufacturer is acceptable.

We are happy to offer advice on these details if you are unsure.

The table below shows what SAP 2012 uses to model your property against, any reduction in this specification will need to be compensated elsewhere in the design.

SAP 2012 Table R1 : Reference values for England and for Wales	
Element or system	**Value**
Climate data	UK Average
Size and shape	Same as actual dwelling
Opening areas (windows, roof windows and doors)	Same as actual dwelling up to a maximum for total area of openings of 25% of total floor area. If the total area of openings in the actual dwelling exceeds 25% of the total floor area, reduce to 25% as follows: 1) Include all opaque and semi-glazed doors with the same areas as the actual dwelling (excluding any doors not in exposed elements, e.g. entrance door to a flat from a heated corridor). 2) Reduce area of all windows and roof windows by a factor equal to [25% of total floor area less area of doors included in 1)] divided by [total area of windows and roof windows in actual dwelling].
External Walls including semi exposed walls	U = 0.18 W/m²K
Party walls	U = 0
Floors	U = 0.13 W/m²K
Roofs	U = 0.13 W/m²K
Opaque doors (<30% glazed area)	U = 1.0 W/m²K
Semi-glazed doors (30%-60% glazed area)	U = 1.2 W/m²K
Windows and glazed doors with >60% glazed area	U = 1.4 W/m²K Frame factor = 0.7 Solar energy transmittance = 0.63 Light transmittance = 0.80 Orientation same as actual dwelling Over-shading same as for DER calculation (average if actual dwelling has very little or average over-shading; same as actual dwelling if greater over-shading)
Roof windows	U = 1.4 W/m²K (Adjustment factor of +0.3 W/m²K applied to roof window as described below Table 6e; resultant U value = 1.7 W/m²K) Over-shading factor 1.0 Other parameters as for windows
Curtain wall	Curtain walling to be treated as standard glazing and opaque wall with the same areas as the actual dwelling. When the total opening area exceeds 25% of floor area the glazed area to be reduced to 25% as for opening areas above. U-value of opaque wall = 0.18 W/m²K U-value of glazing = 1.5 W/m²K (which includes an allowance of 0.1 for thermal bridging within the curtain wall)
Thermal mass	Medium (250 kJ/m²K)
Living area	Same as actual dwelling
Number of sheltered sides	Same as actual dwelling
Allowance for thermal bridging	If the thermal bridging in the actual dwelling has been specified by using the default y-value of 0.15 W/m²K, the thermal bridging is defined by y = 0.05 W/m²K. 2. Otherwise the thermal bridging allowance is calculated using the lengths of junctions in the actual dwelling and the psi values in Table R2. Note. Where the area of openings in the actual dwelling is > 25% of the total floor area the lengths of junctions in the notional dwelling remain the same as the lengths in the actual dwelling, even though window area is reduced as described for 'Opening areas' above.
Ventilation system	Natural ventilation with intermittent extract fans
Air permeability	5 m³/h·m² at 50 Pa
Chimneys	None

Open flues	None
Extract fans / passive vents	2 extract fans for total floor area up to 70 m², 3 for total floor area > 70 m² and up to 100 m², 4 for total floor area > 100 m²
Main heating fuel (space and water)	Mains gas
Heating system	Boiler and radiators Central heating pump 2013 or later, in heated space Design flow temperature > 45°C
Boiler	If gas or oil combi boiler in actual dwelling, instantaneous combi boiler; otherwise regular boiler Efficiency, SEDBUK(2009) = 89.5% Room-sealed, fan-assisted flue Modulating burner control No hot water test for combi boiler
Heating system controls	1. For a single storey dwelling in which the living area is greater than 70% of total floor area, programmer and room thermostat; 2. For any other dwelling, time and temperature zone control. And in all cases: Boiler interlock Weather compensation providing +3% boiler efficiency adjustment
Hot water system	Heated by boiler (regular or combi as above) Separate time control for space and water heating
Hot water cylinder	If cylinder specified in actual dwelling: volume of cylinder in actual dwelling If combi boiler: no cylinder Otherwise: 150 litres If cylinder, declared loss factor = 0.85 x (0.2 + 0.051 V2/3) kWh/day, where V is the volume of the cylinder in litres
Primary water heating losses	Fully insulated primary pipework Cylinder temperature controlled by thermostat Cylinder in heated space
Water use limited to 125 litres per person per day	Yes
Secondary space heating	None
Low energy light fittings	100% of fixed outlets
Air conditioning	None