Amendments to SAP 2005 (version 9.81)

April 2008

The calculation procedure will continue to be known as SAP 2005 but the SAP version number is incremented from 9.80 to 9.81.

1 Very little overshading

The category very little overshading in Table 6d applies to a more-or-less completely open outlook. Even if that is the case when a dwelling is constructed, it is not appropriate for consideration of compliance with regulations which need to take account of conditions applying during the expected lifetime of the building.

Accordingly, if the category of very little overshading is specified, it is substituted by average overshading for the calculation of the DER. The overshading as specified is used for the calculation of ratings and the assessment of overheating. This applies in England & Wales, Scotland and Northern Ireland.

The above applies only to windows, roof windows have an overshading factor of 1.0 in all cases.

2 Underfloor heating

Add thin screed for wet systems (heating type 2, responsiveness 0.75) to Table 4d.

When both underfloor and radiators (e.g. underfloor downstairs and radiators upstairs) the calculation is done for underfloor heating.

3 Photovoltaics

The annual kWh/kWp is amended to 800, see M1 of revised Appendix M.

In the case of a block of flats:
a) where the PV output is connected to the landlord supply the total PV area should be divided between the dwellings in proportion to the total floor area of each dwelling;
b) where the PV output is connected directly to individual flats, the PVs benefit only those flats.

Then assess each flat according to Appendix M. In both cases it is assumed that any electricity generated that is surplus to the instantaneous electricity demand is exported to the grid.

4 Export electricity price

Is amended to 0.8 of the standard tariff, i.e. 5.70 p/kWh in Table 12. This applies to the calculation of SAP ratings.

5 Micro wind turbines

Allow for electricity generated by small wind turbines as described in Appendix M.

6 Fixed air conditioning

The presence of fixed air conditioning to be recorded and mentioned on the EPC. No calculation of cooling energy for now (such calculation is intended for SAP 2009 to be implemented in 2010).

7 Heated but separated conservatory

If there is a separated conservatory with a fixed heater, this is to be recorded and mentioned on the EPC.

8 Infiltration rate (wall infiltration)

When a dwelling has walls of more than one type, for example some masonry and some timber frame, the type forming the largest area (after deduction of window and door area) is used to determine the structural infiltration rate. Thus 60% masonry and 40% timber frame would have a structural infiltration rate of 0.35 ach, and 40% masonry and 60% timber frame would have a structural infiltration rate of 0.25 ach. IF areas equal use 0.35 ach. (This is not relevant to new-build for which the infiltration rate is determined from a measured or assumed air permeability.)

The main purpose of the above is to define the infiltration rate used in calculations starting from reduced data.

9 Air permeability

For new-build in the as-build case (England & Wales, Northern Ireland, not Scotland) record whether the value of air permeability is a measured value (for the dwelling concerned) or a design value. Use "(as tested)" or ("assumed") on the EPC accordingly.

10 Solar water heating

Amendment to formula for (H10), see revised Appendix H.

11 Mechanical ventilation

If the database procedures for mechanical ventilation systems are not being implemented (see 25 below) immediately, the basis for using default values needs to be amended to be in line with section 2.6 of the SAP 9.81 specification. This is to maintain consistency between different SAP calculators. It means:

a) The SPF and efficiency from Table 4g are to be multiplied by the in-use factor for default data (see SAP Table 4h).

b) With MVHR do not include an allowance for gains from fans in the calculation in internal heat gains at worksheet (53b), see last paragraph of SAP 2.6.4.

c) With balanced systems the air throughput is to be according to SAP 2.6.6..

Single storey dwelling: $n_{mech} = 0.30$
Two or more storeys: $n_{mech} = 0.35$

subject to:
if $n_{mech} + (22) < 0.5$ then $n_{mech} = 0.5 – (22)$

to give (22a), see worksheet segment below.

d) The effective air change rate, worksheet (23), includes the MVHR efficiency adjusted for the in-use factor, see SAP 2.6.6 and worksheet segment below.

Adjusted infiltration rate	(19) × (21) =		(22)
Calculate effective air change rate for the applicable case			
If balanced whole house mechanical ventilation,	air throughput (air changes per hour) =		(22a)
If balanced with heat recovery	efficiency in % allowing for in-use factor =		(22b)
a) If balanced with heat recovery	(22) + (22a) × [1 – (22b)/100] =		(23)
b) If balanced without heat recovery	(22) + (22a) =		(23a)

e) In Table 4f change the value for MVHR to $2.44 \times n_{mech} \times SFP \times V$

12 Heating controls

Heat pumps, warm air: control options should be Group 5.

In Group 5 for warm-air heat pumps and other warm air, add
- programmer, no thermostat
- programmer and at least two room thermostats

(see revised Table 4e).

In group 3 for community heating, add:
- Flat rate charging, programmer, no room thermostat
- Flat rate charging, room thermostat only

(see revised Table 4e).

13 Table 4a – gas fires

Separate values for mains gas and LPG are now provided, see revised Table 4a. These are the minimum values required by the British Standards and set the minimum values for compliance with regulations.

14 Two types of community boiler (different fuels)

Sometimes there are two boiler types, e.g. biomass and natural gas.

When the heating is from a community scheme using boilers, the data collection should provide for two boiler types and request:
- average efficiency of boiler type 1
- average efficiency of boiler type 2
- fraction of heat from boiler type 2

When there is only one boiler type, the fraction is given as 0.00 (or 1.00).

Boiler efficiency and fraction from each boiler type are as specified by the designer of the community scheme.

The calculation proceeds as for a community scheme without CHP, i.e. worksheet sections 9b, 10b, 11b and 12a.

Use (83*) for the fraction of heat from boiler type 2 and (84*) for the fraction of heat from boiler type 1. Similarly (86*) to (87b*) are used for the two boiler types. For CO_2 emissions and primary energy, (104) to (106) are used twice, multiplying each (104) and (105) by the applicable fraction of heat.

15 Community system for DHW only

Some community schemes provide DHW only, with the space heating provided by heaters in each dwelling.

In this case the specification and calculation of space heating is the same as for a dwelling not connected to a community scheme. This includes a main heating system and secondary heaters.

For water heating there is a new option "From DHW-only community scheme". The scheme can be:
- from community boilers (one type is sufficient);
- from a community heat pump;
- from a community CHP

Data required are:
- fuel used by community scheme (same fuel options as for community scheme providing space and water heating)
- efficiency of community boilers, heat pump or CHP
- if CHP, the heat-to-power ratio
- heat distribution characteristics for the distribution loss factor (Table 12c)
- whether a hot water cylinder is in the dwelling and if so its volume plus either its measured loss factor or its insulation type and insulation thickness.

The water heating calculation follows that for a full community scheme including, if there is not a cylinder in the dwelling, assigning for the purposes of the calculation a 110 litre cylinder with 50 mm factory-applied insulation. The control efficiency, Table 4c 3), is not applicable and 100% should be used for water heating (but allowing for the distribution loss factor from Table 12b). Include one-half of the normal community standing charge in the calculation of fuel costs.

This also allows for the case where the community system is different for space heating and for water heating. Separate community heating parameters apply to each system including heat distribution characteristics.

16 Electric CPSU

An electric CPSU can serve underfloor heating as well as radiators. Heating type is 2 in either case. Note that the procedure in Appendix F applies for any CPSU volume and any operating temperature.

17 Direct acting electric boiler

There are two types, either the water cylinder is within the same casing or it is a separate cylinder, in both cases with a single or dual immersion. The former may have been implemented incorrectly; in fact the two are identical so far as the calculated results are concerned (immersion heater, no primary pipework).

18 Additional water heating options

Additional water heaters are being added primarily so that they are available for RdSAP assessments. These are:
- a gas or oil boiler (circulator) which is a small boiler that heats hot water only and is associated with a hot-water cylinder;
- range cookers with a boiler that heats hot water only.

Without these options being available, there is no satisfactory way of representing them.

19 Solid fuel open fires with boilers to radiators

Deleted the distinction between two types of grate. Now only one entry in Table 4a.

20 Pellet stove with boiler

To be added to heating systems. The boiler can be for DHW only or for DHW and space heating. See revised Table 4a.

21 Community biomass CHP

In SAP 9.80, for community heating with CHP, there is an instruction at box (115*) to replace a negative value of the CO_2 emission equivalent of the plant (allowing for the generated electricity) by 1. The reason is that, once this quantity becomes negative, it becomes advantageous to increase the heating requirements of the dwellings, e.g. by removing insulation.

This remains in SAP 9.81 except that a negative value is replaced by 0 rather than 1. However, in the case of a CHP plant fuelled by biomass, the residual negative amount is carried forward for possible use in consideration of zero carbon homes. It is therefore essential that the worksheet printout shows the negative value at (115*) and then sets it to zero, see example 5h.

In this way the full benefit of biomass CHP can be taken into account. This is permissible only when:

(a) the DER is less than or equal to 0; and
(b) the Heat Loss Parameter (HLP) does not exceed 0.8 W/m²K, thus ensuring that a high standard of insulation is provided; and
(c) the community CHP is fuelled by biomass, not a fossil fuel.

If all these conditions are not met the residual is set to 0.

In the case of a DHW-only community scheme which is biomass CHP, and the main heating is not community CHP, the same situation can arise at box (107). If (107) is negative it is set to zero but can be carried forward to box (ZC5). See example 10d.

22 Geothermal heat source (community scheme)

Treated the same as community heating using waste heat from power station. Boilers are needed to supplement the geothermal source. Waste heat and geothermal have the same factors in Table 12 at the moment but implementations should allow them to be different in future.

23 Summer overheating

Some minor amendments to Appendix P.

Note that there should be an option for a specified summertime ventilation rate, which if supplied is used instead of the data from Table P1.

24 Electricity tariff

The electricity tariff (standard tariff, off-peak 7, off-peak 10 or 24 hour) to be an explicit item for data entry. Where off-peak exists but is not used for main heating or DHW, all electrical items are calculated using the applicable on-peak rate. Software should check for consistency: the following need an off-peak tariff:
- electric storage heaters (7, 10 or 24 hour)
- electric underfloor heating (those marked "off-peak tariffs" in Table 4a) (7 or 10 hour)
- electric dry core or water storage boiler (7 hour)
- electric CPSU (10 hour)
- dual electric immersion (7, 10 or 24 hour)

and the data is inconsistent if standard tariff is indicated when any of the above are specified.

25 Mechanical ventilation

The possibility for using measured data on the system concerned for specific fan power and, in the case of MVHR, heat exchanger efficiency was introduced in June 2006 via an Appendix Q procedure. The procedures are incorporated into SAP 2005 with this update, so that the parameters of the system are specified as part of the data input to the SAP calculation. The spreadsheets that have been needed up to now as an adjunct to SAP calculators will eventually become redundant.

Moreover, a new section will be introduced into the database (which becomes the "Boiler Efficiency and Product Characteristics Database") that will hold the data on mechanical ventilation systems. Thus, in a manner similar to that presently used for boilers, the SAP assessor selects the ventilation system being used from a list offered by the software, identifying the system by means of brand name and model. The software will then fetch the parameters needed from the database.

SAP now recognises four types of whole-house mechanical ventilation systems:

a) Centralised MEV. Air is extracted from wet rooms via ducting and expelled by means of a central fan. The data required are the system's Specific Fan Power (SFP) and whether the ducting is rigid or flexible.

b) Decentralised MEV (a new option). Air is extracted by continuously-running fans in each wet room. The SFP for the SAP calculation is obtained from the SFP of each fan together with the fan's ducting arrangements (the fan can be in the ceiling of the room with a duct to the outside, or in a duct, or in a through-wall arrangement with no duct).

c) Balanced mechanical ventilation without heat recovery. Air is extracted from wet rooms via ducting and expelled by a central fan. Air is also supplied to habitable rooms, either via ducting and a central fan or by individual supply air fans in each habitable room. The data required is the SFP taking account of all fans.

d) Balanced mechanical ventilation with heat recovery (MVHR). Both the extract and supply air are provided via ducting, with a heat exchanger between the outgoing and incoming air. The SFP is measured as a single value for the system as a whole. In addition, the efficiency of the heat exchanger is included in the calculation.

No changes are being made in this update for other ventilation options, viz.
- natural ventilation with intermittent extract fans;
- natural ventilation with passive stack ventilators;
- positive input ventilation.

Details of the algorithms for mechanical systems are in section 2.6 of the SAP 9.81 specification. The changes include:
- revised procedure for the effective air change rate for balanced systems;
- "in-use" factors to allow for SPF and MVHR efficiency under typical conditions of installation and use compared to laboratory tests;
- amended default values of SFP and MVHR efficiency.

The defaults are somewhat less favourable than those in SAP v 9.80, the difference being:
- in v 9.80, the values in Table 4g were typical values since the option of tested data was not available;
- in v 9.81, they are default values towards to poorer-performing end of the range of typical values, to be used only if test data is not available and to be superseded by test data when available.

Software conforming to v 9.81 will have three options for assigning the parameters of mechanical ventilation systems:

1) Via the database.

2) Values entered by the SAP assessor. This option can be useful for a designer seeking to attain a given overall level of performance for the dwelling. However, for "as-built" assessments the system must be identified and the data obtained from the database (preferably) or from a data sheet obtained from www.sap-appendixq.org.uk.

3) Default values from Table 4g.

26 Curtain walling

Curtain walling is used sometimes for flats, but it needs a special procedure to get the heat loss and the solar gains correct simultaneously.

For curtain walling is a U-value is that for the whole façade, i.e. an average value including mullions, transoms, glazing and spandrel panels. SAP calculations should be done by:
a) entering the façade U-value for the wall U-value;
b) entering the façade U-value for the window U-value;
c) assigning a frame factor of 1.0 to the windows.

In the regulations checklist the limiting U-value for the curtain wall is that for glazing (2.2 W/m²K average) and this should be applied to "wall" as well as windows when it is a curtain wall.

The façade U-value includes all effects of thermal bridging within the façade. It is therefore permissible to calculate the thermal bridging heat loss with the lengths of window surrounds set to zero. All other junctions are included as normal (per Appendix K).

27 Air-source heat pumps

Air source heat pumps can operate on off-peak tariffs (7-hour or 10-hour). This can occur for example when the water heating is by off-peak immersion. For on/off-peak splits see additions to Table 12a.

28 Smoke control areas

For new-build cases only, if solid fuel is specified for any appliance, software should ask whether the property is in a Smoke Control Area.

If it is not in a Smoke Control Area, no action is needed.

If it is, then software should include a statement on the screen, and also in the printout of the input data to the calculation, according to the fuel.

Fuel	**Statement**
House coal*	Not permitted
Anthracite**	(no statement needed)
Smokeless	Authorised smokeless fuel only
Wood logs, wood chips, wood pellets	Exempted appliance only
Dual fuel*	Not permitted
* The calculation cannot be considered as valid under these conditions ** Anthracite is natural smokeless fuel that is permitted in Smoke Control Areas	

Information on Smoke Control Areas is provided at www.uksmokecontrolareas.co.uk. by local authority area. If it is not known whether it is a Smoke Control Area the applicable statement is qualified by "if the dwelling is in a Smoke Control Area".

29 Code for Sustainable Homes

For England only, where the DER for a dwelling is at least 10% lower than the TER, the Level attained for Ene 1 of the Code for Sustainable Homes[1] (CSH) should be calculated.

$$\% \text{ reduction} = (1 - \text{DER/TER}) \times 100$$

If the % reduction is expressed as an integer it is truncated (rather than rounded) to an integer percentage. Thus 99.87% becomes 99%. The Level is obtained from the truncated % reduction according to the following table:

% reduction	**Level**
≥ 10	1
≥ 18	2
≥ 25	3
≥ 44	4
≥ 100	5

[1] www.communities.gov.uk/thecode

If the % reduction is ≥ 100 and in addition the criteria for zero carbon homes are met the Level for Ene 1 is 6.

Note. A dwelling cannot be described as attaining a particular Level of the Code solely on the basis of the above table; there are numerous other issues that are considered in determining the Level.

30 Stamp Duty Land Tax

New section 14 in main text of SAP spec. This is primarily to assess zero-carbon new homes for exemption/limitation of SDLT.

31 Thermal bridging

The possibilities for specifying the thermal bridging heat loss are:

a) Default, which is y = 0.15
b) Accredited construction details, which is y = 0.08
c) User input of y-value (3 d.p., e.g. 0.057) with a reference (user-entered text) as to how it was calculated
d) Detailed calculation of thermal bridging heat loss from junction length and Ψ-values according to Appendix K

a), b) and c) must be included. d) is optional – if not included in the SAP calculator users can do the calculation with a spreadsheet and enter the resulting y-value via c).

Note that c) differs from the present implementation in some software. It is to allow, for instance, a developer to calculate and publish y-values for particular house designs. The reference is to a calculation sheet showing how the y-value was calculated.

For c) and d) values of Ψ for particular cases should be calculated in accordance with BRE IP 1/06, *Assessing the effects of thermal bridging at junctions and around openings*, and BR 497, *Conventions for calculating linear thermal transmittance and temperature factors*.

32 Community solar DHW

Where solar panels are used in a community heating system, the total collector area and the total dedicated solar store volume should be divided between the dwellings in proportion to the total floor area of the dwellings (these can be rounded to the nearest 0.01 m² and 1 litre).
Example. A block of 24 flats, eight with floor area of 50 m² and 16 with floor area of 60 m². Total aperture area of solar panels is 40 m² and the total solar storage volume is 1000 litres. The small flats are each assigned 1.47 m² and 37 litres, and the larger flats 1.76 m² and 44 litres.

The calculation is done as described in Appendix H for single systems, with the above parameters and the orientation, pitch and overshading of the panels set at values representative of the whole installation. Usually the solar store is separate and the arrangement is equivalent to that of diagram a) in Figure H2.

33 Small-scale hydro

Electricity generated by small-scale hydro-electric generators can be included as described in M4 of Appendix M.