

Consultation Paper: CONSP:11

Solid fuel heating efficiencies

Issue 1.0

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DATE	VERSION NO.	AMENDMENT DETAILS	APPROVED BY
28/06/2016	1.0	First issue	Paul Davidson

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1. INTRODUCTION

The preferred source of efficiency data for solid fuel heat generators for use in SAP calculations is the Product Characteristics Database (PCDB). This also holds information on other important characteristics for specific products; it uses laboratory test data that is processed into a form suitable for use in SAP. Not all products available in the UK market are entered in the PCDB so it is necessary to provide default heating system characteristics to enable a SAP calculation to be undertaken. These are provided in tables 4a to 4d of SAP 2012.

Some of the default values provided for the various types of solid fuel heating systems listed in the SAP tables have been questioned in recent years on the basis that they differ from values listed by:

- Heating Equipment Testing & Approval Scheme, HETAS
- Domestic Building Services Compliance Guide, DBSCG
- Microgeneration Certification Scheme, MCS

The purpose of this paper is to review differences between SAP values and those from other sources, and propose revisions for SAP if necessary. It is understood that a field study of solid fuel heating systems is being commissioned by DECC, but results will not be available until well after the publication of SAP 2016.

Gross efficiencies¹ are given throughout this paper; these are normally used in the UK, in contrast to net efficiencies commonly used in the rest of Europe and sometimes in manufacturer's literature.

Efficiencies are sometimes stated in terms of part load and full load in this paper; it may be noted that in SAP equation D3 the seasonal average is attributed to be the average of

¹If water vapour produced during combustion condenses, it releases latent heat. This is accounted for as part of the energy input in gross efficiency, but not in net efficiency. Efficiency is (energy output)/(energy input), therefore net efficiencies are higher values.

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the two values. There is no data with which to review this assumption at present, but this may be possible in future if suitable evidence emerges from the DECC study or other work.
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2. SOLID FUEL EFFICIENCY SOURCES

SAP is the UK's National Calculation Methodology for energy rating of dwellings and was originally used to assess the energy performance of dwellings and to demonstrate compliance with Building Regulations for new dwellings. Its applications have since been broadened, first to Energy Performance Certificates for new and existing dwellings, then to energy efficiency schemes such as Green Deal and ECO, estimating savings from installing specific measures in existing dwellings. Thus, since its inception, its predominant use has changed from new dwellings to existing dwellings. As a result it must retain the flexibility to model both new heating appliances fitted in new and existing dwellings, and older appliances in the existing dwellings that form most of the housing stock. This background and the applications required of SAP must be borne in mind when comparing the efficiency values with those from the other sources described below, all of which relate entirely to new appliances.

HETAS (Heating Equipment Testing & Approval Scheme) is recognised by Government to approve biomass and solid fuel heating appliances, fuels and services, including the registration of competent installers and servicing businesses. HETAS gives minimum efficiencies for solid fuel heating appliances on their website, and states:

“The minimum appliance efficiencies quoted are measured at normal rated output and are on a Gross CV basis. They are not seasonal efficiencies. The majority of appliances listed in the HETAS Guide have efficiencies well above these minimum, pass mark, values. There is also evidence to show that with solid fuel appliances efficiency does not fall off greatly as the output of the appliance reduces. Additional useful heat, which is not included in these minimum values, can be available from the chimney and fireplace particularly if the chimney is centrally placed and enclosed in the building structure.

“Testing has, until recently, been carried out to British Standards (BSS) using an appropriate standard test fuel. It is against these earlier BSS that most of the

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appliances listed in the HETAS Guide have been tested. After 1 January 2003 Type Testing is carried out to the relevant BS ENs.

“The minimum efficiency pass values that are listed are under review with the intent of raising them further.”

The Domestic Building Services Compliance Guide (DBSCG) provides detailed guidance for the installation of fixed building services in new and existing dwellings to help compliance with the energy efficiency requirements of the Building Regulations. The guide sets out recommended minimum energy efficiency standards. For systems installed in new dwellings, the standards are design limits (or backstop values). For new or replacement systems and components installed in existing dwellings, the standards represent reasonable provision for complying with the Building Regulations.²

The minimum efficiencies listed in the DBSCG are identical to those on the HETAS website (though the wording describing the heating systems differs in some cases). They are therefore listed together in the table below.

The Microgeneration Certification Scheme (MCS) is an industry-led and internationally recognised quality assurance scheme, supported by DECC. MCS certifies microgeneration products and also installation companies producing electricity and heat from renewable sources. The certification is based on a set of product scheme requirements and installer standards. Technologies covered by MCS include biomass heating, for which the MCS Standards specify minimum efficiency standards for appliances to be compliant with the scheme.

² It may also be noted that the DBSCG states in a footnote:

Emerging European regulations implementing the Ecodesign Directive will set minimum standards for the efficiency of energy-using products that can be placed on the market. Products should also comply with these standards as they come into effect. Current regulations are listed at:

http://ec.europa.eu/energy/efficiency/ecodesign/doc/overview_legislation_ecodesign.pdf

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3. PROPOSED CHANGES TO SAP

All efficiencies quoted below are gross efficiencies.

3.1 Pellet fired stoves and independent boilers

Solid fuel efficiency values in SAP were based on HETAS minimum appliance values, which have since been revised. The HETAS minimum efficiency used to be 65%; this has been revised to the following current values.

- Pellet Fired Stoves without boiler:
70% (nominal load), 65% (part load).
- Pellet Fired Stove with boiler:
75% (nominal load), 70% (part load)
- Automatic feed independent boiler fired by wood pellets/chips:
75% (nominal load), 70% (part load).

In addition the PCDB currently lists 104 pellet fired independent boilers or stoves with boilers, the lowest seasonal efficiency being 77.8%. This suggests that the HETAS figures are suitably conservative for use as SAP defaults for new units.

The following default efficiencies are therefore proposed:

- ***Pellet fired independent boilers, and stoves with boiler:***
75% (70% if not HETAS approved)
- ***Pellet fired stoves without boiler:***
70% (65% if not HETAS approved)

SAP distinguishes 'HETAS approved appliances' from 'Other appliances', as a short term, pragmatic method to distinguish new from old appliances. The longer term aim is to have a single default value for old appliances, with the efficiency for new appliances listed in the PCDB. This requires almost all new appliances to be in the database, which is not the case as yet. In previous reviews of solid fuel heating efficiencies, in general 'Other appliances' have been made 5 percentage points lower than 'HETAS approved appliances', except where this made the value less than it was previously.

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The above proposal would replace the present SAP default efficiencies for both with and without a boiler, of 65% (63% if not HETAS approved).

3.2 Independent boilers (manual and auto feed)

HETAS solid fuel minimum efficiencies used to include case loss as a heat gain to the dwelling. In SAP, for other fuels the efficiency values disregard case loss heat gain. It was therefore decided that there should be two values in SAP for independent solid fuel boilers (manual and auto feed), the HETAS value if it was located in a heated space, and a 5 percentage point reduction applied if it was located in an unheated space.

Since then, HETAS has adopted ENs instead of BSs, and the case losses are now excluded from the efficiency values. The values remained the same, so the effect was to improve the minimum performance required.

To make the solid fuel efficiency values consistent with other fuels, it is proposed that the heat gain from the case loss is disregarded (as in the HETAS minimum efficiencies).

It is proposed that for independent boiler systems (manual and auto feed), the efficiency values for an unheated space be deleted. The values for a heated space would be retained:

- ***Manual feed boiler: 65% (60% if not HETAS approved³)***
- ***Auto (gravity) feed boiler: 70% (65% if not HETAS approved¹)***

The deleted values for independent boilers in an unheated space are 60% (55% if not HETAS approved¹) for a manual feed boiler and 65% (60% if not HETAS approved¹) for an auto feed boiler.

³ See previous section for explanation of 'if not HETAS approved'

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4. COMPARISON OF SAP WITH OTHER SOURCES

Table 1. ROOM HEATERS

SAP Table 4a	HETAS & DBSCG	MCS
Open fire in grate 37 (32)% ⁴	Simple open fire (radiation only) 37%	-
Open fire with back boiler (no radiators) 50 (50)% ²	Open fire with domestic hot water boiler 50%	-
Closed room heater 65 (60)% ²	Roomheater without boiler 65%	Using biofuel As DBSCG
Closed room heater with boiler (no radiators) 67 (65)% ²	Roomheater with boiler 67%	Using biofuel As DBSCG
Stove (pellet fired) 65 (63)% ² [proposed: 70 (65)%²]	Pellet Fired Stoves without boiler 70% nominal load 65% part load	75% full load 70% part load
Stove (pellet fired) with boiler (no radiators) 65 (63)% ² [proposed: 75 (70)%²]	Pellet Fired Stoves with boiler 75% nominal load 70% part load	75% full load 70% part load

The SAP 'HETAS approved' efficiencies in Table 1 are broadly consistent with HETAS/DBSCG, and the MCS minimum values. For existing dwellings with other, older appliances, slightly lower efficiency values in brackets are attributed in most cases.

New SAP efficiencies for wood pellet stoves have been proposed as described earlier.

⁴ The two values are: HETAS approved appliances (Other appliances)

There are some additional categories in the HETAS and DBSCG lists that are not in Table 4a of the SAP document; these are listed in Table 2. This is provided for information, and we are making no proposals to add these to SAP.

Table 2. ROOM HEATERS; ADDITIONAL HETAS/DBSCG CATEGORIES

SAP	HETAS & DBSCG	MCS
-	Open fire freestanding convector 47%	-
-	Open fire inset convector 45% mineral fuel 43% wood	-
-	Open fire with high output boiler – trapezium or rectangular grate 63%	-
-	Slow heat release appliances 65%	Using biofuel As DBSCG
-	One-off tiled/mortared stoves 70%	Using biofuel As DBSCG

Open fire convector is an open fire unit with a second surrounding wall, so that air between the walls is heated and released into the room as convected heat. These may be 'freestanding', i.e. not set into the wall, or 'inset' i.e. set into an opening in the wall.

Open fire with high output boiler is an open fire unit where the brick fireback is replaced by a boiler; this is now commonly known as a 'high output boiler'

Slow heat release appliance is a closed room heater incorporating heat storage material in the flue directly above the stove, releasing heat after the fire has died down.

One-off tiled/mortared stove is a specialist construction with a tile covering.

Table 3. INDEPENDENT BOILER SYSTEMS WITH RADIATORS OR UNDERFLOOR

SAP Table 4a	HETAS & DBSCG	MCS
Manual feed boiler in heated space 65 (60)% ⁵	Hand Fired Batch Fed 65% mineral fuel 75% logs	Using biofuel 75% full load 70% part load
Manual feed boiler in unheated space 60 (55)% ³ [proposed: delete category]	Same as above	Using biofuel 75% full load 70% part load
Auto (gravity) feed boiler in heated space 70 (65)% ³	Gravity Feed up to 20.5kW – 70% above 20.5kW – 75%	Using biofuel 75% full load 70% part load
Auto (gravity) feed boiler in unheated space 65 (60)% ³ [proposed: delete category]	Same as above	Using biofuel 75% full load 70% part load
Wood chip/pellet boiler 65 (63)% ³ [proposed: 75 (70)%³]	Automatic Feed fired by wood pellets/chips 75% nominal load 70% part load	Using biofuel 75% full load 70% part load

Deletion of the ‘unheated space’ categories in SAP has been proposed as described earlier. HETAS and DCBSG make no such distinction between location in a ‘heated’ and ‘non-heated’ space.

SAP efficiencies are in general similar to the minimums specified in HETAS and DBSCG, matching mineral fuel for a manual feed boiler and ‘up to 20.5kW’ category for an auto gravity feed boiler.

⁵ The two values are: HETAS approved appliances (Other appliances)

Table 4. ROOMHEATERS WITH BOILERS TO RADIATORS OR UNDERFLOOR

SAP Table 4a	HETAS & DBSCG	MCS
Open fire with back boiler to radiators 63 (55)% ⁶	Open fire with domestic hot water boiler (same as Table 1, row 2) 50%	-
Closed roomheater with boiler to radiators 67 (65)% ⁴	Roomheater with boiler (same as Table 1, row 4) 67%	Using biofuel As DBSCG
Stove (pellet-fired) with boiler to radiators 65 (63)% ⁴ [proposed: 75 (70)%⁴]	Pellet Fired Stoves with boiler (same as Table 1, row 6) 75% nominal load 70% part load	75% full load 70% part load
Range cooker boiler; integral oven and boiler 50 (45)% ⁴	Cooker with integral oven and boiler exceeding 3.5kW 65% mineral fuel 60% logs	-
Range cooker boiler; independent oven and boiler 60 (55)% ⁴		-
	Cooker without boiler or with boiler not exceeding 3.5kW 65% mineral fuel 55% wood logs	-

SAP makes a distinction and lists the efficiencies separately for.

- room heaters with a boiler but no radiators (see Table 1, rows 2, 4, 6)
- room heaters with a boiler to radiators (see Table 4, rows 1, 2, 3))

⁶ The two values are: HETAS approved appliances (Other appliances)

However, although listed separately they are attributed the same SAP efficiencies, except in the case of an open fire with boiler (compare Table 1 row 2 and Table 4 row 1).

HETAS and DBSCG minimum efficiencies make no distinction between those that do and do not supply radiators, so Table 1 values in rows 2, 4, 6 are repeated in Table 4.

5. CONCLUSION

SAP default efficiencies are broadly consistent with those stated as minimum values in HETAS, the Domestic Building Services Compliance Guide, and the Microgeneration Certification Scheme, though they differ in detail. This is not surprising since they have been developed for a variety of purposes, and at different times.

Some revisions to SAP efficiency values have been proposed, firstly for pellet fired stoves and boilers, in the light of recent HETAS revisions and SAP test results. Secondly for independent boilers, removing the distinction of being in a 'heated space' or 'unheated space', again in the light of recent HETAS revisions.

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