

TECHNICAL PAPERS SUPPORTING SAP 2012



Default values of Seasonal  
Performance Factor for heat  
pumps

Reference no.	STP11/HP01
Date last amended	7 November 2011
Date originated	20 October 2011
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## Summary

This paper considers and reviews the generic heat pump performance values, tabulated in SAP Table 4a, that have been used to inform SAP assessments. This review was considered to be necessary because:

- provision for the use of measured heat pump performance data was introduced in SAP 2009;
- measured data has now become available through the Appendix Q procedure route; and
- information is now available on the installed performance as observed in the recent Energy Saving Trust field trials.

Given the above there is a need to redefine the basis of the generic heat pump performance values used in SAP assessments from typical values to default values where measured data has not been made available.

The current generic values, which represent expected typical performance, for electric heat pumps are:

<i>Heat pump</i>	<i>efficiency %</i>
Ground-to-water heat pump (electric)	320
Ground-to-water heat pump with auxiliary heater (electric)	300
Water-to-water heat pump (electric)	300
Air-to-water heat pump (electric)	250

In moving from typical values to default values examination of performance data on heat pumps obtained in the EST field trials, assuming the lowest recorded values are discounted as being unreliable, would suggest that the following efficiency values would be more appropriate for Table 4a:

Ground source heat pump: 230%;

Air source heat pump: 230%

These values apply for heat pumps supplying underfloor heating. A factor of 0.7 is applied when the heat pump supplies radiators.

## 1 Treatment of heat pumps by SAP

SAP calculations involving a heat pump access performance data from:

- measured values for specific heat pumps, where this data has been made available, or
- tabulated values which are used when specific measured data are not available.

The tabulated values (SAP Table 4a) are given for underfloor heating and Table 4c gives an adjustment factor of 0.7 for radiators and for water heating. The resultant tabulated system efficiency figures are:

Ground source heat pump supplying underfloor heating: 3.2 (320%)

Ground source heat pump supplying radiators: 2.24 (224%)

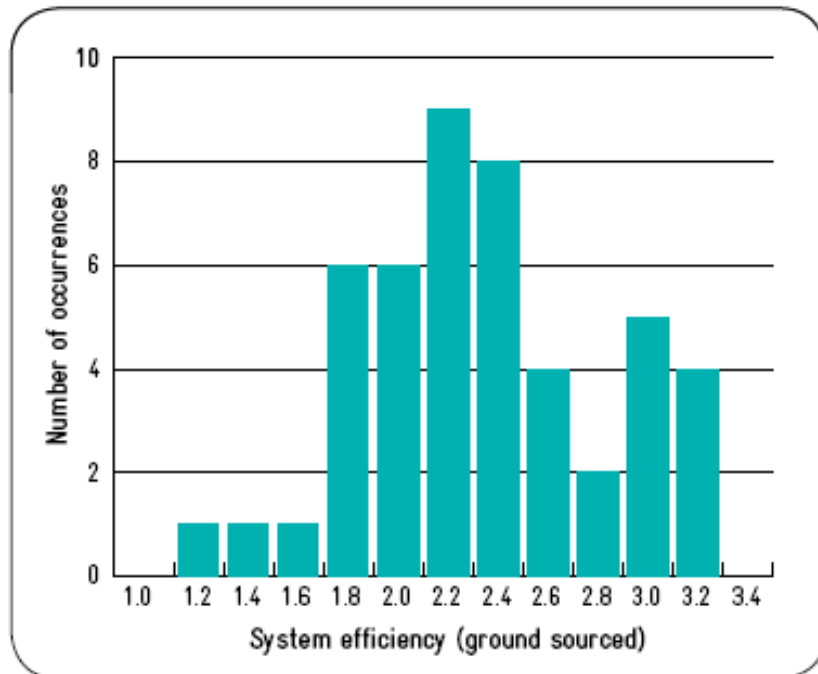
Air source heat pump supplying underfloor heating: 2.5 (250%)

Air source heat pump supplying radiators: 1.75 (175%)

## 2 EST field trials

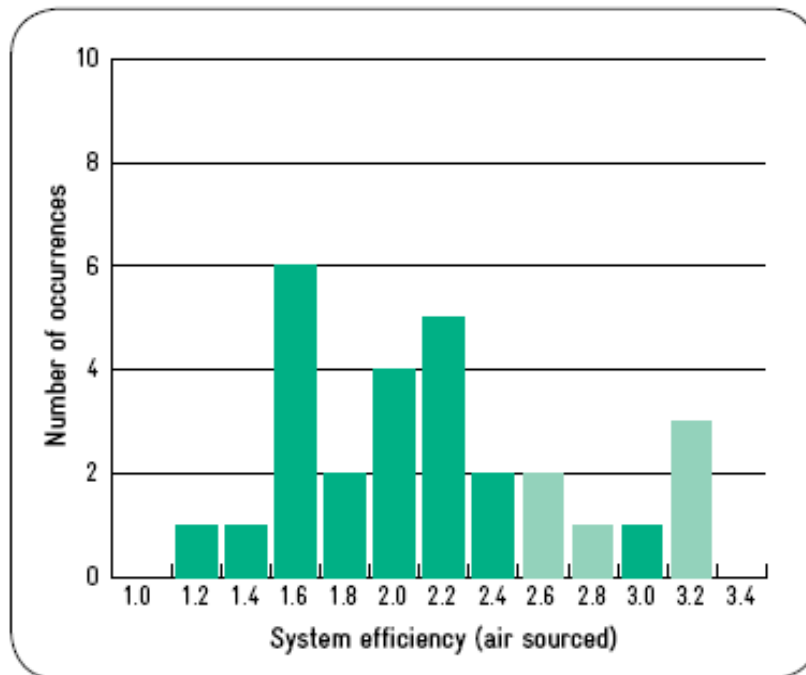
EST are conducting field trials to determine the as installed performance of heat pumps in dwellings. This work is continuing, so the final results report is not yet available. Nonetheless, the interim results from the first year's monitoring, which have been published<sup>1</sup>, suggested there was a need to review the tabulated values within the current SAP review, so potential amendments can be consulted upon.

The distributions of system efficiencies for ground source and air source heat pumps are shown in Figures 1 and 2 respectively. For air source heat pumps the results include estimated (rather than measured) values; these are shown in a lighter colour in Figure 2.



**Figure 1 : Distribution of measured system efficiencies for ground source heat pumps (from ref. 1)**

<sup>1</sup> Getting warmer: a field trial of heat pumps, Energy Saving Trust, September 2010



**Figure 2 : Distribution of measured system efficiencies for air source heat pumps (from ref. 1)**

The average system efficiency from these data is 2.33 for ground source and 2.15 for air source.

Some were supplying underfloor heating and some radiators but which applied to each result is not identified in ref. 1. Some may have included controls or control features that are given additional credit in Table 4e of SAP.

Some of the values are very low, which may be due to installation issues and/or operational issues<sup>2</sup>. If the lowest two of each type are discounted, the average system efficiencies are 2.44 for ground source and 2.22 for air source. This suggests that performance in practice is on average a little lower than the current SAP defaults for ground source (average over emitters is  $(3.2 + 2.24)/2 = 2.72$ ) and similar to the current SAP defaults for air source (average over emitters is  $(2.5 + 1.75)/2 = 2.13$ ).

<sup>2</sup> The results of the field trial informed the revision of the heat pump installation standard MIS 3005 Issue 3.0 (05/09/2001). Also a heat emitter guide for heat pumps has been published recently: MIS 3005 Supplementary Information 2, Heat emitter guide for heat pumps, MCS, September 2011.

### 3 Typical and Default values

The values in SAP 2009 Table 4a are *typical* values, intended to represent likely average performance; as based on discussions with the industry. Average performance is appropriate in the absence of using measured data since that helps to minimise potential errors in any particular instance.

However when the possibility to provide measured data is available the rationale for providing and using average performance values is removed. The logical step is to replace these values with *default* values, where the default values represent the likely minimum performance that can be expected. Otherwise, poor performing heat pumps can hide behind and benefit from overly generous typical values. Default values are over-ridden by measured data whenever possible.

## 4 Potential Default Values

As indicated by the distribution of values in Figures 1 and 2, the minimum performance recorded is appreciably less than the average performance values currently tabulated in Table 4a. So the continued use of these values as inputs to SAP is not appropriate and alternative performance values are needed.

There are a number of options for considering the basis of the default values, but two are considered below: a) minimum recorded performance, where it is assumed that all results were reliable and b) the minimum performance where the lowest values are discounted as not being representative.

In considering likely default values it is necessary to take account of heat emitters, radiator or underfloor, that were installed, as SAP assumes that system efficiencies differ by 0.7.

The minimum recorded performance, assuming all results are reliable, would suggest default values of:

Ground source heat pump supplying underfloor heating: 1.7

Ground source heat pump supplying radiators: 1.2

Air source heat pump supplying underfloor heating: 1.7

Air source heat pump supplying radiators: 1.2

Some of the performance values recorded are very low and there may have been particular issues with those installations. The minimum recorded performance discounting the two lowest ones as unrepresentative would suggest values of:

Ground source heat pump supplying underfloor heating: 2.3

Ground source heat pump supplying radiators: 1.6

Air source heat pump supplying underfloor heating: 2.3

Air source heat pump supplying radiators: 1.6

Further analysis of the trials data, including an allowance for heating of domestic hot water, and whether it is necessary to introduce 'in-use' factors to account for installation related issues, may be undertaken before the next edition of the SAP is published, expected in the second quarter 2012, providing the final field trials report becomes available. It will also be necessary to take account of any regulations made under the Energy-related Products Directive.