Heat Pump Test Data Requirements and Declaration for inclusion in the SAP Product Characteristics Database (PCDB) and Appendix Q Database

This document provides guidance to the applicant on the requirements and procedures for listing a heat pump product on the SAP Product Characteristics Database (PCDB) and Appendix Q Database. The data submitted is used to generate Seasonal Performance Factors (SPFs) at a range of Plant Size Ratios (PSRs) to be held on the PCDB and Appendix Q database.

For the purposes of product listing on the SAP Product Characteristics Database (PCDB) and Appendix Q Database:

- An MCS Certification Body shall be defined as 'a body accredited by UKAS to carry out Heat Pump Product Certification under the Microgeneration Certification Scheme (MSC)'. Details of suitable MCS Certification bodies can be found on the MCS web site (www.microgenerationcertification.org).
- An Accredited Test Laboratory shall be defined as 'a test laboratory accredited for the applicable testing by UKAS or an equivalent accreditation body'.
- All forms and reports must be submitted in English

Contact Details

All submissions should be made to:

sapproductlisting@bre.co.uk

1. Heat Pump Source and Service Provision

There are six categories of heat pumps defined in SAP[1] with reference to the heat source. The applicant must select the appropriate category to identify their heat pump product from the list below:

a) Ground (brine to water)
b) Water (water to water)
c) Air (air to water)
d) Exhaust Air MEV (air to water)
e) Exhaust Air MVHR (air to air or air to water)
f) Exhaust Air Mixed (air to water)

[1] Category definitions can be found in Appendix A

The Service Provision categories for the above are:

i. Space and hot water all year
ii. Space and hot water in heating season only
iii. Space heating only
iv. Water heating only

Note: The applicant must also indicate on the 'Declaration by Heat Pump Manufacturer' form (below) whether the heat pump provides 'space heating' or 'space heating and cooling'.

2. Hot Water Vessel and Synchronised Control of Domestic Hot Water heating

The applicant must define the hot water storage vessel category for the heat pump according to the following table:

Description of hot water vessel	**HW Vessel Category**
Integral hot water store	1
Separate cylinder whose minimum characteristics are specified in the SAP Product Characteristics Database (PCDB)[2] (2)	2
Separate cylinder, characteristics not specified	3
None (heat pump service provision category iii)	4

[2] For SAP 2005, heat pump listings are held within the SAP Appendix Q database.

HW Vessel Category 1

The following data must be provided for the hot water storage vessel:

- Volume of hot water vessel (litres)
- Heat transfer area of heat exchanger within hot water vessel (m^2)
- Standing heat loss (kWh/day) measured according to BS 1566-1:2002

HW Vessel Category 2

The following storage vessel specifications must be provided for the hot water storage vessel:

- Minimum volume of hot water vessel (litres) within the range of manufacturer specified vessels
- Minimum heat transfer area of heat exchanger within hot water vessel (m^2) within the range of manufacturer specified vessels
- Maximum standing heat loss (kWh/day) within the range of manufacturer specified vessels

If multiple storage vessel types are sold with the heat pump, the minimum specification must apply to all storage vessel types. For example, if a heat pump is sold with either a 150L vessel with $2m^2$ heat exchanger area and 1.5 kWh/day heat loss or a 250L vessel with $3m^2$ area and 2.5 kWh/day heat loss, the minimum specification would be 150L, $2m^2$, 2.5 kWh/day.

For hot water vessel categories 1, 2 and 3, the functionality of hot water controls for the heat pump must be defined. One of two options must be selected (see Appendix A for definitions):

1. Synchronized Controls
2. Unsynchronized Controls

Hot water provision for heat pump packages with unsynchronized controls will be assumed to be provided solely by the supplementary system, e.g. a direct electric immersion heater.

3. Test Data Requirements

3.1 Space Heating

Table 1 below shows the mandatory test conditions (in red) for which data must be provided for a product. Test data at a minimum of two sink temperatures is required for all water based sink systems that are not restricted to applications requiring a maximum sink temperature of 35°C. The choice of either 45°C or 55°C as the second sink temperature will depend on the intended applications. If a heat pump is to be specified with a heat emitter requiring a sink temperature of 55°C, test data must be must be supplied at 55°C. Additional data may optionally be provided by the manufacturer at the other test conditions in Table 1.[3] The above data must be submitted in a report as detailed in Clauses 4.5 and 6 of EN14511-3:2011.

For heat pumps that use exhaust air for part or all of the heat source, the above tests shall be carried out at the manufacturer's claimed minimum exhaust airflow rate and nominal exhaust airflow rate. If a heat pump also supplies air, the supply and extract airflow rates must be the same. Test data at the maximum airflow rate may also be supplied. For these heat pumps it is recommended that it is also included in the PCBD as a mechanical ventilation system; if not the default data in SAP Table 4g will be used.

If variations in performance at part load for inverter speed controlled products are to be considered, part load data at 50% duty, obtained at the minimum test data points detailed in Table 1 and undertaken in accordance with EN14825:2012, must be provided. If the heat pump's performance improves at part load, it is recommended that this data is available, as it may result in improved SPF results. Unless additional part-load test data is provided the Plant Size Ratio (PSR) is limited within a range of 0.2 – 2.0 and is defined as:

$PSR = Q_{hp} / (q_{loss} \times 24.2°C)$

- Q_{hp} – Heat pump power output (kW)
- q_{loss} – Heat loss coefficient (W/K) [from SAP]
- 24.2°C is the whole house inside/outside temperature difference under design conditions (i.e 19.2 – -5)

[3] It is recommended that the optional data is provided; if it is not, interpolation and extrapolation algorithms will be applied to the submitted data to produce a full data set, which the EN15316 model requires. These algorithms produce conservative figures that may be lower than the true performance of the heat pump.

3.2 Domestic hot water

If the heat pump is to provide domestic hot water, two options are available for provision of test data.

a) i) For hot water vessel categories 1, 2 and 3:

Test results in accordance with the requirements of EN14511-3:2011 at a flow temperature of 65°C or the maximum attainable sink flow temperature. If the maximum is less than 65°C it shall be submitted and included in the test report described in §3.1. The test(s) must be undertaken as an Application Test, as defined in EN14511:2007 for uncertainties of measurement, permissible deviations, etc. and reported as such. This data will be used to determine the maximum achievable hot water storage vessel temperature. If the hot water vessel is category 1 or 2, then the three defining parameters listed in §2 must be included in the 'Declaration by Heat Pump Manufacturer' form. If the hot water vessel is category 3 the vessel used for the test shall be undertaken with a BS1566-1:2002 indirect hot water storage vessel type 7G, 117+3 litres.

ii) For Service Provision Category iv. (water heating only) and Hot Water Vessel Category 1 (integral hot water store):

A test should be undertaken with the source at the Standard Rating test condition as defined in EN14511-2:2007. For the purpose of this test, the sink inlet should be considered as the hot water storage vessel cold water inlet, and the sink outlet as the hot water storage vessel hot water outlet.

The water flow rate through the hot water storage vessel should be set to achieve an inlet temperature of 55°C and an outlet temperature of 60°C. If an outlet temperature of 60°C cannot be achieved, the flow rate shall be adjusted to achieve 5°C between the inlet and maximum outlet temperature that is achievable.

The Standby Power Input, defined in EN16147:2011, Clause 6.4, should be obtained to allow hot water storage vessel losses to be accounted for in this test.

Test results for this test shall be submitted and included in the test report described in §3.1. The three defining hot water storage vessel parameters listed in §2 must be included in the 'Declaration by Heat Pump Manufacturer' form in the case of hot water vessel categories 1 and 2.

Note. The Coefficient of Performance for hot water provision for SAP is calculated as:

$$CoP_t = \frac{P_H}{P_E - P_{es}}$$

where;

P_H is the heating capacity
P_E is the effective power input
P_{es} is the standby effective power input.

b) For SAP 2012 onwards, EN16147:2011 will be implemented as the principal means to provide test data for the purposes of calculating SAP hot water provision performance for all categories of heat pumps. Test data to EN16147:2011, using tapping cycle M, and optionally also using tapping cycle L, shall be provided in a report as detailed in Clause 7 of EN 16147.

- If the hot water storage vessel is category 1, then the testing is undertaken with the integral hot water storage vessel, and the three defining parameters listed in §2 must be included in the test report.
- If the hot water storage vessel is category 2, then the testing must be undertaken with the specified hot water storage vessel or the vessel with the greatest standing loss if a range of vessels is specified, and the three defining parameters listed in §2 must be included in the test report.
- If no hot water storage vessel is specified (hot water vessel category 3) then the test must be undertaken with a BS1566-1:2002 indirect hot water storage vessel type 7G, 117+3 litres.

An alternative hot water storage vessel to the one which was originally specified (and, where applicable, with which the heat pump was tested) may be specified for an installation, provided its parameters are equivalent or better than the hot water storage vessel originally specified. This is understood as a hot water storage vessel with equal or larger working volume (litres), equal or greater heat exchanger surface area (m^2), and equal or smaller standing heat loss (kWh/day).

4. In-use factors

In-use factors are applied to the space and water heating efficiencies within the SAP calculation. Their values are given in the current SAP specification and are subject to amendment as more evidence is gathered on the in-use performance of heat pumps. Note: The in-use factor for hot water efficiency is much lower (worse) in the following cases:

- Hot Water Vessel Category 2 and the vessel specified for the SAP calculation does not conform to the specified criteria;
- Hot Water Vessel Category 3.

5. Submission Procedure

Data can be submitted via the following submission routes:

1. Test Data from an Accredited Test Laboratory - the required test reports, as defined in §6, should be submitted directly to BRE (see details above).

2. Test data from unaccredited test laboratories (including manufacturers test facilities) assessed by a Microgeneration Certification Scheme (MCS) Certification Body. In this case the heat pump to be listed must also be MCS certified to standard *'MCS 007 - Product Certification Scheme Requirements - Heat Pumps – Version 2.1'* (or any subsequent revision).

   The unaccredited test laboratory which undertook the testing described in §3.1 and §3.2 must have been assessed by an MCS Certification Body and found capable of conducting heat pump testing which cover all test points within the test data to be submitted. The assessment must be in accordance with Microgeneration Certification Scheme Standard: *'MCS 011 – Product Certification Scheme Requirements: Acceptance Criteria for Testing Required for Product Certification, Issue 1.5'* (or any subsequent revision). The heat pump manufacturer must inform the MCS Certification Body when it intends to undertake testing for SAP test data submission for each subsequent product. The manufacturer must provide the MCS Certification Body with sufficient notice to allow mutually convenient dates to be agreed if the MCS Certification Body wishes to witness the tests. Evidence of satisfactory compliance with the standard must be provided with any SAP listing submission.

   Test reports from unaccredited laboratories assessed by an MCS Certification Body and **not** deemed capable of conducting heat pump testing in accordance with the requirements of this document will **not** be accepted

3. Test data from unaccredited test laboratories (including manufacturers test facilities) and **not** assessed by an MCS Certification Body will **not** be accepted.

6. Submission Requirements

In order for a product to be listed in the SAP Product Characterisitics Database (PCDB), the following should be submitted to BRE (see details above).

a) Completed 'Declaration by Heat Pump Manufacturer' form (attached), this must include additional information to support the specification (if applicable) of:
   i. Synchronised Controls for DHW heating (See Appendix A)
   ii. Weather Compensation for space heating (See Appendix A)

b) Where the heat pump provides space heating
   i. Test data to EN14511-3:2011 contained in a report as detailed in Clauses 4.5 as appropriate and Clause 6.
   ii. For part load operation, test data to EN14825:2012 contained in a report as detailed in Clause 10, and Clause 6 of EN14511-3:2011

c) Where the heat pump supplies hot water, one of the following:
   i. Test data to EN16147:2011 in a report containing the details set out in Clause 7.
   ii. Test data to EN14511-3:2011 at a flow temperature of 65°C or the maximum sink flow temperature, if this is less than 65°C, contained in a report as detailed in Clause 4.5 as appropriate, and Clause 6.
   iii. For Service Provision category iv. water heating only - heat pump with an integral hot water storage vessel; test data to EN14511-3:2011 at a flow temperature of 60°C or the maximum sink flow temperature, if this is less than 60°C,and the Standby Power Input, defined in EN16147:2011, Clause 6.4.

d) An electronic example of the product label (NCM (SAP) Identifier) for the heat pump unit. The label must contain the following information:
   i. Brand Name
   ii. Model Name
   iii. Model Qualifier (optional)

   The above combination of Brand Name, Model Name, and Model Qualifier must be unique to the heat pump, see '*Terms and Conditions applicable to the listing of individual branded product performance data as an input to the National Calculation Methodologies for dwellings'.*

   .

Table 1. Minimum test data points

HP type	Emitter Type	Test conditions set out in EN14511							
		Lowest source temp ←				→ Highest source temp		Hot water application	
		Sink	Source	Sink	Source	Sink	Source	Sink	Source
Air to Water (Source -ambient air only)	UFH	35/a	-7/-8	35/a	2/1	35/30	7/6	65°C or the maximum sink flow temperature, if this is less than 65°C	7/6
	Convector	45/a	-7/-8	45/a	2/1	45/a	7/6		
	Radiator	55/a	-7/-8	55/a	2/1	55/a	7/6		
Air to Water (Source - exhaust air only)	UFH	35/a	20/12						20/12
	Convector	45/40	20/12						
	Radiator	55/a	20/12						
Ground water to water	UFH	35/30	10/7	35/a	15/a				10/7
	Convector	45/a	10/a	45/a	15/a				
	Radiator	55/a	10/a	55/a	15/a				
Brine (ground loop) to water	UFH	35/30	0/-3	35/a	5/a	35/a	10/a		0/-3
	Convector	45/a	0/a	45/a	5/a	45/a	10/a		
	Radiator	55/a	0/a	55/a	5/a	55/a	10/a		

a - test performed at the flow rate obtained during the corresponding standard rating condition
Water and brine test conditions given as 'flow temp/return temp' both in °C
Air test conditions given as 'dry bulb temp/wet bulb temp' both in °C
Red text – Minimum number of test condition for SAP listing
Blue text – Optional test points. Test point at high sink temperature, 55°C, must be provided if heat emitters requiring a flow temperature 55°C are to be served.
Black text – optional test conditions

H/P type	Emitter Type	Proposed test conditions for heat pump types not defined in EN14511							
		Lowest source temp ⟷ Highest source temp						Hot water application	
		Sink	Source	Sink	Source	Sink	Source	Sink	Source
Air to Water (Exhaust and ambient air)	UFH	35/a	2/1	35/30	7/6	35/a	20/12	65°C or the maximum sink flow temperature, if this is less than 65°C	7/6
	Convector	45/a	2/1	45/a	7/6	45/a	20/12		
	Radiator	55/a	2/1	55/a	7/6	55/a	20/12		
Air to Air (Source - exhaust air only)	Supply air	-7/-8	20/12	2/1	20/12	7/6	20/12	Air sink: 7/6°C Water sink: 60°C or the maximum hot water flow temperature, if this is less than 60°C	20/12

a - test performed at the flow rate obtained during the corresponding standard rating condition
Water and brine test conditions given as 'flow temp/return temp' both in °C
Air test conditions given as 'dry bulb temp/wet bulb temp' both in °C
Red text – Minimum test points for SAP listing
Blue text – Optional test points. Test point at high sink temperature, 55°C, must be provided if heat emitters requiring a flow temperature 55°C are to be served.
Black text – optional test condition

Appendix A: Definitions

Heat pump
An encased assembly or assemblies designed to act as a unit to provide heat. It includes an electrically operated refrigeration system for heating.

Outside air
Air from the outside environment entering the outdoor heat exchanger

Exhaust air
Air from the conditioned space entering the outdoor heat exchanger

Outdoor (supply) air
Air from the outdoor environment entering the indoor heat exchanger

Synchronised Controls for DHW heating

The primary operation of the supplementary heater (electric immersion) is controlled by the heat pump controller. This ensures that the timing of supplementary heating is coordinated with the heat pump to prevent unnecessary operation of the supplementary heater. Local occupant control to provide additional boosting may be provided, but this should automatically reset once the required hot water temperature is achieved in the cylinder, requiring further manual intervention for any subsequent boosting.

> **Information required**
> Manufacturers shall supply a full installation and commissioning manual including details of how the synchronised control of the supplementary heater is to be set. The manual must provide full details of any manual override functions for boosting hot water, and the method employed to ensure that it is not left in this mode inadvertently.

Weather Compensation for space heating
A control algorithm which varies the heat pump water flow temperature for space heating with the outdoor air temperature.

> **Information required**
> If weather compensation is included in the heat pump controller, and the default is for this function to be enabled, this will be accounted for in the calculation of space heating SPF.
> Manufacturers must provide details of the compensation curve for a range of system flow temperatures (i.e. 35, 45 and 55°C) applicable for the heat pump.
> If details of the curves are not provided, weather compensation will be deemed not to be default and will not be included in the calculation of heating system SPF.

Heat Pump Source

1. **Ground Source Heat Pump**
   A heat pump designed to transfer heat from the ground to a water-based heating system. Heat is extracted from the ground using closed loop pipes buried in the ground. A fluid of water and antifreeze (brine) is circulated in the closed loop. The heat may be used for provision of space heating only, domestic hot water only, or both.

2. **Water Source Heat Pump**
   2.1. Surface water
   A heat pump designed to transfer heat from surface groundwater to a water-based heating system. Heat is extracted from the surface water via pumping groundwater into the evaporator or using closed loop pipes in the water. The heat may be used for provision of space heating only, domestic hot water only, or both.
   2.2. Ground water
   A heat pump designed to transfer heat from below surface groundwater to a water-based heating system. Heat is extracted from the ground via pumping water from below ground level into the evaporator. The heat may be used for provision of space heating only, domestic hot water only, or both.

3. **Air Source Heat Pump (air to water)**
   A heat pump designed to transfer heat from the outside air to a water-based heating system. The heat may be used for provision of space heating only, domestic hot water only, or both.

4. **Exhaust Air Source Heat Pump with Whole House Mechanical Extract Ventilation – Exhaust air only (air to water)**
   A heat pump designed to transfer heat from the exhaust air to a water-based heating system. The heat may be used for provision of space heating only, domestic hot water only, or both.

5. **Exhaust Air-Source Heat Pump with Whole House Balanced Mechanical Ventilation with Heat Recovery (air to air or air to water)**
   A heat pump designed to transfer heat from the exhaust air to the outdoor (supply) air. These heat pumps may also transfer heat from the exhaust air to a water-based heating system. The heat transferred to the water based heating system may be used for provision of space heating only, domestic hot water only, or both.

6. **Exhaust Air Source Heat Pump with Whole House Mechanical Extract Ventilation – Exhaust air plus mixed ambient air (air to water)**
   A heat pump designed to transfer heat from a mixed air stream of exhaust air and outside air to a water-based heating system. The heat may be used for provision of space heating only, domestic hot water only, or both.

DECLARATION BY HEAT PUMP MANUFACTURER

(A) Current Manufacturer and Contact Details

Name .....

Full Address (incl Post Code) .....

…… .....

Telephone.....

Website.....

(B) NCM (SAP) Identifier details for identifying the product within the SAP Product Characteristics Database and Appendix Q database

The company agrees to affix a permanent label to uniquely identify the product. This should be placed where it is visible for the SAP Assessor without the need for dismantling the product or any adjacent systems. The position of the label must be notified and this information made available to SAP Assessors[4].

Brand name.....

Model name.....

Model qualifier (optional).....

Original manufacturer (if different from current) .....

First Year of Manufacture .....

Last Year of Manufacture (if discontinued).....

***An example of the permanent label(s) must be affixed on page 5**

(C) Product name used in tests

Name of the same product as shown on the test report

Product name .....

Test report reference .....

[4] Refer to '*Terms and Conditions applicable to the listing of individual branded product performance data as an input to the National Calculation Methodologies for dwellings*'

DECLARATION BY HEAT PUMP MANUFACTURER

(D) Source of test data

The product testing has been undertaken *(tick one box only)*:

D1. by an Accredited Test Laboratory ..... ☐

D2. by an unaccredited test laboratory ..... ☐

D3. at the manufacturer's test facilities ..... ☐

Heat pump certified under MCS? (mandatory for D2 or D3) ..... ☐

Has an MCS Certificate (*MCS 007, Version 2.1 or later) been supplied?* …….. …….Yes/No

If D2 or D3 – Is evidence supplied of satisfactory compliance with the Microgeneration Certification Scheme Standard: *'MCS 011 – Product Certification Scheme Requirements: Acceptance Criteria for Testing Required for Product Certification, Issue 1.5'* (or any subsequent revision) …….. ..Yes/No

(E) Category *(tick one box only)*

The product conforms to the category definition of:

E1. Air-source heat pump (air to water) ..... ☐

E2. Ground-source heat pump *(brine to water)* ..... ☐

E3. Water-source heat pump – Surface Water *(water to water)* ..... ☐

E4. Water-source heat pump – Ground Water *(water to water)* ..... ☐

E5. Exhaust air-source heat pump with whole house mechanical extract ventilation - exhaust air only *(air to water)* ..... ☐

E6. Exhaust air-source heat pump with whole house mechanical extract ventilation - exhaust air plus mixed ambient air *(air to water)* ..... ☐

E7. Exhaust air-source heat pump with whole house mechanical ventilation with heat recovery *(air to air)* ..... ☐

E8. Exhaust air-source heat pump with whole house mechanical ventilation with heat recovery *(air to water)* ..... ☐

DECLARATION BY HEAT PUMP MANUFACTURER

For exhaust air heat pumps *(tick one box only)*

The mechanical ventilation system is already in the PCDB	
An application for the mechanical ventilation system performance accompanies this application……	
The default data (SAP Table 4g) is to be used for mechanical ventilation……..	

(Z) Service provision *(tick one box only)*

The product provides:

Z1. Space and water heating all year	
Z2. Space and water heating in heating season only.....	
Z3. Space heating only.....	
Z4. Water heating only	

DECLARATION BY HEAT PUMP MANUFACTURER

(F) Space heating & cooling *(tick one box only)*

The heat pump provides:

F1. heating only	
F2. heating and cooling	
F3. domestic hot water only	

Is a weather compensator integrated within the heat pump controller?
(delete as appropriate)…….…… Yes/No

Have weather compensation curves been supplied as detailed in Appendix A?...Yes/No

(G) Hot water service *(tick one box only)*

The domestic hot water service is:

G1. provided by the heat pump via an integrated storage vessel	
G2. provided by the heat pump via a separate specified storage vessel.	
G3. provided by the heat pump via an unspecified (separate) storage vessel	
G5. not provided by the heat pump	

The domestic hot water service has (*tick one box only*):

Synchronized controls	
Unsynchronized controls	
Heat pump does not provide hot water service	

Have full details of control been supplied as detailed in Appendix A?.....Yes/No

DECLARATION BY HEAT PUMP MANUFACTURER

If G1 has been ticked, the specification for the storage vessel is :

Volume (litres).....	
Surface area of heat exchanger, or heat transfer area, (m^2).....	
Standing heat loss (kWh/day) measured according to BS 1566-1:2002.....	

If G2 has been ticked, the specification for the storage vessel is :

Minimum volume (litres) within the range of manufacturer specified vessels.....	
Minimum surface area of heat exchanger, or heat transfer area, (m^2) within the range of manufacturer specified vessels.....	
Maximum standing heat loss (kWh/day) within the range of manufacturer specified vessels.....	

Example permanent label(s) showing NCM (SAP) Identifier details for identifying the product within the SAP Product Characteristics Database and Appendix Q database. For split-type systems, the applicant agrees to supply product installation and commissioning manuals that incorporate an explanation that the heat pump NCM (SAP) Identifier comprises NCM (SAP) Identifier labels on both ‘indoor’ and ‘outdoor’ units:

Label 1:	Label 2 (only applicable for split-type systems):

DECLARATION BY HEAT PUMP MANUFACTURER

I declare that:

- the product tested, under the product name in section (C), is the same in all material respects as the product to be sold under the marketing name in section (B);

I agree to ensure that:

- While on sale under the marketing name in section (B), also known as the NCM (SAP) Identifier, the product will not undergo any modification or material change affecting its heat output or energy performance;

- If any such modification or material change is introduced the marketing name of the product will be changed and the changed name will not conflict with any marketing name used previously;

- If the product has been classified for hot water service as “provided by the heat pump via a specified and controlled storage vessel” the minimum specification and control requirements for the storage vessel will be included within the heat pump installation instructions and will match those of Section G.

Signature	.....
Name in capitals	.....
Name of company Signed on behalf of	.....
Position[5] in company	.....
Date	.....

[5] *Controlling Director as defined in the Income and Corporation Taxes Act 1988 or Technical Director or person of equivalent seniority*