STANDARDS DOCUMENT

MCS XXX ISSUE 1.0 DRAFT

Air to Air Heat Pump
Pre-sale information and performance calculation

To be used in conjunction with MIS 3005 (D & I)

This Standard was prepared by the MCS Working Group 6 'Heat Pumps'

It is published by The MCS Service Company Ltd on behalf of the MCS Charitable Foundation.

The MCS Service Company Ltd welcomes comments of a technical or editorial nature and these should be sent to *meetings@mcscertified.com*

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ABOUT MCS

Giving you confidence in home-grown energy

With energy costs constantly rising and climate change affecting us all, low-carbon technology has an ever-increasing role to play in the future of UK energy.

We're here to ensure it's a positive one.

Working with industry we define, maintain and improve quality – certifying products and installers so people can have confidence in the low-carbon technology they invest in. From solar and wind, to heat pumps, biomass and battery storage, we want to inspire a new generation of home-grown energy, fit for the needs of every UK home and community.

About

The Microgeneration Certification Scheme Service Company Ltd (MCSSCo Ltd) trades as MCS and is wholly owned by the non-profit MCS Charitable Foundation. Since 2007, MCS has become the recognised Standard for UK products and their installation in the small-scale renewables sector.

We create and maintain standards that allow for the certification of products, installers and their installations. Associated with these standards is the certification scheme, run on behalf of MCS by Certification Bodies who hold UKAS accreditation to ISO 17065.

MCS certifies low-carbon products and installations used to produce electricity and heat from renewable sources. It is a mark of quality. Membership of MCS demonstrates adherence to these recognised industry standards; highlighting quality, competency and compliance.

Vision

To see MCS certified products and installations in every UK home and community.

Mission

To give people confidence in low-carbon energy technology by defining, maintaining and improving quality.

Values

1. We are expert – ensuring quality through robust technical knowledge
2. We are inspiring – helping to reshape energy in UK homes and communities
3. We are collaborative – working with industry and government to create positive change
4. We are principled – operating in a way that's clear, open and fair
5. We are determined – supporting the UK's drive towards a clean energy future

CHANGES TO STANDARDS

When MCS Standards are revised, the issue number is also revised to indicate the nature of the changes. This can either be a whole new issue or an amendment to the current issue. Details will be posted online, www.mcscertified.com

Technical or other significant changes which affect the requirements for the approval or certification of the product or service will result in a new issue. Minor or administrative changes (e.g. corrections of spelling and typographical errors, changes to address and copyright details, the addition of notes for clarification etc.) may be made as amendments.

The issue number is given on the left of the decimal point, and the amendment number on the right. For example, issue 3.2 indicates that it is the third significant version of the document which has had two sets of minor amendments.

Users of this Standard should ensure that they are using the latest issue.

Issue No.	Amendment Details	Date
1.0	First issue.	XX/XX/2025

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1 SCOPE

This Standard describes the method to estimate the amount of renewable energy which might be delivered, along with the electricity consumed, by an air to air heat pump heating system during a typical year. This document is to be used in conjunction with MIS 3005-D: The Heat Pump Standard (Design) and MIS 3005-I: The Heat Pump Standard (Installation). The format in which this shall be presented to the customer is also given along with the technical information to accompany the estimate.

A copy of this calculation shall be retained by the contractor for the minimum period defined within MCS001 and made available for audit.

2 METHOD

2.1 Site Evaluation

Using a valid Energy Performance Certificate (EPC) identify:

(a) The property space heating demand (kWh/year); and

(b) The hot water demand (kWh/year); and

(c) The total property floorspace (m^2).

Notes:

A valid EPC is one which has not expired and where the given annual heat demand is not expected to change such as by, for example, an extension or refurbishment of the building, and where the heat pump is intended to supply that changed heat demand. Where no valid EPC exists on the public register, but it is possible to obtain one through a domestic energy assessment, then an EPC should be obtained and lodged. Neither the annual heat demand of the building nor the annual energy performance of the system are appropriate for sizing the system.

Where it is not possible to obtain a valid EPC refer to Appendix A of MIS 3005-D.

The total property floorspace is given in the EPC and is not the same as property footprint.

(d) Using the property postcode identify (lookup) in Appendix A, Table 1 the appropriate number of degree days and the outdoor low temperature.

(e) Calculate the property specific heat loss ($P_{specific}$) in W/K:

$$P_{specific} = \frac{1000 \times Q}{24 \times D}$$

Where:

- Q is the space heating demand (kWh/year) identified in paragraph (a); and

- D is the degree days per year identified in paragraph (d).

(f) Calculate the total heat loss (P_t) in W:

$$P_t = P_{specific} \times (d_i - d_o)$$

Where:

- $P_{specific}$ is the property specific heat loss as calculated in paragraph (e); and
- d_i is the design inside temperature of 21°C; and
- d_o is the outdoor low temperature identified in paragraph (d). Where this is a negative number then, mathematically, subtracting a negative number becomes addition.

(g) Calculate the specific heat loss in W/m² :

$$W/m^2 = P_t \div \text{Total property floorspace } (m^2)$$

Where:

- P_t is the total heat loss as calculated in paragraph (f).

2.2 Indicative Heat Pump Capacity

Where a room-by-room heat loss has been undertaken to establish the heat pump capacity then this step need not be undertaken.

(h) Estimate the heat pump capacity (in kW):

$$\text{Heat pump capacity} = P_t \div 1000$$

Where:

- P_t is the total heat loss as calculated in paragraph (f).

Notes:

For systems where the heat pump is not supplying 100% of the building's space heating demand, the space heating demand (kWh/year) obtained in paragraph (a) should be reduced by the proportion to be supplied by other heat sources, leaving the remainder to be supplied by the heat pump which should then be used to calculate $P_{specific}$ at paragraph (e), then calculate P_t at paragraph (f) and finally the heat pump capacity at paragraph (h).

The estimate of the heat pump capacity is indicative only and may change following the detailed heat loss assessment and system design.

2.3 Calculating Annual Electricity Consumption

(i) Calculate the annual electricity consumption for the space heating (kWh):

$$\text{Annual electricity consumption (space)} = \frac{Q}{XX}$$

Where:

- Q is the space heating demand (kWh/year) identified in paragraph (a); and
- XX is the estimate seasonal performance factor identified for air to air heat pumps

(j) Calculate the annual electricity consumption for the hot water (kWh):

$$\text{Annual electricity consumption (water)} = \frac{W}{1.9}$$

Where:

- W is the hot water demand (kWh/year) identified in paragraph (b); and
- 1.9 is the performance factor when heating hot water only

(k) Calculate the annual electricity consumption from an immersion heater to regularly pasteurise any hot water storage (kWh):

$$\text{Annual electricity consumption (immersion)} = \frac{F \times Vol \times 10 \times 4{,}200}{3{,}600{,}000}$$

Where:

- F is the frequency of pasteurisation. If pasteurisation can be provided by the heat pump (or not required at all) this can be Zero. Otherwise, this should be either 365 where daily or 52 where weekly
- Vol is the nominal size of the proposed hot water storage cylinder (litres)
- The factor of 10 assumes the immersion is used to raise the cylinder temperature 10ºC from 50ºC to 60ºC.

(l) Calculate the total annual electricity consumption of the proposed system:

Annual electricity consumption (space)
+
Annual electricity consumption (water)
+
Annual electricity consumption (immersion)

(m) Convert the result of paragraph (p) into a high/low (+/- 10%) range:

a. Multiply the total annual electricity consumption by 0.9; and

b. Multiply the total annual electricity consumption by 1.1.

3 PRESENTATION FORMAT

The results of the preceding calculation shall be given to the customer using the format given below along with the Key Information from Section 5.

An air to air Heat Pump System Performance Estimate tool is published on the MCS website which can be used to undertake the calculations given in this Standard and produces an output table in the correct format.

Heat Pump System Performance Estimate		
Your energy requirements		
Energy required for heating		**kWh**
Demand to be supplied by the heat pump		**kWh**
Energy required for hot water		**kWh**
Demand to be supplied by the heat pump		**kWh**
Your property		
Your postcode prefix		
Total property floorspace (not property footprint)		**m²**
Average watts per square metre *Note: W/m² is a measure of your property's thermal efficiency. 0-30W/m² is very low heat loss and 120-150W/m² is very high heat loss.*		**W/m²**
Proposed system		
Heat pump capacity *Note: unless a full heat loss calculation has been undertaken, this figure is indicative only and may change.*		**kW**

Your system is proposed to provide (select one):	Space heat and hot water Space heating only Hot water only
How many indoor units with your proposed heating systems have:	

Performance				
The Seasonal Performance Factor is calculated to be:				
Estimate of energy consumption of the proposed heat pump. *Note: you can convert these figures to approximate running costs.*	**High estimate**		**Low estimate**	
		kWh		**kWh**

Important Note: This is not a detailed system design. It offers a reasonable estimate of likely performance and a description of the likely design.

Details may change after the heat loss survey and design / This estimate is based on a full heat loss survey and design (delete as appropriate).

Applicable warning notes (from Table 2):

4 KEY INFORMATION

The heat demand of a building, and therefore the performance and running costs of heating systems, is difficult to predict with certainty due to the variables discussed here. These variables apply to all types of heating systems, although the efficiency of heat pumps is more sensitive to good system design and installation. For these reasons your estimate is given as guidance only and should not be considered as a guarantee.

Seasonal Performance Factor

Seasonal performance factor (SPF) is a measure of the operating performance of a heating system incorporating an electric heat pump over a season, typically a year. It is the ratio of heat delivered to the total electrical energy consumed by the unit over the same period. As a guide, a heat pump system achieving an SPF of 3 would have delivered 3 kWh of heat energy for every 1 kWh of electrical energy it consumed over a 'standard' annual cycle.

Energy Performance Certificate

An energy performance certificate (EPC) is produced in accordance with a methodology approved by the government. As with all such calculations, it relies on the accuracy of the information input. Some of this information, such as the insulation and air tightness properties of the building may have to be assumed and this can affect the final figures significantly leading to uncertainty especially with irregular or unusual buildings.

Identifying the uncertainties of energy predictions for heating systems

We have identified 3 key types of factor that can affect how much energy a heating system will consume and how much energy it will deliver into a home. These are 'Fixed', 'Variable' and 'Random'. Most factors are common to ALL heating systems regardless of the type (e.g oil, gas, solid fuel, heat pump etc.) although the degree of effect varies between different types of heating system as given in the following table.

The combined effect of these factors on energy consumption and the running costs makes overall predictions difficult however an accuracy $\pm$ 25-30% would not be unreasonable in many instances. Under some conditions even this could be exceeded (e.g. considerable opening of windows). Therefore it is advised that when making choices based on mainly financial criteria (e.g. payback based on capital cost verses net benefits such as fuel savings and financial incentives) this variability is taken into account as it could extend paybacks well beyond the period of any incentives received, intended occupancy, finance agreement etc.

Factor	Impact
'Fixed' which include:	
Equipment selection performance figures (SCoP) from ErP data	System Efficiency
Energy assessment via the EPC (e.g. assumptions as to fabric construction and levels of insulation; the variation in knowledge and experience of Energy Assessors)	Energy Required
'Variable' which are affected by the system design and include:	
Accuracy of sizing of heat pump - i.e. closeness of unit output selection (kW) to demand heat requirement (kW)	System Efficiency
Design space and ambient (external) temperatures	Energy Required
'Random' which cannot be anticipated and include:	
User behaviour:	
• Room temperature settings	Energy Required
• Hot water usage and temperature settings	Energy Required
• Occupancy patterns/times	Energy Required
• Ventilation (i.e. opening windows)	Energy Required
Annual climatic variations (i.e. warmer and colder years than average)	Energy Required

Key:

The statement at the end of each item indicates the major factor affected as follows:

Energy Required: the heat energy output requirement of the system which directly impacts on running costs. This requirement exists regardless of the heating system chosen as it is the heat required to keep the space comfortable. Opening windows or increasing room temperatures will demand more heat output, which means more energy input but this would NOT directly affect the efficiency. Thus increased energy demand does NOT automatically mean reduced efficiency.

System Efficiency: the efficiency of the system has been directly affected and will therefore demand more input energy to achieve the same heat output thus increasing running costs. However, increased energy input does NOT necessarily mean lower system efficiency (see above).

APPENDIX A – LOOKUP DATA

Postcode Index for Degree days and Outdoor Low Temperature								
Post-codes AB-HG	**Low Temps** (°C)	**Degree days**	**Post-codes HP-S**	**Low Temps** (°C)	**Degree days**	**Post-codes SA-ZE**	**Low Temps** (°C)	**Degree days**
AB	-5.4	2668	**HA**	-3	2033	**PO**	-4.8	2224
AL	-3	2033	**HD**	-4.5	2307	**PR**	-4.5	2388
B	-5.1	2425	**HG**	-3.3	2307	**RG**	-4.6	2033
BA	-4.6	1835	**HP**	-3	2033	**RH**	-3	2033
BB	-4.5	2228	**HR**	-5.1	2425	**RM**	-3	2033
BD	-3.3	2307	**HS**	-5.6	1800	**S**	-3.3	2228
BH	-4.8	2224	**HU**	-3.3	2307	**SA**	-3.1	2161
BL	-4.5	2228	**HX**	-4.5	2228	**SE**	-3	2033
BN	-4.8	2224	**IG**	-3	2033	**SG**	-3	2033
BR	-3	2255	**IM**	-4.5	2228	**SK**	-4.5	2228
BS	-3.1	1835	**IP**	-4.6	2254	**SL**	-3	2033
BT	-3.2	2360	**IV**	-5.6	2668	**SM**	-3	2033
CA	-3.7	2388	**JE**	-4.8	1800	**SN**	-4.6	2425
CB	-3	2033	**KA**	-5.6	2494	**SO**	-4.8	2224
CF	-3.1	1835	**KT**	-3	2033	**SP**	-4.8	2224
CH	-4.5	2228	**KW**	-5.4	2668	**SR**	-3.7	2370
CM	-3	2033	**KY**	-5.4	2577	**SS**	-3	2033
CO	-4.6	2254	**L**	-4.5	2228	**ST**	-5.1	2228
CR	-3	2224	**LA**	-4.5	2388	**SW**	-3	2033
CT	-3	2255	**LD**	-3.1	2161	**SY**	-5.1	2161
CV	-5.1	2425	**LE**	-3.9	2425	**TA**	-1.5	1835
CW	-4.5	2228	**LL**	-4.5	2228	**TD**	-5.4	2483
DA	-3	2255	**LN**	-3.9	2307	**TF**	-5.1	2425
DD	-5.4	2577	**LS**	-3.3	2307	**TN**	-3	2255
DE	-3.9	2228	**LU**	-3	2033	**TQ**	-1.5	1858
DG	-5.6	2483	**M**	-4.5	2228	**TR**	-1.5	1858
DH	-3.7	2370	**ME**	-3	2033	**TS**	-3.7	2370
DL	-3.7	2388	**MK**	-4.6	2425	**TW**	-3	2203
DN	-3.3	2307	**ML**	-5.4	2494	**UB**	-3	2203
DT	-4.8	2224	**N**	-3	2033	**W**	-3	2203
DY	-5.1	2425	**NE**	-3.7	2370	**WA**	-4.5	2228
E	-3	2033	**NG**	-3.9	2254	**WC**	-3	2203
EC	-3	2033	**NN**	-3.9	2425	**WD**	-3	2203
EH	-5.4	2577	**NP**	-3.1	2425	**WF**	-3.3	2307
EN	-3	2255	**NR**	-4.6	2254	**WN**	-4.5	2228
EX	-1.5	1858	**NW**	-3	2033	**WR**	-5.1	2425
FK	-5.6	2577	**OL**	-4.5	2228	**WS**	-5.1	2425
FY	-4.5	2388	**OX**	-4.6	2425	**WV**	-5.1	2425
G	-5.6	2494	**PA**	-5.6	2494	**YO**	-3.3	2307
GL	-4.6	2425	**PE**	-4.6	2254	**ZE**	-5.4	2668
GU	-3	2033	**PH**	-5.6	2668			
GY	-4.8	1800	**PL**	-1.5	1858			

Table 1: Postcode Index for degree days and outdoor low temperatures

APPENDIX B – WORKED EXAMPLE

An existing property in rural Wales (postcode CF) has a total space heating demand (taken from a valid EPC) of 15,500kWh/year and hot water demand of 2,900kWh/year. An air to air heat pump is proposed to provide 100% of the space heating and hot water demand.

The calculations would be as follows:

(a) *Space heating demand = 15,500kWh*

(b) *Hot water demand = 2,900kWh*

(c) *Total property floorspace = 145m²*

(d) *Degree days = 1835 and outdoor low temperature -3.1℃*

(e) *Property specific heat loss* $P_{specific}$ =

$$\frac{1000 \times 15{,}500}{24 \times 1{,}835}$$

$$= 352\ \text{W/K}$$

(f) *Total heat loss* P_t =

$$P_{specific} \times (di - do)$$

$$352 \times (21 - -3.1)$$

$$352 \times 24.1$$

$$= 8483\text{W}$$

(g) *Specific heat loss =*

$$P_t \div \text{Total Property Floorspace } (m^2)$$

$$8483 \div 145m^2$$

$$= 59W/m^2$$

(h) *Indicative heat pump capacity =*

$$P_t \div 1000$$

$$8483 \div 1000$$

$$= 8.5kW$$

(i) Annual electricity consumption (space) =

$$\frac{Q}{SPF}$$

$$\frac{15{,}500}{4.1}$$

$$= 3780kWh$$

(j) Annual electricity consumption (water) =

$$\frac{W}{1.9}$$

$$\frac{2,900}{1.9}$$

= 1526kWh

(k) Annual electricity consumption (immersion) for 200L cylinder and weekly pasteurisation =

$$\frac{Vol \times F \times 10 \times 4,200}{3,600,000}$$

$$\frac{200 \times 52 \times 10 \times 4,200}{3,600,000}$$

$$\frac{436800000}{3,600,000}$$

= 121kWh

(l) Calculate the total annual electricity consumption of the proposed system:

3780 + 1526 + 121 = 5427kWh

(m) Convert the result of paragraph (p) into a high/low (+/- 10%) range:

a. Multiply the total annual electricity consumption by 0.9 =

5427 x 90% = 4884kWh

b. Multiply the total annual electricity consumption by 1.1 =
5427 x 110% = 5970kWh