STANDARDS DOCUMENT

MIS 3005-D ISSUE 1.0 DRAFT

The Heat Pump Standard

(Design)

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*

The MCS Service Company Ltd
Innovation Centre,
Sci-Tech Daresbury,
Keckwick Lane,
Cheshire WA4 4FS

www.mcscertified.com
hello@mcscertified.com
0333 103 8130

ABOUT MCS

Giving you confidence in home-grown energy

With energy costs constantly rising and climate change affecting us all, low-carbon technology has a bigger and bigger 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 on the website at 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 Publication	XX/XX/2020

FOREWORD

This document contains references to other documents which may be either normative or informative. At the time of publication any editions of those documents, where indicated, were valid. However, as all documents are subject to revision, any users of this document should apply the most recent editions of those referenced documents (unless a dated version is specified).

The previous issue MIS 3005 V5.0 combined Design and Installation into one Standard which are now separated into two separate versions of MIS 3005: this Standard with a "D" suffix for Design only (MIS 3005-D) and another Standard with an "I" suffix for Installation only (MIS 3005-I).

This Standard describes the MCS requirements for the assessment, approval and listing by Accredited Certification Bodies of contractors undertaking the design of heat pump systems where installation (including setting to work and commissioning) is undertaken by others. This Standard also includes requirements where contractors undertaking design also contract with customers to supply and handover a fully working system whilst subcontracting the installation.

Both documents can be used together for contractors contracting with customers to handover a fully working heat pump system (i.e. undertaking all of the supply, design, installation, set to work, commissioning and handover).

The listing and approval is based on evidence acceptable to the certification body:

- that the system or service meets the Standard
- that the contractor has staff, processes and systems in place to ensure that the system or service delivered meets the standard
- And on:
- periodic audits of the contractor including testing as appropriate
- compliance with the contract for the MCS listing and approval including agreement to rectify faults as appropriate

This Standard shall be used in conjunction with the scheme document MCS 001 and any other guidance and supplementary material available on the MCS website specifically referring to this Standard (MIS 3005-D).

NOTES:
This MCS Standard makes use of the terms 'must', 'shall' and 'should' when prescribing certain requirements and procedures. In the context of this document:

- *the term 'must' identifies a requirement by law at the time of publication;*
- *the term 'shall' prescribes a requirement or procedure that is intended to be complied with in full and without deviation;*

- *the term 'should' prescribes a requirement or procedure that is intended to be complied with unless reasonable justification can be given.*

Compliance with this MCS Standard does not in itself confer immunity from legal obligations.

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1 PURPOSE & SCOPE

1.1 This Standard specifies the requirements for MCS Contractors undertaking only the design of microgeneration heat pump systems supplying permanent buildings with space heating and/or domestic hot water.

1.2 Contractors can seek certification:

a) Against this Standard **and** MIS 3005-I (installations)
Or
b) Against **only** this Standard (in which case limitations apply detailed below)

1.3 Where the Contractor is certified against both this Standard and MIS 3005-I then all clauses in both this Standard and MIS 3005-I shall apply.

1.4 Where the Contractor is certified against only this Standard to undertake design yet contracts directly with the customer to handover a fully installed heat pump system, then all clauses in this Standard shall apply and installation shall be undertaken by a subcontractor certified against MIS 3005-I.

Note: MCS 001-1 Clause 4.10.1 makes it a requirement that MCS Contractors shall contract directly with the customer for the installation of a system. This is to ensure a single point of contractual responsibility. Therefore, MCS Contractors certified against this standard for design yet are not themselves also certified against MIS3005-I for installation, need to appoint another contractor who is certified against MIS3005-I as its subcontractor. In this way the MCS Contractor with the contract with the customer has complete responsibility for the compliance of the system.

Where customers contract separately for design and installation, the arrangement is not compliant and an MCS certificate cannot be issued.

1.5 Where the Contractor is certified against only this Standard to undertake design, but not contracting directly with the customer, then clauses 4 (Pre-sale information), 7 (Documentation & Handover) and 8 (Maintenance) do not apply.

Note: In this scenario a Contractor certified against MIS 3005-I will be contracting with the customer so responsible for complying with clauses 4, 7 and 8.

1.6 Microgeneration heat pump systems can use different primary heat sources (ground, air, and water), each of which requires different design and installation considerations. This standard includes the requirements for both compression and thermally activated heat pumps, as well as heat pump systems for heating only or for both heating and cooling. Heat pumps may be either "Monobloc" or "Split" units.

1.7 The following are expressly excluded from this Standard:

- Cooling only systems
- Direct expansion (DX) ground-loop systems
- Heat pumps used for extraction of heat from loft spaces.

1.8 Reversible heat pump systems able to provide both heating and cooling are included but shall be designed and optimised for heating.

1.9 For the purposes of this Standard, microgeneration heat pumps are defined as those having a thermal output not exceeding 45 Kilowatt (kW_{th}) as defined by the MCS Product Certification scheme document MCS 007.

1.10 Multiple MCS certified heat pumps may be used in a single installation with a total design heat load of not exceeding $70kW_{th}$ (determined in accordance with BS EN 12831:2003) provided that no single heat pump shall exceed an output of $45kW_{th}$.

1.11 The MCS Contractor shall be assessed under one or more of the following five categories of heat pump installation work:

- Ground/Water source heat pump (GSHP/WSHP) systems;
- Air source heat pump (ASHP) systems including High Temperature (HTHP) and CO_2 heat pumps;
- Exhaust air heat pump (EAHP) systems;
- Gas absorption and adsorption heat pump (GAHP) systems;
- Solar assisted heat pump (SAHP) systems.
- Domestic hot water heat pumps (DHWHP)

1.12 Hot water heat pump systems installed in accordance with this standard shall be used for the provision of domestic hot water only.

1.13 The Certification Body shall identify the scope of works that the MCS Contractor wishes to be registered for and undertake the assessment in accordance with this Standard using the clauses relevant to the category of heat pump installation work.

1.14 MCS Contractors successfully assessed for the design of GSHP/WSHP systems are deemed able to also design ASHP systems but not vice versa.

2 DEFINITIONS

Refer to MCS 001 for definitions.

3 REQUIREMENTS OF THE MCS CONTRACTOR

3.1 CAPABILITY

3.1.1 MCS Contractors shall have the competency (see Section 9) and capacity to undertake the design of heat pumps Microgeneration systems.

3.2 ORGANISATION

3.2.1 MCS Contractors shall organise themselves using policies, procedures and systems which meet the minimum requirements in MCS001 to ensure every heat pump design meets this Standard.

Note: MCS001 defines the requirements for "MCS Contractors" but for certification against this standard then Designers need to meet those same requirements.

MCS001 includes requirements for Quality Management System, Customer Care, Personnel, Continual Improvement, External Documents, Software Control, Customer Requirements, Contracts, Subcontracting, Purchasing, Test and Measurement Equipment, Product Handling, Training and Competence, all of which can affect the quality of installed systems.

4 PRE-SALE INFORMATION

4.1 PERFORMANCE ESTIMATION

4.1.1 For domestic installations a valid Energy Performance Certificate (EPC) should be used to produce an estimate of the annual energy performance of the system using MCS 031: Heat Pump System Performance Estimate Template.

Note: neither the annual heat energy demand of the building nor the annual energy performance of the system are appropriate for sizing the system.

4.1.2 Where it is not possible to obtain a valid EPC or it is not possible to use a SCOP (e.g. GAHP, SAHP), an estimate of the annual energy performance shall be made using the methodology given in Appendix B.

Note: Examples of where a valid EPC would not be obtainable for this performance estimation would be non-domestic buildings and new-build housing.

4.1.3 This estimate shall be communicated to the client at or before the point that the contract is awarded and accompanied by the Key Facts (Appendix D).

4.1.4 Additional estimates may be provided using an alternative methodology, including proprietary software packages, but:

a) such estimates shall clearly describe and justify the approach taken and factors used
b) they shall not be given greater prominence than the standard MCS estimate
c) they shall be accompanied by warning text stating that it should be treated with caution if it is significantly better than the result given by the standard method.

4.2 MINIMUM TECHNICAL INFORMATION

4.2.1 As a minimum, the following technical information shall be communicated in writing to the customer at or before the point that the contract is awarded:

a) The result of the performance estimate calculated in accordance with Section **Error! Reference source not found.**
b) Manufacturer's datasheet for the proposed heat pump
c) Manufacturer's datasheet for the proposed hot water cylinder (if applicable)
d) Any other requirements stipulated by RECC (if applicable)
e) Details of any subcontractors proposed to undertake installation

5 DESIGN

5.1 TIMESCALES

5.1.1 Completion of the design of the heat pump system shall not be unduly delayed and should be complete within 60 calendar days from the day the contract is agreed.

5.2 LEGISLATION

5.2.1 All applicable legislation and directives must be met in full.

Note: the legislation which applies may be different in England, Wales, Scotland and Northern Ireland.

5.2.2 MCS Contractors shall ensure, and be able to demonstrate, that they are aware of all current applicable legislation.

5.2.3 MCS Contractors shall make their customers aware of all permissions, approvals and licences required for the installation including, but not limited to, abstraction and discharge of ground water.

5.2.4 For Air Source Heat Pumps, where an installation is intended to proceed with Permitted Development Rights for air source heat pumps in England, MCS 020 Planning Standards must be complied with.

Commented [C1]: We would welcome suggestions, if necessary, for wording covering devolved nations.

5.2.5 The MCS Contractor shall ensure the building (including curtilage) is assessed by a competent professional experienced in heat pump systems to ensure that it is suitable for the installation and, by undertaking the proposed works, the building's compliance with the Building Regulations (in particular those relating to energy efficiency) is not compromised.

5.2.6 Suitable and sufficient risk assessments shall be conducted before any work on site commences.

5.2.7 Where work is undertaken that is notifiable under the Building Regulations it shall be made clear to the customer who shall be responsible for this notification.

5.2.8 The MCS Contractor shall ensure that notification under the Building Regulations has been completed prior to handing over the installation.

Note: Self-certification, in lieu of building control approval, is only permitted where installation and commissioning is undertaken by a person or organisation deemed competent and registered with a Competent Persons Scheme (CPS) approved by the relevant government department for the scope of work being undertaken. Further details can be found at http://www.competentperson.co.uk.

5.2.9 The MCS Contractor shall ensure that the installation is notified to the Distribution Network Operator in accordance with the procedures published by the Energy Networks Association and permission sought to connect to the network in advance of installation where necessary.

Note: a Flow-chart detailing the ENA procedure is available from the website www.energynetworks.org along with the process to follow for connection and notification.

5.3 MANUFACTURER'S INSTRUCTIONS

5.3.1 All equipment specified should be able to be installed in accordance with its manufacturer's instructions.

5.3.2 Where the manufacturer's instructions conflict with the requirements of this Standard then the requirements of this Standard take precedence unless it can be proven that system performance, safety and durability are no worse than if the requirements of this Standard are followed.

5.4 EQUIPMENT CERTIFICATION AND LISTING

5.4.1 The heat pump(s) specified shall be listed on the MCS website (www.mcscertified.com). These listings include heat pumps both MCS certified and by other schemes MCS considers equivalent.

5.4.2 All equipment specified:

a) Shall be fit for its purpose in the installation
b) Has completed the conformity assessment process and is appropriately marked by a Notified Body in compliance with the relevant legislation.

Note: for example this means the CE mark but could change as the UK leaves the EU.

5.5 SPACE HEATING DESIGN

5.5.1 For systems delivering space heating, the following procedure shall be followed for the correct sizing and selection of a heat pump and related components for each installation:

a) A heat loss calculation should be performed on the building using internal temperatures not less than those specified in Table 1 and external temperatures specified in Table 2 column A or B, according to the MCS Contractor's assessment of the building location. If column B is selected no uplift factor for intermittent heating is required. Heat loss calculation shall in other respects comply with BS EN 12831.

b) Any supplementary electric heater shall be designed to not operate above the external temperatures in Table 2.

c) When calculating the heat loss through a solid floor in contact with the ground, the temperature difference to be used is the internal design room temperature (Table 1) minus the local annual average external air temperature (Appendix D).

d) When calculating the heat loss through a suspended floor, the temperature difference to be used is the internal design room temperature (Table 1) minus the design external air temperature (Table 2).

Room	Internal design temperatures (°C)
Living room	21
Dining room	21
Bedsitting room	21
Bedroom	18
Hall and landing	18
Kitchen	18
Bathroom	22
Toilet	18

Table 1: Internal design temperatures taken from CIBSE Guide which should be consulted for data for other applications. CIBSE Guide A also contains information on how to adapt this data for non-typical levels of clothing and activity.

Location	Altitude (m)	Hourly dry-bulb temperature (°C) equal to or exceeded for % of the hours in a year	
		A (99%)	B (99.6%)
Belfast	68	-1.2	-2.6
Birmingham	96	-3.4	-5.4
Cardiff	67	-1.6	-3.2
Edinburgh	35	-3.4	-5.4
Glasgow	5	-3.9	-5.9
London	25	-1.8	-3.3
Manchester	75	-2.2	-3.6
Plymouth	27	-0.2	-1.6

Table 2: Outside design temperatures for different locations in the UK taken from CIBSE Guide A. which also gives information on how to adapt and use this data.

e) A heat pump should be selected that will provide at least 100% of the calculated heat loss taking into consideration the flow temperature at the heat pump and without input from any supplementary electric heater. Performance data from both the heat pump manufacturer and the emitter system designer should be provided to support the heat pump selection.

f) An air source heat pump system should be able to maintain the internal design temperatures across multiple defrost cycles.

g) Where clauses e) or f) cannot be met then clause 5.5.2 shall apply.

Note: an example of where e) or f) cannot be met would be if the building has insufficient electrical supply for the heat pump to meet 100% of the calculated heat loss.

5.5.2 Where other heat sources are available to the same building then:

a) The combined output of all heat sources shall be not less than 100% of the calculated heat loss

b) All heat sources intended to supply 100% of the calculated heat loss, including the heat pump, shall be fully and correctly integrated into a single control system.

Note: the control system should preferably prioritise the source of heat which causes the lowest carbon emissions.

c) It shall be clearly stated in the contract what proportion of the building's space heating and domestic hot water has been designed to be provided by the heat pump (excluding any heat supplied by a supplementary electric heater) taking into account the heat emitter circuit and flow rate.

5.5.3 The selection of High Temperature Heat Pumps (HTHPs) should be avoided unless the application requires a flow rate higher than 55°C.

Note: Listed buildings or other design limitations may prevent the use of larger heat emitters.

5.5.4 Where a system design proposes a flow temperature greater than 55°C, an alternative design using a flow temperature of 55°C or lower should also be provided. Differences to the efficiency and energy consumption of these systems shall be explained to the customer allowing them to choose.

5.6 DOMESTIC HOT WATER DESIGN

5.6.1 In non-domestic buildings calculate the daily hot water demand using an appropriate method accounting for building usage along with number and type of hot water outlets.

Commented [C2]: We welcome comments on specific methods that may be useful for non-domestic buildings.

5.6.2 In domestic buildings calculate the daily hot water demand ($V_{d,average}$) using the following formula:

$$V_{d,average} = 45 \times N$$

Where:

N = the greater of

a) The number of bedrooms + 1 or

b) The number of known occupants

5.6.3 Using the daily hot water demand and proposed heat pump heating capacity, an appropriately sized hot water cylinder should be specified.

Note: Guidance for cylinder sizes is given in MGD 0XX. It is also acknowledged that the size of cylinder may be limited by the available space.

Commented [C3]: This is a new guidance document being developed which will incorporate most of the separate heat pump guidance documents published by MCS.

The document including guidance on cylinder sizing is currently published with the title “Domestic HW cylinder selection guide”.

5.6.4 The hot water cylinder specified shall be tested and labelled in accordance with the HWA specification (HWA 002:2020) and compatible with the heat pump specified as::

a) Where a Class 1 cylinder, the heat pump shall be rated for a flow temperature of 55°C at design conditions.

b) Where a Class 2 cylinder, the heat pump shall be rated for a flow temperature of at least that given on the cylinder label for Primary Flow temperature (T_{pri})

c) Where a Class 3 cylinder, evidence that the cylinder has been tested by the heat pump manufacturer whilst connected to the model of heat pump being specified.

5.6.5 The domestic hot water cylinder reheat time given on the cylinder label shall be agreed with the customer.

5.6.6 Where an existing domestic hot water cylinder is used then:

a) The thermal insulation of the hot water cylinder, and all pipes connected to it, shall be upgraded to a level at least equivalent to that applicable to new installations under relevant legislation and guidance. For cylinders with factory applied insulation, this condition can be satisfied if the cylinder standing heat loss is certified to comply with Section 12 of BS 1566-1:2002 or equivalent. Where this certification is not apparent, or where the cylinder does not have factory-applied insulation, the MCS Contractor shall install additional insulation certified to comply with BS 5615:1985

b) Proper duty of care shall be exercised to ensure that the hot water cylinder is fit for purpose as regards its mechanical integrity. Consideration shall be given to scale build-up affecting overall system efficiency, damage, and deterioration caused by corrosion. Such issues shall be considered in the context of any additional stress placed upon the cylinder through the connection of the heat pump (e.g. thermal stress or additional system pressure)

c) Where applicable any refrigerant pipe work connecting the external evaporator with the cylinder and other the heat pump components shall be secured and protected in such a way that it is protected from accidental impact and escape of refrigerant gas

d) The size of the cylinder shall comply with the heat pump manufacturer's requirements

5.6.7 Domestic hot water systems shall incorporate a means to prevent bacterial growth (including *legionella bacteria*).

NOTE: Further guidance can be found within the Health and Safety Executive Approved Code of Practice L8 document (HSE ACoP L8).

Commented [C4]: Is signposting to this guidance helpful? Is there any other guidance that could also be referenced here?

5.6.8 Hot water heat pumps delivering domestic hot water shall use waste heat from boiler rooms, waste heat from server rooms, or waste heat from external ambient air only as detailed in Commission Regulation (EU) No 814/2013. The extraction of heat by the heat pump shall not deplete the heat in the inhabited building space (thus increasing the space heating requirement).

5.7 GENERAL DESIGN CONSIDERATIONS

5.7.1 The MCS Contractor shall ensure that the electricity supply is adequate for the size of heat pump specified.

5.8 DESIGN OF CLOSED-LOOP GROUND HEAT EXCHANGERS

Note: Designing ground heat exchangers is a complex engineering procedure. If insufficient information is available to accurately design a ground heat exchanger, the MCS Contractor should adopt a conservative approach.

5.8.1 Closed-loop ground heat exchangers shall be designed such that the temperature of the thermal transfer fluid entering the heat pump achieves a state of thermal equilibrium at a temperature greater than 0°C.

NOTE: Thermal equilibrium is where the temperature of the thermal transfer fluid at the end of each year is the same as at the end of the previous year. The ground temperature should fully recover each year. This assumes that, where the heat pump unit is changed, it is a like-for-like replacement extracting no more heat from the ground than originally designed.

5.8.2 Simplified design methods, including look-up tables and nomograms, should only be used where these are location specific and have been designed to take into account UK average ground temperatures conditions, installation practices and comply with clause 5.8.1 above.

5.8.3 The following site characteristics shall be established using the methods or default values given in table 3:

a) average ground temperature (in °C).

b) local ground thermal conductivity (in W/mK)

c) the temperature of the thermal transfer fluid entering the heat pump

Heat Exchanger Type	Method	Default Values
Vertical Borehole	Thermo-geological assessment	???
Horizontal Collector	Soil conductivity test	???
Surface Water	Refer to CIBSE CP2: Surface water source heat pumps: Code of Practice for the UK	???

Table 3

Commented [C5]: These default values are those currently published as Appendices in Issue 5 of MIS 3005.

Notes:

For horizontal collectors the average ground temperature should account for the temperature swing throughout a typical year.

The British Geological Survey (BGS) keeps logs from a great many boreholes from all forms of drilling and site investigation work. These can be used to estimate the depth and thermal conductivity of solid geology for closed-loop borehole systems. BGS also compiles reports with information on the estimated thermal conductivity of superficial deposits for horizontal loop systems. Experienced geologists and hydro-geologists will also be able to estimate the local ground thermal conductivity. For larger systems, it may be beneficial to conduct a thermal response test. The Ground Source Heat Pump Association publication "Closed-loop vertical borehole design, installation and materials Standard" contains guidance on thermal response testing. See MGD0XX for ranges of thermal conductivity for different geologies.

5.8.4 The following procedure for designing the ground heat exchanger should be used unless a smaller ground loop heat exchanger can be justified through the use of proprietary software and/or ground loop replenishment through cooling or otherwise is to be implemented:

Commented [C6]: Issue 5.0 of MIS 3005 includes a threshold of 30kW above which proprietary software is required or a specialist should be consulted. Given the MCS scope of ≤70kW some argue this not necessary. We'd welcome thoughts on this particular point.

a) The total heating energy demand over a year (in kWh) for space heating and domestic hot water shall be estimated using a suitable method. The calculation shall include appropriate consideration of internal heat gains, heat gains from solar insolation, local external air temperature and the heating pattern used in the building (e.g. continuous, bi-modal, with an Economy10 tariff or otherwise).

b) The total heating energy demand calculated in clause 5.8.4 part (a) shall be divided by the heat pump heating capacity selected in clause 5.5.1 Part (e) to determine the parameter called the Full Load Equivalent (FLEQ) Run Hours:

$$\text{FLEQ Run Hours} = \frac{\text{Total Heating Energy Demand}}{\text{Heat Pump heating capacity}}$$

c) Using the Seasonal Coefficient of Performance or Seasonal Primary Energy Ratio (SCOP or SPERh) as shown on the MCS website (www.mcscertified.com) for the heat pump unit, determine the maximum power to be extracted from the ground ("G") in Watts (W) using the following formulae:

For electrically driven heat pumps:

$$G = H \cdot \left(1 - \frac{1}{SCOP}\right)$$

For gas absorption and adsorption heat pumps:

$$G = 1.1 \cdot H \cdot \left(1 - \frac{1}{SPERh}\right)$$

Where:

"H" is the HP heating capacity at 0°C ground return temperature and design emitter temperature.

d) Using tables in MGD0XX lookup the specific heat power extraction from the ground ("g") in Watts per metre (W/m) based on the type of ground heat exchanger (borehole, horizontal or slinky), the average ground temperature, the local ground thermal conductivity and the FLEQ hours.

e) Calculate the minimum length of the ground heat exchanger active elements ("L_b") in metres (m)), using the formula:

$$L_b = \frac{G}{g}$$

f) For horizontal and slinky ground heat exchangers, calculate the total ground heat exchanger area, A (in m^2) using the formula:

$$A = L_b d$$

Where:

"d" is the minimum centre-to-centre spacing of the horizontal or slinky ground heat exchanger specified in the look-up tables and charts.

g) The minimum length of ground heat exchanger pipe in the active elements, L_p (in m), is determined according to the formula:

$$L_p = L_b R_{pt}$$

Where:

"R_{pt}" is a non-dimensional ratio and R_{pt} = 2 for boreholes; R_{pt} = 1 for horizontal ground heat exchangers; and R_{pt} is the minimum pipe length to trench length ratio specified in the look-up tables and charts for slinky ground heat exchangers.

h) The characteristics of the ground heat exchanger active element and thermal transfer fluid shall be such that the Reynolds number is ≥ 2500 at all times.

Note: The look-up charts presume a Reynolds number (a measure of flow characteristic either laminar, transitional or turbulent) greater than 2500.

5.8.5 The hydraulic layout of the ground loop system shall be such that the overall closed-loop ground collector system pumping power at the lowest operating temperature is less than 3% of the heat pump heating capacity.

5.8.6 Where manufacturers' in-house software or another commercial software packages is used to design the ground heat exchanger it shall be location specific taking into account UK average ground temperatures, the annual heat load of the building (space heating and domestic hot water) and the site characteristics established in clause 5.8.3.

5.9 POST-DESIGN CUSTOMER INFORMATION

5.9.1 Where there is a change to the agreed design and/or estimated performance of the system from that given before the detailed design then customer shall be given:

a) an updated estimate of performance, in accordance with the 'MCS Heat Pump System Performance Estimate'

b) a variation to contract

c) the opportunity to cancel the contract without further cost, obligation or liability.

5.9.2 Prior to the installation commencing, the customer shall be notified in writing of:

a) all specific room heat losses (in W/m^2)

Note: specific heat loss is the total heat loss divided by floor area.

b) the calculated daily hot water demand

c) the type and dimensions of emitter(s) to be used in the system.

d) the design emitter temperature based on the worst performing room.

e) the specification of any new domestic hot water cylinder and its recovery rate

f) the design flow temperature of the water leaving the heat pump and before any blending valves.

g) the installation's SCOP/SPER (as taken from the MCS website) based on the above design flow temperature, when supplying space heating at the external design temperature.

h) any metering that can be installed and may be required to access any financial incentives.

i) a completed copy of Table 4 (if closed-loop ground heat exchanger)

Table 4 - Details of ground heat exchanger design to be provided to the customer

Parameter	Value	Unit	Ref	Comments
Average ground temperature		°C	[1]	
Local ground thermal conductivity		W/mK	[2]	
Estimate of total heating energy demand over a year for space heating and domestic hot water		kWh	[3]	(state calculation method)
HP heating capacity at 0°C ground return temperature and design emitter temperature, H		kW	[4]	
FLEQ run hours [3]/[4]		hrs	[5]	
Heat pump SCOP or SPERh (from MCS website)			[6]	
Maximum power extracted from the ground (i.e. the heat pump evaporator capacity) G = [4]*1000*(1 - (1/ [6])) for electrical or G = [4]*1000*1.1*(1 – (1/[6])) for absorption		W	[7]	
Maximum power to be extracted per meter length of borehole, horizontal or slinky ground heat exchanger, g		W/m	[8]	
Minimum length of ground heat exchanger required L_b = [7] / [8]		m	[9]	(e.g. 2 no. 50m slinkies)
Borehole, horizontal loop or slinky spacing, d		m	[10]	
Total length of ground heat exchanger active elements, L_p = [9]*R_{pt}		m	[11]	(NB: does not include header pipes)
Total length of the ground heat exchanger active elements installed in the ground, L_p'		m	[12]	(NB: state if proprietary software has been used to determine the design length)

6 INSTALLATION & COMMISSIONING

6.1 Installation and commissioning shall be in accordance with MIS 3005-I and undertaken by a contractor certified against that Standard.

7 DOCUMENTATION & HANDOVER

7.1 **DOCUMENTATION**

7.1.1 The MCS Contractor shall collate a comprehensive document pack which, as a minimum, includes:

- Copies of all forms and checklists used to commission the system
- The maintenance requirements and maintenance services available
- Manufacturer user manuals and warranty details.
- Any documentation or checklists required for any incentive schemes

7.2 **HANDOVER**

7.2.1 At the point at which the heat pump system is handed over to the customer, the documentation as detailed in 7.1.1 shall be provided and explained along with a document signed by the MCS Contractor containing at least the following:

- A declaration, signed by the MCS Contractor's on-site representative, confirming that the installation meets the requirements of this Standard
- Client name and address
- Site address (if different)
- MCS Contractor's name, address, contact details etc.
- List of the key components installed
- The estimation of system performance calculated according to Section 4
- Recommended interval for the first periodic inspection
- MCS contact details (helpline telephone number and email address)

7.2.2 No later than 10 working days after commissioning, the installation shall be registered by the MCS Contractor on the MCS Installation Database (MID) and an MCS Certificate generated.

7.2.3 The MCS Certificate shall be sent to the customer with instruction to include it within the handover pack.

7.2.4 The generation of the certificate shall be undertaken in full compliance with the terms and conditions of use of the MID[1] and the registration of the system on the MID shall be undertaken only after the system has been fully installed and commissioned and not before.

7.2.5 A "per installation" fee is levied on MCS Contractors for each registration added to the database. Details of any such fee will be advised from time to time through MCS Certification Bodies.

8 MAINTENANCE

8.1 System design should allow safe access of all components necessary for commissioning and maintenance.

8.2 For recommended maintenance requirements see MIS 3005-I?

9 ROLES & COMPETENCY

9.1 All personnel involved in the design and installation of heat pump systems either employed by, or subcontracted to, the MCS Contractor shall be competent or instructed for the activities they undertake.

9.2 For two or multi-piece split systems, personnel shall be appropriately qualified for the handling of refrigerants e.g. EU F-GAS regulations, the Fluorinated Greenhouse Gases Regulations and Gas Safe.

9.3 Complete records of training (where appropriate) and competence skills of personnel shall be maintained by the MCS Contractor, in particular:

- Design personnel - Shall be able to demonstrate a thorough technical knowledge of the technologies involved and the interaction of associated technologies and be able to deliver a compliant design to the requirements of this Standard.
- Installation personnel – Shall be able to demonstrate an adequate level of technical knowledge and installation skills, to install systems to the specified design in accordance with the requirements of this standard, applicable codes of practice, manufacturer's instructions and Statutory Regulations.

Note: As a minimum MCS Contractors should have personnel with demonstrable training and / or experience of heat pump systems in accordance with the requirements of this Standard. Entry level qualifications as shown in Appendix A, may be deemed as suitable for simple non-complex systems.

[1] The terms and conditions of use can be found on the MCS Installation Database website.

10 REGIONAL OFFICES

Where the MCS Contractor wishes to design and commission under the Certification Scheme in regional offices, then these offices shall meet the requirements of this standard to be eligible for Certification.

11 PUBLICATIONS, REFERENCE AND FURTHER READING

11.1.1 The below lists are provided so that MCS Contractors know which documents have been used as a basis for the development of the requirements of this MIS standard and they are able to further research topics if they need to do so.

11.1.2 It is a scheme requirement for MCS Contractors to own or have immediate access to at least one copy of the following documents in each office or regional office undertaking design, installation and commissioning work:

- MIS 3005 – D
- MIS 3005 - I
- MGD 0XX – MCS – Heat Pump Guidance Document

Commented [C7]: This document is in progress and is simply a consolidation of all those already published.

11.1.3 It is not a scheme requirement for MCS Contractors to own or have immediate access to the following documents unless this MIS standard does not adequately cover off the aspects required.

- BS 7671:2018 Requirements for Electrical Installations (IET Wiring Regulations Eighteenth Edition). Available from British Standards Institution (BSI): www.bsi-global.com or The Institution of Engineering and Technology (IET): www.theiet.org/publications/
- GSHPA standards
- BS EN 805:2000
- Approved Document G3 "Hot Water Supply and Systems" (England and Wales)
- Hot Water Association Specification HWA 002:2020: Hot water storage vessels for Domestic Purposes for use with Heat Pumps
- BS EN 12831:2003: Heating systems in buildings
- CIBSE Domestic Heating Design Guide. A CIBSE publication
- Closed-loop Vertical Borehole – Design, Installation & Materials Standard Issue 1.0 2011 www.gshp.org.uk
- "Design of low-temperature domestic heating systems – a guide for system designers and installers", 2013, BRE Trust publication FB59, www.brebookshop.com

- EN 806-5:2012: Specifications for installations inside buildings conveying water for human consumption
- EN ISO 13790:2008: Energy performance of buildings- Calculation of energy use for space heating and cooling
- EN 8558:2011: Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Complementary guidance to BS EN 806-5:2012
- Environmental good practice guide for ground source heating and cooling. GEHO0311BTPA-E-E. Published by Environment Agency 2011 www.environment-agency.gov.uk
- Guide A: Environmental Design. A CIBSE publication
- HSE Approved code of practice (ACOP) L8 - The control of legionella bacteria in water systems approved code of practice and guidance
- MCS 001 MCS Contractor certification scheme requirements document.
- MGD 002 – Guidance for MIS 3005.
- MCS 012 – Product Certification Requirements: Pitched Roof Installation Kits.
- MCS 022 – Ground heat exchanger look-up tables. Supplementary Material to MIS 3005.
- MCS 021 – Heat Emitter Guide.
- MCS 020 – Planning Standards.
- MCS 031 – MCS Heat Pump System Performance Estimate
- "Report for DECC: Measurement of domestic hot water consumption in dwellings", Energy Monitoring Company, March 2008. Available from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48188/3147-measure-domestic-hot-water-consump.pdf
- The Compliance Certificate template for heat pump systems.
- CP2: Surface water source heat pumps — a Code of Practice for the UK (CIBSE, 2016)

Commented [C8]: We would welcome any suggestions for additions or edits to this section.

APPENDIX A – ENTRY LEVEL QUALIFICATIONS

The following courses and qualifications can help demonstrate competency but a single qualification should not be presumed to prove an individual competent for all situations.

Working group to populate this appendix with a list of qualifications that could be used to demonstrate competency.

Helpful links

Manufacturer

Relevant F Gas qualifications and/or Accredited Certification Scheme (ACS) Certificates along with the appropriate registration e.g Gas Safe Register.

APPENDIX B – PERFORMANCE ESTIMATION METHOD

For all systems where the premises are not entitled to obtain a domestic EPC (e.g. non-domestic) as defined in clause 4.1.2 or where it is not possible to use a SCOP (e.g. GAHP, SAHP), the means of estimating the annual energy performance shall be as follows:

a) Assess the annual heat load for the building (space heating and / or hot water) using any suitable performance calculation method. Such calculation method shall be clearly described and justified.

b) Multiply the result from a) by the proportion of the relevant heat load provided by the heat pump system as determined in accordance with Clause 5.5.2.

c) For space heating, divide the result from b) by the default efficiency (expressed as a Seasonal Coefficient of Performance or Seasonal Primary Energy Ratio (SCOP or SPERh)) for heat pumps calculated using the data available on the MCS website (www.microgenerationcertification.org). For water heating, divide the result from b) by the efficiency (expressed as a Seasonal Coefficient of Performance or Seasonal Primary Energy Ratio (SCOP or SPERh)) when the heat pump is operating at the flow temperature of the heat pump while providing water heating service.

d) For Domestic Hot Water (SAHPs and HWHPs), the efficiency to be expressed as a Seasonal Performance Factor (SPF) shall be taken as the Coefficient of Performance (COP) (in accordance with the SEPEMO report: D2.5/D3.5 Position paper on heat pump SPF) obtained from the test results undertaken as part of the MCS 007 heat pump product certification scheme requirements for SAHPs and HWHPs.

e) Calculate the energy supplied by the auxiliary heater by multiplying the result from a) by the proportion of the relevant heat load not supplied by the Heat Pump.

f) Add the result from c) to the result from d) to give the total energy required for the relevant heat load.

g) The results from e) for space heating and hot water are added together to give an overall energy requirement for the building for these heat loads.

APPENDIX C – KEY FACTS

The performance of microgeneration heat pump systems is impossible to predict with certainty due to the variables discussed here and their subsequent effect on both heat supply and demand. Your estimate is given as guidance only and should not be considered as a guarantee.

Seasonal Coefficient of Performance:

MCS Seasonal Coefficient of Performance (SCoP) is derived from the EU ErP labelling requirements, and is a theoretical indication of the anticipated efficiency of a heat pump over a whole year using standard (i.e. not local) climate data for 3 locations in Europe. It is used to compare the relative performance of heat pumps under fixed conditions and indicates the units of total heat energy generated (output) for each unit of electricity consumed (input). As a guide, a heat pump with a MCS SCoP of 3 indicates that 3 kWh of heat energy would be generated for every 1 kWh of electrical energy it consumes 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 insulating 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 ± 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 period, finance agreement period 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
Design flow /return water temperatures, and weather compensation	System Efficiency
Type of Heat emitter (e.g. Under-floor; natural convector (e.g. 'radiator'), fan convector etc.)	System Efficiency
'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
• Changing the design HP flow temperatures	System Efficiency
• 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).