

Heat pump design and specification

(Withdrawn – January 2024)

The Technical Guidance Notes are produced by NHBC as guidance solely for our builder customers as to how to interpret the technical requirements in relation to the warranty cover provided by NHBC under its Buildmark, Buildmark Choice, Buildmark Link, Buildmark Solo, Buildmark Connect or any similar product from time to time. It has not been created or intended for distribution or use outside of that purpose. The information contained in this Technical Guidance Note does not constitute advice and is not to be relied upon by any third party. Nothing in this Technical Guidance Note is intended to, nor should it be taken to, create any legal or contractual relationship. Any third party who chooses to rely upon the information contained in the Technical Guidance Notes shall do so entirely at their own risk and NHBC accepts no duty of care or liability, however caused, in connection with its use or reliance by any third party.

Question

What are the design considerations for low temperature space heating when using heat pumps?

Scope

This guidance note covers the outline provision of heat pump specification and design guidance for low temperature space heating systems in domestic dwellings (heat loss).

Ground loops or boreholes are not covered within this guidance and will require appropriate experts for design ensuring correct energy delivery to the heat pump.

Who should read this?

Technical and construction directors and managers, architects, designers, contractors, building services engineers and site managers.

Who is responsible?

Those who are responsible for building work (e.g., agent, designer, builder, or installer) must ensure that the work follows compliance requirements within NHBC standards 2.1 (R1 to R5).

- The durability of any external heat pump must be confirmed as appropriate for the installed location including coastal locations or installation at high level.
- The heat pump installed must be installed by an appropriately trained individual and commissioned in accordance with manufacturer's instructions. A maintenance programme designed to ensure longevity of the appliance must be offered by the manufacturer or manufacturer's agents or installer.

EU Product directives to be complied with (depending on heat pump type)

2014/35/EU Low voltage directive (LVD)

2006/42/EC machinery directive (MD)

2014/30/EU Electromagnetic compatibility directive (EMC)

2014/68/EU Pressure equipment directive (PED)

2011/65/EU Restriction of hazardous substances (RoHS) in electrical and electronic equipment

2015/863/EU Amending directive to 2011/65/EU

2017/2102 EU Amending directive to 2011/65/EU

2009/125/EC Energy related products directive (ErP)

813/2013/EU ecodesign requirements heat pumps

814/2013/EU ecodesign requirements of water heaters and water tanks

Heat pump design and specification

(Withdrawn – January 2024)

Normalised standard references (depending on heat pump type)

BS EN 60335-1 Household and similar electrical appliances safety (heat pumps)

BS EN 60335-2 Specification for safety of household and similar electric appliances (heat pumps)

BS EN 62233 Measurement methods for electromagnetic fields of household appliances

BS EN 55014-1 Electromagnetic compatibility

BS EN 55014-2 Electromagnetic compatibility

BS EN 61000-3-2 Electromagnetic compatibility limits for harmonic current emissions

BS EN 61000-3-3 Electromagnetic compatibility limitation of voltage changes

BS EN 50581 Technical documentation for the assessment of electrical/electronic products (RoHS)

BS EN 12102-1 Determination of the sound power level compressors

BS EN 12102-2 Determination of the sound power level heat pump water heaters

BS EN 12309 1-7 Gas fired absorption heat pumps not exceeding 70kW

BS EN 13203-5 DHW testing standard for hybrid boiler

BS EN 14511-1 Heat pumps terms and definitions

BS EN 14511-2 Determination of the sound power level heat pump water heaters

BS EN 14511-3 Heat pump test methods

BS EN 14511-4 Heat pumps for space heating and cooling with electrically driven compressors

BS EN 14825 Calculation of seasonal performance

BS EN 15879-1 Testing and rating of direct exchange ground source heat pumps for space heating

BS EN 16147 Testing and performance rating and marking requirements for domestic water units

BS EN 16905 1-5 Gas fired endothermic engine driven heat pumps

UK Building Regulations

England and Wales ADL & ADJ, Part F Northern Ireland or Scottish Technical Handbook

UK Certification

A manufacturer's Declaration of Conformity (DOC) detailing the appropriate standards complied with should be provided together with the certification from a registered UKAS certification body confirming compliance with the relevant standards.

UK product and installation guidance

MCS certified or other relevant and recognised body accepted by NHBC

MIS 3005-i Heat pump Installation

MIS 3005-D Heat pump Design

CIBSE Domestic heating compliance guide

Space heating design considerations for low temperature systems

- Type and suitability
- Where required "F" gas regulations must be complied with
- Back up heating requirements
- Buffer tanks to prevent short cycling

Heat pump design and specification

(Withdrawn – January 2024)

- Suitable fixings
- System and design to be included within SAP/ Part L and ensure compliance
- Running costs

Requirements for heat pump space heating design

- The heat pump selected should provide not less than 100% of the calculated design space heating power requirement at the winter design condition and include any energy required for defrost cycles. Any supplementary electric heating shall only operate when the conditions are outside of the design principle detailed in this document.

Heat loss

- All heat loss calculations should be in accordance with recognised standards and guidance, e.g., CIBSE Domestic Heating Design Guide or other approved by NHBC.
- Fabric heat loss should be based on the building design and thermal conductivity of the materials from which the element is constructed.
- The heating designs must include allowances where applicable for thermal bridging.

Additional values to be added to the U value based on construction type as set out by CIBSE domestic heating design guide (other suitable methods are used within SAP)

Type of construction	Additional thermal transmittance to be added W/m ² K
Buildings built with a high level of heat insulation (over and above national standards) and implement minimisation of thermal bridging	0.02
Buildings built to current national standards and in compliance with recognised practices regarding the minimisation of thermal bridging	0.05
Buildings with exterior wall insulation broken by solid ceilings (e.g., reinforced concrete)	0.15
All other buildings	0.1

Indoor design temperatures

Room	Temp °C	Room	Temp °C	Room	Temp °C
Lounge/sitting room	21	Cloakroom/WC	21	Internal room or corridor	21
Living room	21	Toilet	21	Bedroom/study	21
Breakfast room	21	Utility room	21	Landing	21
Dining room	21	Study	21	Bathroom	22
Kitchen	21	Games room	21	Shower room	22
Family/breakfast room	21	Bedroom	21	Dressing room	21
Hall	21	Bedroom with ensuite	21	Storeroom	21

- Where elevated temperatures are required for frail, elderly, or infirm use 23°C

Heat pump design and specification

(Withdrawn – January 2024)

External design temperatures

Typical winter external design temperatures for sites in the British Isles up to 50m above sea level. Based on CIBSE domestic heating design guide

Region	Latitude	Outdoor design temperature °C	Ground reference temperature (winter mean °C)
Scotland & Isles	56–60°N	-5	+5.5
Northern England & Northern Ireland	54–56°N	-4	+6.0
Midlands, Wales and ROI	52–54°N	-3	+6.5
London, SW England	51–52°N	-2	+7.0
Southern England	50–51°N	-1	+7.5

- To account for altitude the outside design temperature should be lowered by 0.3°C for every additional 50m above sea level or 1°C if in proximity of the coast or river or steep cliff.
- When calculating a basement or ground floor heat loss the ground reference temperatures should be used.
- When calculating heat loss to adjoining properties they should be treated as unheated, in these instances the temperature used should be the same as the UK mean of 10°C.
- Heat transfer between rooms in the same property can be disregarded if the same indoor temperature is used for all room.

Ventilation heat loss

Ventilation heat loss will depend on the rate at which the air leaves or enters the building. When calculating use the as built air change rate if known otherwise overheating or under heating may occur in given situations. If not known the below information is taken from the CIBSE domestic heating design guide.

Air changes per hour for new build housing complying with current building regulations England and Wales Part F, Northern Ireland Part K, Scottish Technical Handbook

* Where mechanical extract ventilation is to be installed in a room and the extract volume exceeds the natural infiltration, due allowance for the air extracted from any connecting room or corridor must be made.

Room	ACH	Room	ACH	Room	ACH
Lounge/sitting room	0.5	Cloakroom/WC	1.5*	Internal room or corridor	0.0
Living room	0.5	Toilet	1.5*	Bedroom/study	0.5
Breakfast room	0.5	Utility room	0.5*	Landing	0.5
Dining room	0.5	Study	0.5	Bathroom	0.5*
Kitchen	0.5	Games room	0.5	Shower room	0.5*
Family/breakfast room	0.5*	Bedroom	0.5	Dressing room	0.5
Hall	0.5	Bedroom with ensuite	1.0	Storeroom	0.5

- Where a room contains an open fire or chimney, allowances to the ventilation rate must be made as detailed in CIBSE domestic heating design guide.

Heat pump design and specification

(Withdrawn – January 2024)

Heat pump system considerations

- The heat pump selected should provide not less than 100% of the calculated design space heating power requirement at the winter design condition and include any energy required for defrost cycles. Any supplementary electric heating shall only operate when the conditions are outside of the design principle detailed in this document.
- Design mean water temperature (MWT) 42.5°C the design can utilise design mean water temperature (MWT) lower than this.
- The number and sizing of heat emitters eg. radiators or size of underfloor system must be sized to the design mean water temperature (MWT).
- The system pipework or underfloor heating must be sized to the design mean water temperature (MWT).
- The heat pump must have a minimum coefficient of performance of 3.0 for space heating.
- The heat pump must have a minimum Seasonal Coefficient of Performance of 2.7.
- The heat pump must control the pump operation.
- The heat pump must control any outdoor fan operation.
- The heat pump must control the defrost cycle for the external air side.
- Weather compensation or internal temperature control must be adopted with all heat pumps.
- Where the dwelling contains other heat sources all control should be done from a singular control unit.
- Controls need to be appropriately located and easy to access.
- Heat pumps should not be sited adjacent to sleeping areas or located on materials that transmit vibration.
- Heat pumps must be correctly sited and installed to minimise noise impact.
- Buffer tanks must be correctly designed to the system .
- A suitable electrical supply must be provided to ensure power and amperage.
- Manufacturer's installation instructions must be followed with respect to installation clearances and free space around heat pumps.
- Where required safety guards must be supplied to prevent risk of injury or damage.
- Internal systems must be hydraulically balanced to ensure correct performance.

Definitions

- **F Gas** F stands for fluorinated, and F-Gas is the term used to describe a particular family of fluorinated gases which are widely used as refrigerants in air conditioning and commercial refrigeration systems. This family of fluorinated gases is subject to stringent EU and national regulations drawn up in response to the Kyoto Protocol. The F-gases most used as refrigerants in commercial air conditioning equipment are hydrofluorocarbons [HFCs], but the F-Gas family also comprises: Perfluorocarbons [PFCs] Sulphur Hexafluoride [SF6] F-gas refrigerants are sometimes referred to by their 'R-numbers' (such as R134a, R407c, R404A and R401A, etc)
- **Short Cycling** is a term used to define when a heat pump or heating system shuts down early before completing the heating cycle. This has a detrimental effect on the system as the heat pump will not run at its most optimum as well as potential to increase wear and tear on components. Correct sizing of heat pumps, systems and buffer tanks if required is essential for an efficient overall system
- **Mean water temperature (MWT)** is a term used to denote the midpoint between the flow and return temperature, heating systems utilising a heat pump commonly use a 10°C delta. With a design flow temperature of 45°C with a return temperature of 40 °C a MWT of 42.5 °C is achieved. This should then be used in heat emitter/underfloor heating and pipe sizing calculations

Heat pump design and specification

(Withdrawn – January 2024)

Codes & reference standards

BSRIA guide BG 4/2011 Underfloor heating and cooling

MIS 3005 Heat pump systems

BS EN 14511 Air conditioners, liquid chilling packages and heat pumps for space heating

BS EN 15450 Heating systems in buildings. Design of heat pump systems

CIBSE Domestic heating compliance guide



NHBC, NHBC House, Davy Avenue, Knowlhill, Milton Keynes, Bucks MK5 8FP
Tel: 0344 633 1000 Web: [nhbc.co.uk](https://www.nhbc.co.uk)

National House-Building Council (NHBC) is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority for carrying on insurance business and insurance distribution activities.

NHBC is registered in England and Wales under company number 00320784. NHBC's registered address is NHBC House, Davy Avenue, Knowlhill, Milton Keynes, Buckinghamshire, MK5 8FP. Note that only certain parts of our products and services are within the scope of UK financial services regulations. For more information on our products and services, please see our website [nhbc.co.uk](https://www.nhbc.co.uk) or your NHBC product documentation.