INTERNATIONAL STANDARD

ISO 11855-5

Second edition
2021-08

Building environment design — Embedded radiant heating and cooling systems —

Part 5: Installation

Conception de l'environnement des bâtiments — Systèmes intégrés de chauffage et de refroidissement par rayonnement —

Partie 5: Installation

Reference number
ISO 11855-5:2021(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 205, *Building environment design*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 228, *Heating systems and water based cooling systems in buildings,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 11855-5:2012), which has been technically revised.

The main changes compared to the previous edition are as follows:

— modified Clause 2 (Normative references) and the Bibliography;

— modified Clause 4 (Symbols);

— added a new subclause on vapour barrier and other layers (see 5.1.2.2);

— modified the subclause on insulating layers, perimeter insulating strip adding a new approach and adding details for thermal resistance of insulating layer (see 5.1.2.3);

— added new subclauses on insulating layers for systems in new constructions (see 5.1.2.3.2) and in refurbished systems (see 5.1.2.3.3);

— modified the subclauses on joints (see 5.1.2.8.3), leak test (see 5.1.3), initial heating up of the emission system (see 5.1.4) and general structural preconditions (see 5.2.2);

— removed the subclause on maximum heating fluid flow temperatures (previously 5.2.4);

— improved wording and made editorial changes.

A list of all parts in the ISO 11855 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The radiant heating and cooling system consists of heat emitting/absorbing, heat supply, distribution, and control systems. The ISO 11855 series deals with the embedded surface heating and cooling system that directly controls heat exchange within the space. It does not include the system equipment itself, such as heat source, distribution system and controller.

The ISO 11855 series addresses an embedded system that is integrated with the building structure. Therefore, the panel system with open air gap, which is not integrated with the building structure, is not covered by this series.

The ISO 11855 series is applicable to water-based embedded surface heating and cooling systems in buildings. The ISO 11855 series is applied to systems using not only water but also other fluids or electricity as a heating or cooling medium. The ISO 11855 series is not applicable for testing of systems. The methods do not apply to heated or chilled ceiling panels or beams.

The object of the ISO 11855 series is to provide criteria to effectively design embedded systems. To do this, it presents comfort criteria for the space served by embedded systems, heat output calculation, dimensioning, dynamic analysis, installation, control method of embedded systems, and input parameters for the energy calculations.

The ISO 11855 series consists of the following parts, under the general title *Building environment design — Embedded radiant heating and cooling systems*:

— Part 1: *Definitions, symbols, and comfort criteria*

— Part 2: *Determination of the design heating and cooling capacity*

— Part 3: *Design and dimensioning*

— Part 4: *Dimensioning and calculation of the dynamic heating and cooling capacity of Thermo Active Building Systems (TABS)*

— Part 5: *Installation*

— Part 6: *Control*

— Part 7: *Input parameters for the energy calculation*

ISO 11855-1 specifies the comfort criteria which should be considered in designing embedded radiant heating and cooling systems, since the main objective of the radiant heating and cooling system is to satisfy thermal comfort of the occupants. ISO 11855-2 provides steady-state calculation methods for determination of the heating and cooling capacity. ISO 11855-3 specifies design and dimensioning methods of radiant heating and cooling systems to ensure the heating and cooling capacity. ISO 11855-4 provides a dimensioning and calculation method to design Thermo Active Building Systems (TABS) for energy saving purposes, since radiant heating and cooling systems can reduce energy consumption and heat source size by using renewable energy. ISO 11855-5, this document, addresses the installation process for the system to operate as intended. ISO 11855-6 shows a proper control method of the radiant heating and cooling systems to ensure the maximum performance which was intended in the design stage when the system is actually being operated in a building. ISO 11855-7 presents a calculation method for input parameters to ISO 52031.

Building environment design — Embedded radiant heating and cooling systems —

Part 5: Installation

1 Scope

This document establishes requirements for the installation of embedded radiant heating and cooling systems. It specifies general and uniform requirements for the design and construction of heating and cooling floors, ceiling and wall structures to ensure that the heating/cooling systems are suited to the particular application. The requirements specified by this document are applicable only to the components of the heating/cooling systems and the elements which are part of the heating/cooling surface and which are installed due to the heating/cooling systems.

This document is applicable to water-based embedded surface heating and cooling systems in residential, commercial and industrial buildings. The methods apply to systems integrated into the wall, floor or ceiling construction without any open-air gaps, but are not applicable to panel systems with open-air gaps which are not integrated into the building structure.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11855-1, *Building environment design — Design, dimensioning, installation and control of embedded radiant heating and cooling systems — Part 1: Vocabulary, symbols, and comfort criteria*

ISO 11855-3, *Building environment design — Design, dimensioning, installation and control of embedded radiant heating and cooling systems — Part 3: Design and dimensioning*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11855-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Symbols

For the purposes of this document, the symbols in Table 1 apply.

Table 1 — Symbols

Symbol	Unit	Quantity
D	m	External diameter of the pipe, including sheathing where used
[a] Heating/cooling system can be work on heating mode, cooling mode or both.		

Table 1 *(continued)*

Symbol	Unit	Quantity
$R_{\lambda,ins}$	m^2K/W	Thermal resistance of the insulating layer of the heating/cooling system[a]
s_{ins}	m	Thickness of thermal insulation
ϑ_d	°C	External design temperature
$\vartheta_{V,des,max}$	°C	Maximum heating water flow temperatures
λ_{ins}	W/(m·K)	Thermal conductivity of the thermal insulation layer
q	W/m^2	Heat flow density at the surface
q_u	W/m^2	Outward heat flow density
s_h	m	In type B systems, thickness of thermal insulation from the outward edge of the insulation to the inward edge of the pipes (see Figure 2)
s_1	m	Thickness of the upper part of the slab
W	m	Pipe spacing
[a] Heating/cooling system can be work on heating mode, cooling mode or both.		

5 Installation

5.1 Floor heating and cooling systems

5.1.1 General structural preconditions

The installation of a hydronic floor heating and cooling system shall follow the previous installation of any electrical, sanitary or other pipe facilities. The structure including the closure of all building openings, e.g. windows and outer doors, shall be completed or closed.

5.1.2 Building layers, building components

5.1.2.1 Supporting base and wall requirements

Any pipe work or conduits shall be fixed and encased to provide a level base upon which thermal insulation and acoustic insulation or both is added before laying the heating pipes. In this respect, the necessary structural height shall be taken into account. If the external doors and windows are not present before the installation of the radiant system, it is recommended to close all windows holes, even with provisional systems (in order to avoid too high / low temperatures and to limit the effect of the speed of the air). Walls plaster shall be completed.

5.1.2.2 Vapour barrier and other layers

Before the installation of perimeter insulating strip and insulating layers, the installation of any other layers, for example, vapour barrier or similar shall be evaluated. This is related the type of flooring (e.g. wood floor, resin floor, etc.) and the system's boundary conditions (installation of floor system on the ground, installation of floor system above unheated environment).

5.1.2.3 Insulating layers, perimeter insulating strip

5.1.2.3.1 Thermal resistance of insulating layers

The thermal resistance $R_{\lambda,ins}$ of the insulating layers of the heating/cooling system shall be calculated as reported in ISO 11855-3:2021, Annex A.

The position of the insulation affects the inertia of the system. In case of insulation not near piping, inertia and system time constant shall be evaluated.

5.1.2.3.2 Insulating layers for systems in new construction

Insulating layers of the heating/cooling system have the function of limitation of thermal losses. For heating and cooling system it is recommended to limit the percentage of losses towards the environment as reported in Formula (1).

$$\frac{q_u}{q+q_u} < 20\,\% \tag{1}$$

where

q is the thermal output of floor heating systems divided by the surface area;

q_u is the specific thermal output throughout the floor construction, to rooms beyond, the ground or cold void.

The calculation shall be performed by using FEM and/or FDM calculations (see ISO 11855-2:2021, Annex D) or other calculation methods. The calculation shall be done for each type of stratigraphy (e.g. for all types of flooring and insulation).

If materials and thickness are not known, instead of Formula (1) the heat conduction resistance of system-insulating layers below the pipes of heating/cooling systems in $(m^2 \cdot K)/W$ can be limited according to the following values:

— 0,75 $(m^2 \cdot K)/W$ for heated room below or adjacent;

— 1,25 $(m^2 \cdot K)/W$ for unheated or intermittent heated room below, adjacent or directly on the ground (with ground water level ≤5 m below the supporting base, the value should be increased) and external air temperature below or adjacent (external design temperature ≥0 °C);

— 1,5 $(m^2 \cdot K)/W$ for external air temperature below or adjacent (external design temperature between 0 °C and -5 °C);

— 2 $(m^2 \cdot K)/W$ for external air temperature below or adjacent (external design temperature between -5 °C and -15 °C).

NOTE 1 Insulation is not vapour barrier.

NOTE 2 National building codes can require higher insulation levels.

5.1.2.3.3 Insulating layers for systems in refurbished systems

For systems for refurbished systems, a calculation shall be made for the evaluation of thermal downward heat loss (thermal output throughout the floor construction, to rooms beyond, the ground or cold void).

It is recommended to limit the percentage of losses towards the environment as reported in Formula (2).

$$\frac{q_u}{q+q_u} < 30\,\% \tag{2}$$

where

q is the thermal output of floor heating systems divided by the surface area, in W/m^2;

q_u is the specific thermal output throughout the floor construction, to rooms beyond, the ground or cold void, in W/m^2.

The calculation shall be performed by using FEM and/or FDM calculations (see ISO 11855-2:2021, Annex D) or other calculation methods. The calculation shall be done for each type of stratigraphy (e.g. for all types of flooring and insulation).

5.1.2.3.4 Peripheral strip

Before laying the screed, a peripheral strip (edge joint) shall be placed along the walls and other building components penetrating the screed and firmly secured to the vertical structures (e.g. door frames, pillars and risers).

The peripheral strip shall rise from the supporting base up to the surface of the finished floor and permit a movement of the screed of at least 5 mm.

In the case of multiple insulating layers, the peripheral strip shall be placed before application of the upper insulating layer. When laying the screed, the peripheral strip shall be secured against any change in position. The top part of the peripheral strip which rises over the finished floor shall not be cut off until completion of the floor covering and, in the case of textile and plastic coverings, hardening of the filler.

5.1.2.4 Protection layer

Before laying the screed, the insulating layer shall be covered with a protective layer consisting of a plastic film of at least 0,15 mm thickness, with a minimum of 80 mm overlap, or with another product of equivalent function.

The protective layer shall be turned upwards above the upper edge of the peripheral strip unless the strip itself fulfils the function of protection. The peripheral strip shall be firmly secured to the insulating layer to avoid the infiltration of the liquid screed. When using synthetic resin screeds or calcium sulphate screeds, the protective layer of the insulating layer must be liquid-tight by, for instance, being stuck or welded together.

NOTE Protective layers are not moisture barriers.

5.1.2.5 Equipment

5.1.2.5.1 Safety

For heating systems, a safety device, independent of the control unit, and which operates even in the absence of electric power, shall cut off the heat supply in the floor heating circuit in such a way that the temperature around the heating elements does not exceed 55 °C in the case of cement or calcium sulfate; for other screed materials, this value can be reduced to, for instance 45 °C for asphalt screed. For cooling systems, the control system shall prevent condensation with interruption of flow rate or increase in flow temperature.

5.1.2.5.2 Manifolds

The central manifold of the piping system shall be placed in such a manner as to get the shortest flow pipes. Otherwise, the flow pipes can have an unwanted impact on the control of the room temperature.

5.1.2.5.3 Stop valves and balancing devices

Each circuit shall have two stop valves and a balancing device.

5.1.2.6 Plastic and copper piping

Requirements for plastic and copper pipes shall conform to relevant International Standards.

For plastic pipes it is recommended to use pipes with an oxygen-barrier layer in conformity with Annex A. The system shall be protected against corrosion.

In the case of junction of the circuit, or repair of tubes, the technical information of the manufacturer shall be followed.