INTERNATIONAL STANDARD

ISO 11855-5

First edition
2012-04-15

Building environment design — Design, dimensioning, installation and control of embedded radiant heating and cooling systems —

Part 5: Installation

Conception de l'environnement des bâtiments — Conception, construction et fonctionnement des systèmes de chauffage et de refroidissement par rayonnement —

Partie 5: Installation

Reference number
ISO 11855-5:2012(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 11855-5 was prepared by Technical Committee ISO/TC 205, *Building environment design*

ISO 11855 consists of the following parts, under the general title *Building environment design — Design, dimensioning, installation and control of embedded radiant heating and cooling systems*:

— *Part 1: Definition, symbols, and comfort criteria*[1)]

— *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 1 of this International Standard defines 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. In Part 2, steady-state calculation methods for determination of the heating and cooling capacity are provided. Part 3 specifies the design and dimensioning method of radiant heating and cooling systems to ensure the heating and cooling capacity. Part 4 provides a dimensioning and calculation method to design Thermo Active Building Systems (TABS) for energy-saving, since radiant heating and cooling systems can reduce energy consumption and heat source size by using renewable energy. Part 5 describes the installation process for the system to operate as intended. Finally, Part 6 describes a proper control method for 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.

1) Parts 1, 2, 3, 4 and 6 are to be published.

Building environment design — Design, dimensioning, installation and control of embedded radiant heating and cooling systems —

Part 5: Installation

1 Scope

This part of ISO 11855 establishes guidelines on the installation of embedded radiant heating and cooling systems. It specifies 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 part of ISO 11855 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 part of ISO 11855 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 referenced documents are indispensable for the application 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 10508:2006, *Plastics piping systems for hot and cold water installations — Guidance for classification and design*

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

ISO 15874 (all parts), *Plastics piping systems for hot and cold water installations — Polypropylene (PP)*

ISO 15875 (all parts), *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PEX)*

ISO 15876 (all parts), *Plastics piping systems for hot and cold water installations — Polybutylene (PB)*

ISO 15877 (all parts), *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C)*

ISO 21003-1 (all parts), *Multilayer piping systems for hot and cold water installations inside buildings*

ISO 22391 (all parts), *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT)*

EN 1057, *Copper and copper alloys — Seamless, round copper tubes for water and gas in sanitary and heating applications*

EN 1254 (all parts), *Copper and copper alloys — Plumbing fittings*

DIN 4724, *Kunststoff-Rohrleitungssysteme für Warmwasserheizung und Heizkörperanbindung — Vernetztes Polyethylen mittlerer Dichte (PE-MDX)*

3 Terms and definitions

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

NOTE All terms and definitions in this part of ISO 11855 are consistent with ISO 7345, ISO 9229, ISO 9288, ISO 9346 and ISO 16818.

4 Symbols and abbreviations

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

Table 1 — Symbols and abbreviations

Symbol	Unit	Quantity
$R_{\lambda,ins}$	m^2K/W	thermal resistance of the insulating layer of the heating/cooling system
ϑ_d	°C	external design temperature
$\vartheta_{V,des,max}$	°C	maximum heating water flow temperatures
PB	—	polybutylene
PE-X	—	cross-linked polyethylene
PE-MDX	—	cross-linked polyethylene, medium density
PE-RT Systems	—	polyethylene of raised temperature resistance
PP	—	polypropylene
PVC-C	—	chlorinated polyvinyl chloride

5 Installation

5.1 Floor heating and cooling systems

5.1.1 General structural preconditions

The installation of a hot water floor heating and/or cooling system must follow the previous installation of any electrical, sanitary and other pipe facilities. The structure as specified in 5.1.2.1, along with the draught-free closure of all building openings, e.g. windows and outer doors, must be completed.

5.1.2 Building layers, building components

5.1.2.1 Supporting base

The supporting base shall be prepared in accordance with relevant standards. Any pipe work or conduits shall be fixed and encased to provide a level base upon which thermal insulation and/or acoustic insulation is added before laying the heating pipes. In this respect, the necessary structural height shall be taken into account. Where service pipes are installed within the insulating layer, they must be protected against temperature change in accordance with national regulations.

5.1.2.2 Insulating layers, perimeter insulating strip

5.1.2.2.1 Insulating layers

The resistance $R_{\lambda,ins}$ of the insulating layer of the heating/cooling system is specified in Table 2. These requirements are for heating and cooling systems. For cooling systems only, these values are recommended.

Table 2 — Minimum thermal resistance of insulating layers below the pipes of heating/cooling systems (m^2 K)/W

	Heated room below	Unheated or intermittent heated room below or directly on the ground [a]	External design temperature below		
			$\theta_d \geq 0$ °C	0 °C > $\theta_d \geq -5$ °C	-5 °C > $\theta_d \geq -15$ °C
thermal resistance $R_{\lambda,ins}$	0,75	1,25	1,25	1,50	2,00
[a] With ground water level ≤ 5m below the supporting base, the value should be increased.					

When installing the insulating layer, the insulating panels shall be butted tightly together. Multiple insulating layers shall be staggered or placed in such a way that the joints between panels of one layer are out of line with the next layer.

NOTE National building codes may require higher insulation levels.

5.1.2.2.2 Peripheral insulating strip

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

The peripheral insulating 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 insulating strip shall be placed before application of the upper insulating layer. When laying the screed, the peripheral insulating strip shall be secured against any change in position. The top part of the peripheral insulating 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.

5.1.2.3 Protection layer

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

In accordance with 5.1.2.2.2, the protective layer shall be turned pulled up above the upper edge of the peripheral insulating strip unless the strip itself fulfils the function of protection. The peripheral insulating strip shall be firmly secured to the insulating layer to avoid the infiltration of the liquid screed. When using synthetic resin screeds or calcium sulfate 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 humidity barriers.

5.1.2.4 Equipment

5.1.2.4.1 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 the data given in 5.1.2.8.2. For cooling systems, a dew point sensor device is required to interrupt cooling water flow just before condensation forming or coalescing.

5.1.2.4.2 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.

5.1.2.4.3 Stop valves and balancing devices

Each circuit shall have two stop valves and a balancing device. The shut-off and balancing functions shall be independent. At least one circuit per heated/cooled room shall be installed in order to permit temperature control to be either manual or automatic.

NOTE The purpose of installing a balancing device in each circuit is to make sure that each circuit gets its design medium flow rate under design conditions as calculated in the design procedure (see ISO 11855-3).

If other equipment within the heating and cooling system produces the same effect, it is acceptable to install and use this equipment instead of balancing devices, only with the precondition that the effect is verified by testing or calculation performed by an approved institute.

5.1.2.5 Piping (pipes and couplings)

5.1.2.5.1 Plastic piping

Requirements for plastic pipes shall comply with the following International Standards:

— PE-X ISO 15875 (all parts);

— PB ISO 15876 (all parts);

— PP ISO 15874 (all parts);

— PVC-C ISO 15877 (all parts);

— Multilayer Piping Systems ISO 21003 (all parts);

— PE-RT Systems ISO 22391 (all parts);

— PE-MDX DIN 4724.

Calculate the minimum wall thickness in accordance with the following conditions:

a) Service conditions: Class 4 in accordance with ISO 10508:2006;

b) Operating pressure: $\geq$ 4 bar;

c) Lifetime $>$ 50 years.

It is recommended to use pipes with an oxygen-barrier layer in conformity with Annex A. Precautions shall be taken to protect the system against corrosion.

5.1.2.5.2 Copper piping

Copper piping shall comply with the requirements of EN 1057 (pipes) and EN 1254 (fittings). The preferred temper is annealed R220 (see EN 1057, Clause 4).

5.1.2.6 Installation of piping

5.1.2.6.1 Storage and transport

While the pipes are transported, stored and handled, they shall be:

— Protected from anything which could damage them;

— Stored out of direct sunlight (for plastic pipes).

5.1.2.6.2 Clearance area (distance)

The pipes should be placed a distance of more than:

— 50 mm from vertical structures;

— 200 mm from smoke ducts and open fireplaces, open or walled shafts or lift wells.

5.1.2.6.3 Bending radius

Use only a bending radius equal to the radius of bending for the pipes as recommended by the system supplier.

5.1.2.6.4 Couplings

All couplings within the floor construction shall be located and designated exactly on the record drawing.

5.1.2.7 Attachment of pipes

The pipes and their attachment systems shall be secured such that their horizontal and vertical positions are maintained as planned. The vertical deviation upwards of the pipes before and after application of the screed shall not exceed 5 mm at any point. The horizontal deviation of the specified pipe spacing in the heating circuit shall not exceed ± 10 mm at the attachment points. These requirements are not applicable in the area of bends and deflections. The attachment spacing necessary to comply with these requirements is dependent on the tube materials, dimensions and systems. The manufacturer shall specify the maximum permissible distance between attachments.

NOTE More frequent attachments provide greater security concerning pipe positioning. Spacing of the attachments depends on the system applied. Experience has shown that systems with individual attachments necessitate spacing of approximately 50 cm in order to comply with the above-mentioned requirements.

5.1.2.8 Weight-bearing layers

5.1.2.8.1 General

Weight-bearing layers may be screed or timber. Type A and Type C Systems rely on a screed layer. Type B Systems use timber for the load-bearing surface, as well as screed, depending on the construction methods.

Reduced-mass systems such as timber, fibre-reinforced cement screeds or gypsum planks are all examples of Type B Systems.

Only the applicable parts of this part of ISO 11855 are to be taken into account.

5.1.2.8.2 Construction types

For heating screeds, the following types are distinguished (see ISO 11855-2):

— Type A - Systems with pipes inside the load-bearing layer (screed);

— Type B - Systems with pipes under the load-bearing layer (screed or timber);

— Type C - Systems with pipes in a levelling screed, on which the screed is deposited with a double separating layer. The thickness of the levelling screed must be at least 20 mm greater than the diameter of the heating pipes. The screed deposited shall have a thickness of not less than 45 mm.

The thickness of the screed is calculated according to relevant standards taking into account loading capacity and flexural strength class. National standards should be used until an international standard is available.

The nominal thickness above the heating pipes (covering height) shall be, for manufacturing reasons, at least three times the maximum grain of the loading material, but at least 30 mm. For gush asphalt screed, this thickness is at least 15 mm. Otherwise, for gush asphalt screed, Table 3 applies.