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Načrtovanje notranjega okolja v stavbah - Vgrajeni sevalni ogrevalni in hladilni sistemi - 2. del: Določanje načrtovane grelne in hladilne moči (ISO 11855-2:2021)

Building environment design - Embedded radiant heating and cooling systems - Part 2: Determination of the design heating and cooling capacity (ISO 11855-2:2021)

Umweltgerechte Gebäudeplanung - Flächenintegrierte Strahlheizungs- und -kühlsysteme - Teil 2: Bestimmung der Auslegungs-Heiz- bzw. Kühlleistung (ISO 11855-2:2021)

Conception de l'environnement des bâtiments - Systèmes intégrés de chauffage et de refroidissement par rayonnement - Partie 2: Détermination de la puissance calorifique et frigorifique à la conception (ISO 11855-2:2021)

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European foreword

This document (EN ISO 11855-2:2021) has been prepared by Technical Committee ISO/TC 205 "Building environment design" in collaboration with Technical Committee CEN/TC 228 “Heating systems and water based cooling systems in buildings” the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2022, and conflicting national standards shall be withdrawn at the latest by April 2022.

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INTERNATIONAL STANDARD

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Building environment design — Embedded radiant heating and cooling systems —

Part 2: Determination of the design heating and cooling capacity

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

Partie 2: Détermination de la puissance calorifique et frigorifique à la conception

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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).

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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 11855-2:2012), which has been technically revised.

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

— update of the figures for type A and C,

— update of the thermal, relevant material characteristics,

— editorial corrections.

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, this document, 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 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 2: Determination of the design heating and cooling capacity

1 Scope

This document specifies procedures and conditions to enable the heat flux in water-based surface heating and cooling systems to be determined relative to the medium differential temperature for systems. The determination of thermal performance of water-based surface heating and cooling systems and their conformity to this document is carried out by calculation in accordance with design documents and a model. This enables a uniform assessment and calculation of water-based surface heating and cooling systems.

The surface temperature and the temperature uniformity of the heated/cooled surface, nominal heat flux between water and space, the associated nominal medium differential temperature, and the field of characteristic curves for the relationship between heat flux and the determining variables are given as the result.

This document includes a general method based on finite difference or finite element Methods and simplified calculation methods depending on position of pipes and type of 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 —Embedded radiant heating and cooling systems — Part 1: Definitions, symbols, and comfort criteria*

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
A_A	m^2	Surface of the occupied area
A_F	m^2	Surface of the heating or cooling surface area

Table 1 *(continued)*

Symbol	Unit	Quantity
A_R	m^2	Surface of the peripheral area
b_u	—	Calculation factor depending on the pipe spacing
B, B_G, B_0	$W/(m^2 \cdot K)$	Coefficients depending on the system
D	m	External diameter of the pipe, including sheathing where used
d_a	m	External diameter of the pipe
d_i	m	Internal diameter of the pipe
d_M	m	External diameter of sheathing
c_{Wa}	kJ/(kg·K)	Specific heat capacity of water
h_t	$W/(m^2 \cdot K)$	Total heat transfer coefficient (convection + radiation) between surface and space
$h_{A\text{-}F}$	$W/(m^2 \cdot K)$	Total heat transfer coefficient (convection + radiation) between surface and space (floor)
$h_{A\text{-}W}$	$W/(m^2 \cdot K)$	Total heat transfer coefficient (convection + radiation) between surface and space (wall)
$h_{A\text{-}C}$	$W/(m^2 \cdot K)$	Total heat transfer coefficient (convection + radiation) between surface and space (ceiling)
K_H	$W/(m^2 \cdot K)$	Equivalent heat transmission coefficient
K_{WL}	—	Parameter for heat conducting devices
k_{CL}	—	Parameter for heat conducting layer
L_{WL}	m	Width of heat conducting devices
L_{fin}	m	Width of fin (horizontal part of heat conducting device seen as a heating fin)
L_R	m	Length of installed pipes
m	—	Exponents for determination of characteristic curves
m_D	—	Exponents for determination of characteristic curves
m_u	—	Exponents for determination of characteristic curves
m_T	—	Exponents for determination of characteristic curves
m_H	kg/s	Design heating or cooling medium flow rate
n, n_G	—	Exponents
q	W/m^2	Heat flux at the surface
q_A	W/m^2	Heat flux in the occupied area
q_{des}	W/m^2	Design heat flux
q_G	W/m^2	Limit heat flux
q_N	W/m^2	Nominal heat flux
q_R	W/m^2	Heat flux in the peripheral area
q_u	W/m^2	Outward heat flux
R_o	$m^2 \cdot K/W$	Partial inwards heat transmission resistance of surface structure
R_u	$m^2 \cdot K/W$	Partial outwards heat transmission resistance of surface structure
$R_{\lambda,B}$	$m^2 \cdot K/W$	Thermal resistance of surface covering
$R_{\lambda,ins}$	$m^2 \cdot K/W$	Thermal resistance of thermal insulation
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_l	m	In type B systems, thickness of thermal insulation from the outward edge of the insulation to the outward edge of the pipes (see Figure 2)
s_{ins}	m	Thickness of thermal insulation
s_R	m	Pipe wall thickness
s_u	m	Thickness of the layer above the pipe

Table 1 *(continued)*

Symbol	Unit	Quantity
s_{WL}	m	Thickness of heat conducting device
S	m	Thickness of the screed (excluding the pipes in type A systems)
W	m	Pipe spacing
h	W/(m²·K)	Heat exchange coefficient
α_i	—	Parameter factors for calculation of characteristic curves
λ_{WL}	W/(m·K)	Heat conductivity of the heat diffusion device material
$\theta_{s,max}$	°C	Maximum surface temperature
$\theta_{s,min}$	°C	Minimum surface temperature
θ_i	°C	Design indoor temperature
θ_m	°C	Temperature of the heating or cooling medium
$\theta_{s,m}$	°C	Average surface temperature
θ_R	°C	Return temperature of heating or cooling medium
θ_V	°C	Supply temperature of heating or cooling medium
θ_u	°C	Indoor temperature in an adjacent space
$\Delta\theta_H$	K	Heating or cooling medium differential temperature
$\Delta\theta_{H,des}$	K	Design heating or cooling medium differential temperature
$\Delta\theta_{H,G}$	K	Limit of heating or cooling medium differential temperature
$\Delta\theta_N$	K	Nominal heating or cooling medium differential temperature
$\Delta\theta_V$	K	Heating or cooling medium differential supply temperature
$\Delta\theta_{V,des}$	K	Design heating or cooling medium differential supply temperature
λ	W/(m·K)	Thermal conductivity
σ	K	Temperature drop $\theta_V - \theta_R$
φ	—	Conversion factor for temperatures
ψ	—	Volume ratio of the attachment studs in the screed

5 Concept of the method to determine the heating and cooling capacity

A given type of surface (floor, wall, ceiling) delivers, at a given average surface temperature and indoor temperature (operative temperature θ_i), the same heat flux in any space independent of the type of embedded system. It is, therefore, possible to establish a basic formula or characteristic curve for cooling and a basic formula or characteristic curve for heating, for each of the type of surfaces (floor, wall, ceiling), independent of the type of embedded system, which is applicable to all heating and cooling surfaces (see Clause 6).

Two methods are included in this document:

— simplified calculation methods depending on the type of system (see Clause 7);

— finite element method and finite difference method (see Clause 8).

Different simplified calculation methods are included in Clause 7 for calculation of the surface temperature (average, maximum and minimum temperature) depending on the system construction (type of pipe, pipe diameter, pipe distance, mounting of pipe, heat conducting devices, distribution layer) and construction of the floor/wall/ceiling [covering, insulation layer, trapped air layer (Annex E), etc.]. The simplified calculation methods are specific for the given type of system, and the boundary conditions listed in Clause 7 shall be met. In the calculation report, it shall be clearly stated which calculation method has been applied.