# SVENSK STANDARD
# SS-EN ISO 11855-4:2015

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**Byggnadsprojektering med miljöhänsyn – Projektering, dimensionering, installation och reglering av inbyggda strålningsverkande värme- och kylsystem –**
**Del 4: Dimensionering och beräkning av den dynamiska värme- och kylkapaciteten i Thermo-Active Building Systems (TABS) (ISO 11855-4:2012)**

**Building environment design – Design, dimensioning, installation and control of embedded radiant heating and cooling systems –**
**Part 4: Dimensioning and calculation of the dynamic heating and cooling capacity of Thermo Active Building Systems (TABS) (ISO 11855-4:2012)**

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Europastandarden EN ISO 11855-4:2015 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN ISO 11855-4:2015.

Denna standard ersätter SS-EN 15377-3:2007, utgåva 1 och SS-ISO 11855-4:2012, utgåva 1.

The European Standard EN ISO 11855-4:2015 has the status of a Swedish Standard. This document contains the official English version of EN ISO 11855-4:2015.

This standard supersedes the Swedish Standard SS-EN 15377-3:2007, edition 1 and SS-ISO 11855-4:2012, edition 1.



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Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på www.sis.se - där hittar du mer information.

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN ISO 11855-4

August 2015

ICS 91.140.10; 91.140.30

Supersedes EN 15377-3:2007

English Version

# Building environment design - Design, dimensioning, installation and control of embedded radiant heating and cooling systems - Part 4: Dimensioning and calculation of the dynamic heating and cooling capacity of Thermo Active Building Systems (TABS) (ISO 11855-4:2012)

Conception de l'environnement des bâtiments - Conception, construction et fonctionnement des systèmes de chauffage et de refroidissement par rayonnement - Partie 4: Dimensionnement et calculs relatifs au chauffage adiabatique et à la puissance frigorifique pour systèmes thermoactifs (TABS) (ISO 11855-4:2012)

Umweltgerechte Gebäudeplanung - Planung, Auslegung, Installation und Steuerung flächenintegrierter Strahlheizungs- und -kühlsysteme - Teil 4: Auslegung und Berechnung der dynamischen Wärme- und Kühlleistung für thermoaktive Bauteilsysteme (TABS) (ISO 11855-4:2012)

This European Standard was approved by CEN on 30 July 2015.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**



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# European foreword

The text of ISO 11855-4:2012 has been prepared by Technical Committee ISO/TC 205 “Building environment design” of the International Organization for Standardization (ISO) and has been taken over as EN ISO 11855-4:2015 by 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 February 2016, and conflicting national standards shall be withdrawn at the latest by February 2016.

This standard is applicable for design, construction and operation of radiant heating and cooling systems. The methods defined in part 2 are intended to determine the design heating or cooling capacity used for the design and evaluation of the performance of the system.
For identifying product characteristics by testing and proving the thermal output of heating and cooling surfaces embedded in floors, ceilings and walls the standard series EN 1264 can be used.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15377-3:2007.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

**Endorsement notice**

The text of ISO 11855-4:2012 has been approved by CEN as EN ISO 11855-4:2015 without any modification.

# 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 shall be applied to systems using not only water but also other fluids or electricity as a heating or cooling medium.

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, operation, and control method of embedded systems.

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

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

## 1 Scope

This part of ISO 11855 allows the calculation of peak cooling capacity of Thermo Active Building Systems (TABS), based on heat gains, such as solar gains, internal heat gains, and ventilation, and the calculation of the cooling power demand on the water side, to be used to size the cooling system, as regards the chiller size, fluid flow rate, etc.

This part of ISO 11855 defines a detailed method aimed at the calculation of heating and cooling capacity in non-steady state conditions.

The ISO 11855 series 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. It does not apply to panel systems with open air gaps which are not integrated into the building structure.

The ISO 11855 series also applies, as appropriate, to the use of fluids other than water 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.

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

## 3 Terms and definitions

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

## 4 Symbols and abbreviations

For the purposes of this part of ISO 11855, the symbols and abbreviations in Table 1 apply:

**Table 1 — Symbols and abbreviations**

| Symbol | Unit | Quantity |
|---|---|---|
| $A_F$ | $m^2$ | Area of the heating/cooling surface area |
| $A_W$ | $m^2$ | Total area of internal vertical walls (i.e. vertical walls, external façades excluded) |
| $C$ | $J/(m^2 \cdot K)$ | Specific thermal capacity of the thermal node under consideration |
| $C_W$ | $J/(m^2 \cdot K)$ | Average specific thermal capacity of the internal walls |
| $c_j$ | J/(kg·K) | Specific heat of the material constituting the j-th layer of the slab |
| $c_w$ | J/(kg·K) | Specific heat of water |
| $d_a$ | m | External diameter of the pipe |
| $E_{Day}$ | $kWh/m^2$ | Specific daily energy gains |
| $f_{rm}^h$ | - | Running mode (1 when the system is running; 0 when the system is switched off) in the h-th hour |
| $f_s$ | - | Design safety factor |
| $F_{v\ F\text{-}C}$ | - | View factor between the floor and the ceiling |
| $F_{v\ F\text{-}EW}$ | - | View factor between the floor and the external walls |
| $F_{v\ F\text{-}W}$ | - | View factor between the floor and the internal walls |
| $h_{A\text{-}C}$ | $W/(m^2 \cdot K)$ | Convective heat transfer coefficient between the air and the ceiling |
| $h_{A\text{-}F}$ | $W/(m^2 \cdot K)$ | Convective heat transfer coefficient between the air and the floor |
| $h_{A\text{-}W}$ | $W/(m^2 \cdot K)$ | Convective heat transfer coefficient between the air and the internal walls |
| $h_{F\text{-}C}$ | $W/(m^2 \cdot K)$ | Radiant heat transfer coefficient between the floor and the ceiling |
| $h_{F\text{-}W}$ | $W/(m^2 \cdot K)$ | Radiant heat transfer coefficient between the floor and the internal walls |
| $H_A$ | W/K | Heat transfer coefficient between the thermal node under consideration and the air thermal node (“A”) |
| $H_C$ | W/K | Heat transfer coefficient between the thermal node under consideration and the ceiling surface thermal node (“C”) |
| $H_{Circuit}$ | W/K | Heat transfer coefficient between the thermal node under consideration and the circuit |
| $H_{CondDown}$ | W/K | Heat transfer coefficient between the thermal node under consideration and the next one |
| $H_{CondUp}$ | W/K | Heat transfer coefficient between the thermal node under consideration and the previous one |
| $H_{Conv}$ | - | Fraction of internal convective heat gains acting on the thermal node under consideration |
| $H_F$ | W/K | Heat transfer coefficient between the thermal node under consideration and the floor surface thermal node (“F”) |
| $H_{Inertia}$ | W/K | Coefficient connected to the inertia contribution at the thermal node under consideration |
| $H_{IWS}$ | W/K | Heat transfer coefficient between the thermal node under consideration and the internal wall surface thermal node (“IWS”) |
| $H_{Rad}$ | - | Fraction of total radiant heat gains impinging on the thermal node under consideration |
| $h_t$ | $W/(m^2 \cdot K)$ | Total heat transfer coefficient (convection + radiation) between surface and space |
| $J$ | - | Number of layers constituting the slab as a whole |

| Symbol | Unit | Quantity |
|---|---|---|
| $J_1$ | - | Number of layers constituting the upper part of the slab |
| $J_2$ | - | Number of layers constituting the lower part of the slab |
| $L_R$ | m | Length of installed pipes |
| $\dot{m}_{H,sp}$ | kg/(m$^2$·s) | Specific water flow in the circuit, calculated on the area covered by the circuit |
| $m_j$ | - | Number of partitions of the j-th layer of the slab |
| $n$ | - | Actual number of iteration in iterative calculations |
| $n_h$ | h | Number of operation hours of the circuit |
| $n^{Max}$ | - | Maximum number of iterations allowed in iterative calculations |
| $P_{Circuit}^{Max,h}$ | W | Maximum cooling power reserved to the circuit under consideration in the h-th hour |
| $P_{Circuit,Spec}^{Max}$ | W/m$^2$ | Maximum specific cooling power (per floor square metre) |
| $q_i$ | W/m$^2$ | Inward specific heat flow |
| $q_u$ | W/m$^2$ | Outward specific heat flow |
| $Q_C^h$ | W | Heat flow impinging on the ceiling surface (“C”) in the h-th hour |
| $Q_{Circuit}^h$ | W | Heat flow extracted by the circuit in the h-th hour |
| $Q_{Conv}^h$ | W | Total convective heat gains in the h-th hour |
| $Q_F^h$ | W | Heat flow impinging on the floor surface (“F”) in the h-th hour |
| $Q_{IntConv}^h$ | W | Internal convective heat gains in the h-th hour |
| $Q_{IntRad}^h$ | W | Internal radiant heat gains in the h-th hour |
| $Q_{IWS}^h$ | W | Heat flow impinging on the internal wall surface (“IWS”) in the h-th hour |
| $Q_{PrimAir}^h$ | W | Primary air convective heat gains in the h-th hour |
| $Q_{Rad}^h$ | W | Total radiant heat gains in the h-th hour |
| $Q_{Sun}^h$ | W | Solar heat gains in the room in the h-th hour |
| $Q_{Transm}^h$ | W | Transmission heat gains in the h-th hour |
| $Q_W$ | W/m$^2$ | Average specific cooling power |
| $R$ | (m$^2$·K)/W | Generic thermal resistance |
| $R_{Add\ C}$ | (m$^2$·K)/W | Additional thermal resistance covering the lower side of the slab |
| $R_{Add\ F}$ | (m$^2$·K)/W | Additional thermal resistance covering the upper side of the slab |
| $RCAC$ | K/W | Convection thermal resistance connecting the air thermal node (“A”) with the ceiling surface thermal node (“C”) |
| $RCAF$ | K/W | Convection thermal resistance connecting the air thermal node (“A”) with the floor surface thermal node (“F”) |
| $RCAW$ | K/W | Convection thermal resistance connecting the air thermal node (“A”) with the internal wall surface thermal node (“IWS”) |