SLOVENSKI STANDARD
SIST EN 15377-1:2008

01-november-2008

Ogrevalni sistemi v stavbah - Naļ rtovanje vodnih sistemov za ogrevanje in hlajenje, vgrajenih v konstrukcijo - 1. del: Doloļ evanje naļ rtovane izhodne toplotne in hladilne moļ i povrġine

Heating systems in buildings - Design of embedded water based surface heating and cooling systems - Part 1: Determination of the design heating and cooling capacity

Heizungssysteme in Gebäuden - Planung von eingebetteten Flächenheiz- und -kühlsystemen mit Wasser als Arbeitsmedium - Teil 1: Bestimmung der Norm-Heiz- bzw. -kühlleistung

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7e9-795c-4242-94a8-
Systèmes de chauffage dans les bâtiments - Méthode de calculs économiques appliquée aux systèmes énergétiques dans les bâtiments, avec prise en compte des énergies renouvelables

Ta slovenski standard je istoveten z: **EN 15377-1:2008**

ICS:

91.140.10	Sistemi centralnega ogrevanja	Central heating systems

SIST EN 15377-1:2008 **en,de**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

SIST EN 15377-1:2008

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

SIST EN 15377-1:2008

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15377-1

June 2008

ICS 91.140.10; 91.140.30

English Version

Heating systems in buildings - Design of embedded water based surface heating and cooling systems - Part 1: Determination of the design heating and cooling capacity

Systèmes de chauffage dans les bâtiments - Méthode de calculs économiques appliquée aux systèmes énergétiques dans les bâtiments, avec prise en compte des énergies renouvelables

Heizungsanlagen in Gebäuden - Planung von eingebetteten Flächenheiz- und Kühlsystemen mit Wasser als Arbeitsmedium - Teil 1: Bestimmung der Auslegungs-Heiz- bzw. Kühlleistung

This European Standard was approved by CEN on 22 May 2008.

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 Management Centre or to any CEN member.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

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 Management Centre has the same status as the official versions.

SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/0b58a7f9-793c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

© 2008 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

SIST EN 15377-1:2008

Contents

Page

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

SIST EN 15377-1:2008

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

SIST EN 15377-1:2008

Foreword

This document (EN 15377-1:2008) has been prepared by Technical Committee CEN/TC 228 “Heating systems in buildings”, the secretariat of which is held by DS.

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 December 2008, and conflicting national standards shall be withdrawn at the latest by December 2008.

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.

The subjects covered by CEN/TC 228 are the following:

— design of heating systems (water based, electrical, etc.);

— installation of heating systems;

— commissioning of heating systems;

— instructions for operation, maintenance and use of heating systems;

— methods for calculation of the design heat loss and heat loads;

— methods for calculation of the energy performance of heating systems;

— methods for design and dimensioning of embedded water based surface heating and cooling systems.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ea5c1da/sist-en-15377-1-2008

Heating systems also include the effect of attached systems such as hot water production systems.

All these standards are systems standards, i.e. they are based on requirements addressed to the system as a whole and not dealing with requirements to the products within the system.

Where possible, reference is made to other European or International Standards, a.o. product standards. However, use of products complying with relevant product standards is no guarantee of compliance with the system requirements.

The requirements are mainly expressed as functional requirements, i.e. requirements dealing with the function of the system and not specifying shape, material, dimensions or the like.

The guidelines describe ways to meet the requirements, but other ways to fulfil the functional requirements might be used if fulfilment can be proved.

Heating systems differ among the member countries due to climate, traditions and national regulations. In some cases requirements are given as classes so national or individual needs may be accommodated.

In cases where the standards contradict with national regulations, the latter should be followed.

EN 15377 *Heating systems in buildings — Design of embedded water based surface heating and cooling systems* consists of the following parts:

— *Part 1: Determination of the design heating and cooling capacity;*

SIST EN 15377-1:2008

— *Part 2: Design, dimensioning and installation;*

— *Part 3: Optimizing for use of renewable energy sources.*

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

SIST EN 15377-1:2008

Introduction

The determination of thermal performance of water based surface heating and cooling systems and their conformity to this standard is carried out by calculation in accordance with design documents and a model. In the case of special constructions and if necessary, the determination of thermal performance by calculation is combined with a test method according to EN 1264.

This standard specifies procedures and conditions to enable the heat flow in water based surface heating and cooling systems to be determined relative to the medium differential temperature for systems. This should enable 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 flow intensity between water and space, the associated nominal medium differential temperature and the field of characteristic curves for the relationship between heat flow intensity and the determining variables are given as the result.

This standard includes several methods like general Finite Difference or Finite Element Methods, simplified calculation methods depending on position of pipes and type of building structure. The simplified calculation methods are specific for the type of system. For systems which are calculable in accordance with EN 1264, the standard refers to EN 1264-2 and -5. The simplified methods include certain boundary conditions which need to be met before the given method is applied.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

SIST EN 15377-1:2008

1 Scope

This European Standard is applicable to water based 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.

The methods do not apply to heated or chilled ceiling panels or beams.

This European Standard provides steady-state calculation methods for determination of the heating and cooling capacity (part 1).

This European Standard estimates an equivalent system resistance to be used in dynamic building simulation programs.

This European Standard applies also, as appropriate, to the use of other fluids instead of water.

A separate standard provides a method for design, dimensioning and installation of the system (part 2).

This European Standard is not applicable for testing or certification of systems.

A separate standard provides a method and guidance on how to optimise the design for use of renewable energy sources and take system dynamic effects into account (part 3).

iTeh STANDARD PREVIEW
(standards.iteh.ai)

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.

SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

EN 1264-1, *Floor heating — Systems and components — Part 1: Definitions and symbols*

prEN 1264-2, *Water based surface embedded heating and cooling systems — Part 2: Floor heating: Prove methods for the determination of the thermal output using calculation and test methods*

prEN 1264-3, *Water based surface embedded heating and cooling systems — Part 3: Dimensioning*

prEN 1264-4, *Water based surface embedded heating and cooling systems — Part 4: Installation*

prEN 1264-5, *Water based surface embedded heating and cooling systems — Part 5: Heating and cooling surfaces embedded in floors, ceilings and walls — Determination of the thermal output*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1 Embedded surface heating and cooling system

3.1.1
embedded surface heating and cooling system
system that consists of circuits of pipes embedded in floor, wall or ceiling construction, distributors and control equipment

SIST EN 15377-1:2008

3.1.2
floor (wall, ceiling) heating and cooling system, water based
embedded surface heating and cooling system where pipes carrying water with or without additives as a medium are laid in the floor (wall, ceiling)

3.1.3
circuit
section of an embedded surface heating/cooling system connected to a distributor which can be independently switched and controlled

3.1.4
distributor
common connection point for several circuits

3.1.5
open air gap
air gap in the floor, wall, ceiling construction, where air exchange with space or outside may occur

3.2 Design parameters

3.2.1
design heat load ($Q_{N,h}$)
required heat flow necessary to achieve the specified design conditions at the outside winter design conditions

NOTE When calculating the value of the design heat load, the heat flow from embedded heating systems into neighbour rooms is not taken into account.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

3.2.2
design heating capacity ($Q_{H,h}$)
thermal output at design conditions of a surface heated room

SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

3.2.3
design cooling load ($Q_{N,c}$)
required heat flow necessary to achieve the specified design conditions at the outside summer design conditions

3.2.4
design cooling capacity ($Q_{H,c}$)
thermal output at design conditions of a surface cooled room

3.2.5
heating/cooling capacity for circuit (Q_{HC})
heat exchange between a pipe circuit and the conditioned room

3.2.6
design heating/cooling medium flow rate (m_H)
mass flow rate in a circuit which is needed to achieve the design heat flow intensity

3.2.7
design indoor temperature (θ_i)
operative temperature at the centre of the conditioned space used for calculation of the design load and capacity

NOTE The operative temperature is considered as relevant for thermal comfort assessment and heat loss calculations. This value of internal temperature is used for the calculation method.

SIST EN 15377-1:2008

3.2.8
heating or cooling surface area (A_f)
area of surface (floor, wall, ceiling) covered by the embedded surface heating/cooling system between the pipes at the outer edges of the system with the addition of a strip at each edge of width equal to half the pipe spacing, but not exceeding 0,15 m

3.2.9
non-active area
area of the surface not covered by the embedded surface heating/cooling system

3.2.10
peripheral area
surface area which is heated or cooled to a higher or lower temperature and which is an unoccupied area generally of maximum 1 m width along exterior walls

3.2.11
occupied zone
part of the conditioned zone in which persons normally reside and where requirements as to the internal environment are to be satisfied

NOTE Normally the zone between the floor and 1,8 m above the floor and 1,0 m from external walls/windows and 0,5 m from internal walls.

3.2.12
surface heating and cooling components
components for surface heating and cooling comprising:

iTeh STANDARD PREVIEW
(standards.iteh.ai)

— insulating layer (for thermal and/or impact noise insulation);

— the protection layer (to protect the insulating layer);

SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

— the pipes or plane sections;

— the load and thermal distribution layer, where pipes are embedded;

— covering;

— other items such as conducting devices, peripheral strips, attachment items etc.

NOTE Components can differ depending on the system.

3.3 Thermal capacity

3.3.1
heat flow intensity (q)
heat flow between the space and surface divided by the heated/cooled surface

3.3.2
limit heat flow intensity (q_G)
heat flow intensity at which the maximum or minimum permissible surface temperature is achieved

3.3.3
nominal heat flow intensity (q_N)
limit heat flow intensity achieved without surface covering

SIST EN 15377-1:2008

3.3.4
design heat flow intensity (q_{des})
heat flow divided by the heating or cooling surface, taking into account the surface temperature required to reach the design thermal capacity of a surface heated or cooled space, Q_H, reduced by the thermal capacity of any supplementary heating or cooling equipment, if applicable

3.3.5
outward heat flow intensity (q_U)
heat flow which is exchanged through the construction with unconditioned spaces, another building entity, the ground or outdoor air

3.3.6
thermal output of surface system (Q_F)
sum of the products of the heating or cooled surfaces of a space with the associated design heat flow densities

3.3.7
heat transfer coefficient (h_t)
combined convective and radiant heat transfer coefficient between the heated or cooled surface and the space operative temperature (design indoor temperature)

3.4 Surface temperatures

3.4.1
maximum surface temperature ($\theta_{S,max}$)
maximum temperature permissible for physiological reasons or building physics reasons, for calculation of the limit curves, which may occur at a point on the surface (floor, wall, ceiling) in the occupied or peripheral area depending on the particular usage at a temperature drop σ of the heating medium equal to 0

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

3.4.2
average surface temperature ($\theta_{S,m}$)
average value of all surface temperatures in the occupied or peripheral area

3.4.3
mean surface temperature difference
difference between the average surface temperature $\theta_{S,m}$ and the design indoor temperature θ_i

NOTE The mean surface temperature difference determines the heat flow intensity.

3.4.4
minimum surface temperature ($\theta_{S,min}$)
minimum temperature permissible for physiological reasons or building physics reasons, for calculation of the limit curves, which may occur at a point on the surface (floor, wall, ceiling) in the occupied or peripheral area depending on the particular usage at a temperature drop σ of the heating medium equal to 0

3.5 Temperatures of the heating/cooling medium

3.5.1
heating/cooling medium differential temperature ($\Delta\theta_H$)
logarithmical determined average difference between the temperatures of the heating/cooling medium and the design indoor temperature:

SIST EN 15377-1:2008

$$\Delta\theta_H = \frac{|\theta_V - \theta_R|}{\ln \frac{|\theta_V - \theta_i|}{|\theta_R - \theta_i|}} \quad \textbf{(K)} \qquad (1)$$

3.5.2
nominal heating/cooling medium differential temperature ($\Delta\theta_N$)
absolute temperature difference at nominal heat flow intensity q_N

3.5.3
design heating/cooling medium differential temperature ($\Delta\theta_{H,des}$)
temperature difference at design heat flow intensity

3.5.4
temperature of the heating/cooling medium (θ_m)
average temperature between the supply and the return temperature defined as:

$$\theta_m = \theta_I + \Delta\theta_H = \theta_I + \frac{|\theta_V - \theta_R|}{\ln \frac{|\theta_V - \theta_i|}{|\theta_R - \theta_i|}} \quad \textbf{(°C)} \qquad (2)$$

3.5.5
temperature drop (σ)
difference between the supply and return temperature of the heating/cooling medium in a circuit

iTeh STANDARD PREVIEW
(standards.iteh.ai)

3.6 Characteristic curves

SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

3.6.1
basic characteristic curve
curve or formula reflecting the relationship between the heat flow intensity and the mean surface temperature difference

NOTE The basic characteristic curve is dependent on heating/cooling and surface (floor/wall/ceiling) but not on the type of embedded system.

3.6.2
family of characteristic curves
curves denoting the system-specific relationship between the heat flow intensity q and the required heating medium differential temperature $\Delta\theta_H$ for conduction resistance of various floor coverings

3.6.3
limit curves
curves in the field of characteristic curves showing the pattern of the limit heat flow intensity depending on the heating medium differential temperature and the floor covering

3.6.4
limit heating medium differential temperature ($\Delta\theta_{H,G}$)
differential temperature determined by the intersection of the system characteristic curve with the limit curve

SIST EN 15377-1:2008

4 Symbols and units

For the purposes of this standard, the symbols and units in Table 1 apply.

Table 1 — Symbols and units

Symbol	Unit	Quantity
a_i	-	Parameter factors for calculation of characteristic curves
A_A	m^2	Surface of the occupied area
A_F	m^2	Surface of the heating/cooling surface area
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
c_W	$kJ/(kg \cdot K)$	Specific heat capacity of water
h_t	$W/(m^2 \cdot K)$	Total heat transfer coefficient (convection + radiation) between surface and space
L_R	m	Length of installed pipes
m_i	-	Exponents for determination of characteristic curves
m_H	kg/s	Design heating/cooling medium flow rate
n, n_G	-	Exponents
q	W/m^2	Heat flow intensity at the surface
q_A	W/m^2	Heat flow intensity in the occupied area
q_{des}	W/m^2	Design heat flow intensity
q_G	W/m^2	Limit heat flow intensity
q_N	W/m^2	Nominal heat flow intensity
q_R	W/m^2	Heat flow intensity in the peripheral area
q_u	W/m^2	Outward heat flow intensity
Q_s	W	Thermal output of surface heating-cooling
Q_H	W	Design capacity
Q_N	W	Design heat load
$Q_{N,f}$	W	Design heat load of surface heated room
Q_{out}	W	Heat output of supplementary heating equipment
R_i	$m^2 \cdot K/W$	Partial inwards heat transmission resistance of surface structure
R_e	$m^2 \cdot K/W$	Partial external 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

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/a2958aa7c9-795c-4242-94a8-6caa9ca3cfda/sist-en-15377-1-2008

SIST EN 15377-1:2008

Table 1 — Symbols and units

Symbol	Unit	Quantity
s_h	m	For 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	For 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_R	m	Pipe wall thickness
s_u	m	Thickness of the layer inward from the pipe
s_{WL}	m	Thickness of heat conducting device
S	m	Thickness of the screed (excluding the pipes in type A systems)
T	m	Pipe spacing
U	W/m^2·K	Heat transfer coefficient between a conductive layer and a space
α	W/(m^2·K)	Convective heat exchange coefficient
$\theta_{s,m}$	°C	Average surface temperature
$\theta_{s,max}$	°C	Maximum surface temperature
$\theta_{s,min}$	°C	Minimum surface temperature
θ_i	°C	Design indoor temperature
θ_m	°C	Temperature of the heating/cooling medium
θ_R	°C	Return temperature of heating/cooling medium
θ_V	°C	Supply temperature of heating/cooling medium
θ_u	°C	Indoor temperature in an adjacent space
$\Delta\theta_H$	K	Heating/cooling medium differential temperature
$\Delta\theta_{H,des}$	K	Design heating/cooling medium differential temperature
$\Delta\theta_{H,G}$	K	Limit of heating/cooling medium differential temperature
$\Delta\theta_N$	K	Nominal heating/cooling medium differential temperature
$\Delta\theta_V$	K	Heating/cooling medium differential supply temperature
$\Delta\theta_{V,des}$	K	Design heating/cooling medium differential supply temperature
λ	W/(m·K)	Thermal conductivity
σ	K	Temperature drop θ_V - θ_R

iTeh STANDARD PREVIEW
(standards.iteh.ai)
SIST EN 15377-1:2008
https://standards.iteh.ai/catalog/standards/sist/058aa7c9-795c-4242-94a8-