SLOVENSKI STANDARD
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Ploskovni sistemi za ogrevanje in hlajenje z vodo - 2. del: Talno ogrevanje - Preskusne metode za določevanje oddaje toplote z metodo izračuna in preskušanjem

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

Raumflächenintegrierte Heiz- und Kühlsysteme mit Wasserdurchströmung - Teil 2: Fußbodenheizung: Prüfverfahren für die Bestimmung der Wärmeleistung unter Benutzung von Berechnungsmethoden und experimentellen Methoden

Systèmes de surfaces chauffantes et rafraîchissantes hydrauliques intégrées - Partie 2 : Chauffage par le sol: Méthodes de démonstration pour la détermination de l'émission thermique utilisant des méthodes par le calcul et à l'aide de méthodes d'essai

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 130.

If this draft becomes a European Standard, 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.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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European foreword

This document (prEN 1264-2:2020) has been prepared by Technical Committee CEN/TC 130 “Space heating appliances without integral heat sources”, the secretariat of which is held by UNI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1264-2:2008+A1:2012.

This European Standard, *Water based surface embedded heating and cooling systems*, consists of the following parts:

— *Part 1: Definitions and symbols;*

— *Part 2: Floor heating: Methods for the determination of the thermal output using calculations and experimental tests;*

— *Part 3: Dimensioning;*

— *Part 4: Installation;*

— *Part 5: Determination of the thermal output for wall and ceiling heating and for floor, wall and ceiling cooling.*

The main changes with respect to the previous edition are listed below:

a) Modified the title;

b) Clarified the scope;

c) Improved wording, especially the term “prove method”;

d) Modified Clause 9;

e) Deleted Clause 10 Test procedure for the determination of the effective thermal resistance of carpets and all references to this Clause;

f) Removed Figures A.9, A.10 and A.11;

g) Table A.13 Heat conductivities for materials was moved to the new Annex D and was expanded;

h) Deleted Annex B Test procedure for the determination of parameters for application in EN 15377;

i) Added new Annex C Calculation of the specific heat capacity (C-Value).

Introduction

EN 1264 is based on the realization that in the field of commercial trade, the thermal output of heating and cooling systems represents the basis of rating. In order to be able to evaluate and compare different heating and/or cooling systems, it is, therefore, necessary to refer to values determined using one single, unambiguously defined method. The basis for doing so are the test methods for the determination of the thermal output of floor heating systems specified in EN 1264-2. In analogy to EN 442-2, *Radiators and convectors — Part 2: Test methods and rating*, these test methods provide characteristic partial load curves under defined boundary conditions as well as the characteristic output of the system represented by the standard thermal output together with the associated standard temperature difference between the heating medium and the room temperature.

1 Scope

EN 1264 covers surface embedded heating and cooling systems installed in buildings, residential and non-residential (e.g. office, public, commercial and industrial buildings) and focuses on systems installed for the purpose of thermal comfort.

EN 1264 applies to water based heating and cooling systems embedded into the enclosure surfaces of the room to be heated or to be cooled. It also applies as appropriate to the use of other heating media instead of water.

EN 1264 applies to identify standardized product characteristics by calculation and testing the thermal output of heating for technical specifications and certification. For the design, construction and operation of these systems, EN ISO 11855 applies.

The systems covered in EN 1264 are adjoined to the structural base of the enclosure surfaces of the building, mounted directly or with fixing supports. It does not cover ceiling systems mounted in a suspended ceiling with a designed open air gap between the system and the building structure which allows the thermally induced circulation of the air. The thermal output of these systems can be determined according to ISO 18566, EN 14037 and EN 14240.

EN 1264-2 applies to hot water floor heating systems. Applying of EN 1264-5 requires the prior use of EN 1264-2. EN 1264-5 deals with the conversion of the thermal output of floor heating systems determined in EN 1264-2 into the thermal output of heating surfaces embedded in walls and ceilings as well as into the thermal output of cooling surfaces embedded in floors, walls and ceilings.

EN 1264-2 specifies the boundary conditions and the test methods for the determination of the thermal output of hot water floor heating systems as a function of the temperature difference between the heating medium and the room temperature.

The thermal output is tested by a calculation method and by a measurement method. The calculation method is applicable to systems corresponding to the definitions in EN 1264-1 (type A, type B, type C, type D). For systems not corresponding to these definitions, the measurement method shall be used. The calculation method and the measurement method are consistent with each other and provide correlating and adequate test results.

The test results, expressed depending on further parameters, are the standard specific thermal output and the associated standard temperature difference between the heating medium and the room temperature as well as fields of characteristic curves showing the relationship between the specific thermal output and the temperature difference between the heating medium and the room.

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.

EN 1264-1, *Water based surface embedded heating and cooling systems - Part 1: Definitions and symbols*

prEN 1264-3:2019, *Water based surface embedded heating and cooling systems — Part 3: Dimensioning*

EN 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*

EN ISO 11855, *Building environment design — Design, dimensioning, installation and control of embedded radiant heating and cooling systems*

EN 14037, *Free hanging heating and cooling surfaces for water with a temperature below 120 °C*

EN 14240, *Ventilation for buildings - Chilled ceilings - Testing and rating*

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2017)*

ISO 18566, *Building environment design — Design, test methods and control of hydronic radiant heating and cooling panel systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1264-1 apply.

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

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

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

4 Thermal boundary conditions

A floor heating surface with a given average surface temperature exchanges the same thermal output in any room with the same indoor room temperature (standard indoor room temperature ϑ_i). It is therefore possible to give a basic characteristic curve of the relationship between specific thermal output and average surface temperature that is independent of the heating system and applicable to all floor heating surfaces (including those having peripheral areas with greater heat emissions) (see Figure A.1).

In contrast, every floor heating system has its own maximum permissible specific thermal output, the limit specific thermal output, q_G. This output is calculated for an ambient (standard) indoor room temperature ϑ_i = 20 °C. The other condition is the maximum surface temperature $\vartheta_{F,max}$ = 29 °C[1] at temperature drop between supply and return of the heating medium σ = 0 K. The maximum specific thermal output for the peripheral area will be achieved at a maximum surface temperature $\vartheta_{F,max}$ = 35 °C[2] and σ = 0 K.

For the calculation and for the test procedure, the centre of the heating surface is used as the reference point for $\vartheta_{F, max}$, regardless of system type.

The average surface temperature $\vartheta_{F, m}$, determining the specific thermal output (see basic characteristic curve) is linked with the maximum surface temperature. In this context, $\vartheta_{F,m} < \vartheta_{F, max}$ always applies.

The achievable value $\vartheta_{F,m}$ depends on both the floor heating system and the operating conditions (temperature drop $\sigma = \vartheta_V - \vartheta_R$, downward thermal output q_u and heat resistance of the floor covering $R_{\lambda,B}$).

1 National regulations may limit this temperature to a lower value.

2 Some floor covering materials may require lower temperatures.

The calculation of the specific thermal output is based on the following conditions:

— The heat transfer at the floor surface occurs in accordance with the basic characteristic curve.

— The temperature drop of the heating medium $\sigma = 0$; the extent to which the characteristic curve depends on the temperature drop, is covered by using the logarithmically determined temperature difference between the heating medium and the room $\Delta\vartheta_H$ (see Formula (1)).

— Turbulent pipe flow: $m_H/d_i > 4\,000$ kg/(h · m).

— There is no lateral heat flow.

— The heat-conducting layer of the floor heating system is thermally decoupled by thermal insulation from the structural base of the building.

NOTE The aforementioned last condition does not concern the test procedure of Clause 9.

5 Documents for testing

The system supplier's documents are taken as the basis for the determination of the thermal output. The following documents shall be provided:

— Installation drawing (section) of the floor heating system, covering two pipe spacing, including the peripheral area and giving information on the materials used (if necessary, the test results regarding the heat conductivity values of the materials shall be provided).

— Technical documentation of the system.

This information shall contain any details necessary for the calculation of the construction customary on site. It shall be submitted to the installer in the same form.

With a member of the testing body present, a demonstration surface of approximately 2 m × 2 m is constructed to represent the actual construction used on site.

6 Calculation of the specific thermal output (characteristic curves and limit curves)

6.1 General approach

The specific thermal output q at the surface of a floor is determined by the following parameters:

— Pipe spacing T;

— Thickness s_u and heat conductivity λ_E of the layer above the pipe;

— Heat conduction resistance $R_{\lambda,B}$ of the floor covering;

— Pipe external diameter $D = d_a$, including the sheathing ($D = d_M$) if necessary and the heat conductivity of the pipe λ_R or the sheathing λ_M. In case of pipes having non-circular cross sections, the equivalent diameter of a circular pipe having the same circumference shall be used in the calculation (the screed covering shall not be changed). Thickness and heat conductivity of permanently mounted diffusion barrier layers with a thickness up to 0,3 mm need not be considered in the calculation. In this case, $D = d_a$ shall be used;

— Heat diffusion devices having the characteristic value K_{WL} in accordance with 6.3;

— Contact between the pipes and the heat diffusion devices or the screed, characterized by the factor a_K.

The specific thermal output is proportional to $(\Delta\vartheta_H)^n$, where the temperature difference between the heating medium and the room temperature is:

$$\Delta\vartheta_H = \frac{\vartheta_V - \vartheta_R}{\ln\frac{\vartheta_V - \vartheta_i}{\vartheta_R - \vartheta_i}} \quad (1)$$

and where experimental and theoretical investigations of the exponent n have shown that:

$$1{,}0 < n < 1{,}05 \quad (2)$$

Within the limits of the achievable accuracy,

$n = 1$

is used.

The specific thermal output is calculated using Formula (3).

$$q = B \cdot \prod_i \left(a_i^{m_i}\right) \cdot \Delta\vartheta_H \quad (3)$$

where

B is a system-dependent coefficient, in $W/(m^2 \cdot K)$;

$\prod_i \left(a_i^{m_i}\right)$ is a power product linking the parameters of the floor construction with one another (see 6.2, 6.3 and 6.4).

A distinction shall be made between systems, where the pipes are installed inside or below the screed or wood floors, and systems with surface elements (plane section systems). For usual constructions, Formula (3) applies directly. For systems with additional devices for heat distribution, for air filled hollow sections or for other components influencing the heat distribution, the thermal output is determined experimentally in accordance with Clause 9.

6.2 Systems with pipes installed inside the screed (type A and type C)

For these systems (see Figure A.2), the characteristic curves are calculated in accordance with Formula (4a).

$$q = B \cdot a_B \cdot a_T^{m_T} \cdot a_u^{m_u} \cdot a_D^{m_D} \Delta \cdot \vartheta_H \quad (4a)$$

The product $B \cdot a_B \cdot a_T^{m_T} \cdot a_u^{m_u} \cdot a_D^{m_D}$ is called the equivalent heat transmission coefficient K_H, which leads to the abbreviated form of the expression, Formula (4b):

$$q = K_H \cdot \Delta\vartheta_H \tag{4b}$$

where

$B = B_0 = 6{,}7\ \text{W}/(\text{m}^2 \cdot \text{K})$	for a pipe heat conductivity $\lambda_R = \lambda_{R,0} = 0{,}35\ \text{W}/(\text{m}^2 \cdot \text{K})$ and a pipe wall thickness $s_R = s_{R,0} = (d_a - d_i)/2 = 0{,}002$ m.
a_T	is a spacing factor in accordance with Table A.1; $a_T = f(R_{\lambda,B})$;
a_u	is a covering factor in accordance with Table A.2; $a_u = f(T, R_{\lambda,B})$;
a_D	is the pipe external diameter factor in accordance with Table A.3; $a_D = f(T, R_{\lambda,B})$.

$$m_T = 1 - \frac{T}{0{,}075} \quad \text{applies where } 0{,}050\ \text{m} \le T \le 0{,}375\ \text{m} \tag{5}$$

$$m_u = 100 \cdot (0{,}045 - s_u) \quad \text{applies where } s_u \ge 0{,}010\ \text{m} \tag{6}$$

$$m_D = 250 \cdot (D - 0{,}020) \quad \text{applies where } 0{,}008\ \text{m} \le D \le 0{,}030\ \text{m} \tag{7}$$

For other materials with different heat conductivities or for different pipe wall thicknesses, or for sheathed pipes, B shall be calculated in accordance with 6.6.

For a heating screed with reduced moisture addition, $\lambda_E = 1{,}2\ \text{W}/(\text{m}^2 \cdot \text{K})$ shall be used. This value is also applicable to other heating screeds. If a different value is used, its validity shall be checked.

a_B is the floor covering factor in accordance with Formula (8):

$$a_B = \frac{\dfrac{1}{\alpha} + \dfrac{s_{u,0}}{\lambda_{u,0}}}{\dfrac{1}{\alpha} + \dfrac{s_{u,0}}{\lambda_E} + R_{\lambda,B}} \tag{8}$$

where

α	$= 10{,}8\ \text{W}/(\text{m}^2 \cdot \text{K})$;
$\lambda_{u,0}$	$= 1\ \text{W}/(\text{m} \cdot \text{K})$;
$s_{u,0}$	$= 0{,}045$ m;
$R_{\lambda,B}$	is the heat conduction resistance of the floor covering, in $\text{m}^2 \cdot \text{K/W}$;
λ_E	is the heat conductivity of the screed, in $\text{W}/(\text{m} \cdot \text{K})$;

In Formulae (5), (6) and (7)

T	is the pipe spacing;
D	is the external diameter of the pipe, including sheathing, where applicable;
s_u	is the thickness of the screed covering above the pipe.

For a pipe spacing $T > 0{,}375$ m, the specific thermal output is approximately calculated using

$$q = q_{0,375} \frac{0{,}375}{T} \tag{9}$$

where

$q_{0,375}$ is the specific thermal output, calculated for a spacing T = 0,375 m.

For systems with $s_u \leq 0{,}065$ m as well as $0{,}065 \text{ m} < s_u \leq s_u^*$ (for s_u^* see below), Formula (4a) applies directly. The value of s_u^* depends on the pipe spacing as follows:

For a spacing $T \leq 0{,}200$ m, $s_u^* = 0{,}100$ m applies.

For a spacing $T > 0{,}200$, $s_u^* = 0{,}5\ T$ applies. In this relation, always the actual spacing T shall be used, even if the calculation is done in accordance with Formula (9).

For coverings above the pipe $s_u > s_u^*$, Formula (4b) shall be used. In this case, the equivalent heat transmission coefficient shall be determined in accordance with the Formula (10):

$$K_H = \frac{1}{\dfrac{1}{K_{H,\, s_u = s_u^*}} + \dfrac{s_u - s_u^*}{\lambda_E}} \qquad (10)$$

In Formula (10), $K_{H,\, s_u = s_u^*}$ is the power product from Formula (4a), calculated for a covering s_u^* above the pipe.

The limit curves are calculated in accordance with 6.5.

6.3 Systems with pipes installed below the screed or timber floor (type B)

For these systems (see Figure A.3), the variable thickness s_u of the weight bearing layer and its variable heat conductivity λ_E are covered by the factor a_u. The pipe diameter has no effect. However, the contact between the heating pipe and the heat diffusion device or any other heat distribution device is an important parameter. In this case, the characteristic curve is calculated using Formula (11):

$$q = B \cdot a_B \cdot a_T^{m_T} \cdot a_u \cdot a_{WL} \cdot a_K \cdot \Delta\vartheta_H \qquad (11)$$

where

B	$= B_0 = 6{,}5\ \text{W}/(\text{m}^2 \cdot \text{K})$ under the conditions given for Formulae (4a) and (4b);
a_T	is the pipe spacing factor in accordance with Table A.6; $a_T = f(s_u/\lambda_E)$;
m_T	see Formula (5);
a_u	is the covering factor, which is calculated in accordance with Formula (12):