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Ploskovni sistemi za ogrevanje in hlajenje z vodo - 2. del: Talno ogrevanje - Metode za določevanje oddaje toplote z izračuni in preskušanjem

Water based surface embedded heating and cooling systems - Part 2: Floor heating: Methods for the determination of the thermal output using calculations and experimental tests

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 European Standard was approved by CEN on 12 April 2021.

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 1264-2:2021) 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 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of an identical text or by endorsement, at the latest by November 2021 and conflicting national standards shall be withdrawn at the latest by November 2021.

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

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

The main changes compared to the previous edition are listed below:

a) Modification of the Title;

b) Clarification of the Scope;

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

d) Modification of Clause 9;

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

f) Deletion of Figures A.9, A.10 and A.11;

g) Table A.13, Heat conductivities for materials was moved to the new Annex C and was modified;

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

i) Addition of new Clause 12, Calculation of the specific heat capacity of the system (C-Value).

EN 1264, *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.*

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

Introduction

The EN 1264 series 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 is 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

The EN 1264 series gives guidelines for 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.

The EN 1264 series gives guidelines for water based heating and cooling systems embedded into the enclosure surfaces of the room to be heated or to be cooled. It also specifies the use of other heating media instead of water, as appropriate.

The EN 1264 series specifies 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, see EN 1264-3 and EN 1264-4 for the types A, B, C, D, H, I and J. For the types E, F and G, see the EN ISO 11855 series.

The systems specified in the EN 1264 series are adjoined to the structural base of the enclosure surfaces of the building, mounted directly or with fixing supports. The EN 1264 series does not specify 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 the EN 14037 series and EN 14240.

EN 1264-2 specifies hot water floor heating systems. The application of EN 1264-5 requires the prior use of EN 1264-2. EN 1264-5 specifies 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, B, C, D, H, I and J). The measurement method gives guidance for systems not corresponding to these definitions. 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*

EN 1264-3:2021, *Water based surface embedded heating and cooling systems — Part 3: Dimensioning*

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 https://www.iso.org/obp

— IEC Electropedia: available at https://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 normative Annex A).

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 $\vartheta_i = 20$ °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 $\sigma = 0$ 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 $\sigma = 0$ 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 thermal resistance of the floor covering $R_{\lambda,B}$).

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

2 Some floor covering materials can 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. The thermal insulation need not be directly below the system.

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 thermal 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 thermal conductivity λ_E of the layer above the pipe;

— Thermal 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 thermal 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 thermal 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 calculation method is limited to the boundary conditions listed in Table 1.

Table 1 — Criteria for selection of the simplified calculation method

Type of system	Figure	Boundary conditions	Reference to method
A, C, H, I, J	Figure A.2	$T \geq 0{,}050$ m $s_u \geq 0{,}01$ m $0{,}008$ m $\leq D \leq 0{,}03$ m $s_u/\lambda_e \geq 0{,}01$	6.2
B	Figure A.3	$0{,}05$ m $\leq T \leq 0{,}45$ m $0{,}014$ m $\leq D \leq 0{,}022$ m $0{,}01$ m $\leq s_u/\lambda_e \leq 0{,}18$	6.3
D	Figure A.4		6.4

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).

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

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 (types A, C, H, I, J)

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

$$q = B \cdot a_B \cdot a_T^{m_T} \cdot a_u^{m_u} \cdot a_D^{m_D} \Delta \cdot \vartheta_H \tag{4}$$

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 (5):

$$q = K_H \cdot \Delta\vartheta_H \tag{5}$$

where

$B = B_0 = 6{,}7\ W/(m^2 \cdot K)$ for a pipe thermal conductivity $\lambda_R = \lambda_{R,0} = 0{,}35\ W/(m^2 \cdot K)$ 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; $a_D = f(T, R_{\lambda,B})$.

$$m_T = 1 - \frac{T}{0{,}075} \quad \text{applies where } 0{,}050\ m \le T \le 0{,}375\ m \tag{6}$$

$$m_u = 100 \cdot \left(0{,}045 - s_u\right) \quad \text{applies where } s_u \ge 0{,}010\ m \tag{7}$$

$$m_D = 250 \cdot \left(D - 0{,}020\right) \quad \text{applies where } 0{,}008\ m \le D \le 0{,}030\ m \tag{8}$$

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, a value for λ_E of Table C.1 shall be used. If a different value is used, its validity shall be checked.

a_B is the floor covering factor in accordance with Formula (9):

$$a_B = \frac{\frac{1}{\alpha} + \frac{s_{u,0}}{\lambda_{u,0}}}{\frac{1}{\alpha} + \frac{s_{u,0}}{\lambda_E} + R_{\lambda,B}} \tag{9}$$

where

α = 10,8 W/(m^2 · K);

$\lambda_{u,0}$ = 1 W/(m · K);

$s_{u,0}$ = 0,045 m;

$R_{\lambda,B}$ is the thermal conduction resistance of the floor covering, in m^2 · K/W;

λ_E is the thermal conductivity of the screed, in W/(m · K);

In Formulae (6), (7) and (8)

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

$$q = q_{0,375}\,\frac{0,375}{T} \tag{10}$$

where

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

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

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

For a spacing T > 0,200 m, 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 (10).

For coverings above the pipe $s_u > s_u^*$, Formula (5) shall be used. In this case, the equivalent heat transmission coefficient shall be determined in accordance with the Formula (11):

$$K_H = \frac{1}{\frac{1}{K_{H,\, s_u = s_u^*}} + \frac{s_u - s_u^*}{\lambda_E}} \tag{11}$$

In Formula (11), $K_{H,\, s_u = s_u^*}$ is the power product from Formula (4), 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 thermal 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 (12):

$$q = B \cdot a_B \cdot a_T^{m_T} \cdot a_u \cdot a_{WL} \cdot a_K \cdot \Delta\vartheta_H \tag{12}$$

where

B = B_0 = 6,5 W/(m² · K) under the conditions given for Formulae (4) and (5);

a_T is the pipe spacing factor in accordance with Table A.8; $a_T = f(s_u/\lambda_E)$;

m_T see Formula (6);

a_u is the covering factor, which is calculated in accordance with Formula (13):

$$a_u = \frac{\frac{1}{\alpha} + \frac{s_{u,0}}{\lambda_{u,0}}}{\frac{1}{\alpha} + \frac{s_u}{\lambda_E}} \tag{13}$$

where

α = 10,8 W/(m² · K);

$\lambda_{u,0}$ = 1 W/(m · K);

$s_{u,0}$ = 0,045 m;

a_{WL} is the heat conduction factor (see Tables A.10 onwards); $a_{WL} = f(K_{WL}, T, D)$.