SLOVENSKI STANDARD
SIST EN 1264-2:1997

01-november-1997

Talno ogrevanje - Sistemi in sestavni deli - 2. del: Ugotavljanje toplotne oddaje

Floor heating - Systems and components - Part 2: Determination of the thermal output

Fußboden-Heizung - Systeme und Komponenten - Teil 2: Bestimmung der Wärmeleistung

Chauffage par le sol - Systèmes de composants - Partie 2: Détermination de l'émission thermique

Ta slovenski standard je istoveten z: EN 1264-2:1997

ICS:

91.140.10	Sistemi centralnega ogrevanja	Central heating systems

SIST EN 1264-2:1997 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1264-2

August 1997

ICS 91.140.10

Descriptors: heating, hot water heating, heated floors, soils, thermal properties, heat emission, specific area, limits, computation

English version

Floor heating - Systems and components - Part 2: Determination of the thermal output

Chauffage par le sol - Systèmes et composants - Partie 2: Détermination de l'émission thermique

Fußboden-Heizung - Systeme und Komponenten - Teil 2: Bestimmung der Wärmeleistung

This European Standard was approved by CEN on 1997-07-11. 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 Central Secretariat or to any CEN member.

The European Standards exist 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 Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart,36 B-1050 Brussels

Ref. No. EN 1264-2:1997 E

Contents

Foreword

This European Standard 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 February 1998, and conflicting national standards shall be withdrawn at the latest by February 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

This European Standard for floor heating systems consists of the following parts :

- Part 1 : Definitions and Symbols
- Part 2 : Determination of the thermal output
- Part 3 : Dimensioning
- Part 4 : Installation

1 Scope

This European Standard is applicable to hot water floor heating systems as defined in EN 1264-1.

The determination of thermal performance of hot water floor heating systems and their conformity to this standard is carried out by calculation in accordance with design documents and model: in the case of special constructions and if necessary, the determination of thermal performance by calculation is combined with measurement techniques.

This European Standard specifies procedures and conditions to enable the heat flow density of hot water floor heating systems to be determined relative to the heating medium differential temperature for standard systems. For special systems the additional influencing factors are experimentally determined and introduced in the calculation. This should enable a uniform assessment and calculation of floor heating systems.

The nominal heat flow density, the associated nominal heating medium differential temperature and the field of characteristic curves for the relationship between heat flow density and the determining variables are given as the result.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies :

EN 1264 - 1	Floor heating - Systems and components - Part 1 : Definitions and Symbols

3 Definitions and symbols

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

4 Thermal boundary conditions

A floor heating surface with a given average surface temperature delivers the same heat flow density in any room with the same indoor room temperature (nominal indoor room temperature θ_i) [1]. It is therefore possible to give a basic characteristic curve, independent of the heating system, which is applicable to all floor heating surfaces (including those with peripheral areas with greater heat emissions), for the relationship between heat flow density and average differential surface temperature (see Figure A.1).

In contrast, for every floor heating system there is a maximum allowable heat flow density, the limit heat flow density q_G. This is determined for a nominal indoor room temperature of $\theta_i = 20°C$ under the secondary condition that the maximum surface temperature $\theta_{F,max} = 29°C$ [1] at $\sigma = 0$ K. The maximum heat flow density for the peripheral area is reached at a maximum surface temperature of $\theta_{F,max} = 35°C$[2] and $\sigma = 0$ K.

For calculation the centre of the heating floor area, regardless of the type of system, is used as a reference point for $\theta_{F,max}$ [2].

The average floor surface temperature $\theta_{F,m}$, which determines the heat flow density (refer to basic characteristic curve) is linked with this maximum floor surface temperature. $\theta_{F,m} < \theta_{F,max}$ always applies.

The attainable value $\theta_{F,m}$ depends, not only on the floor heating system, but also on the operating conditions (temperature drop $\sigma = \theta_V - \theta_R$, downward heat flow q_u and heat resistance of the floor covering $R_{\lambda,B}$).

The following assumptions form the basis of the calculation of the heat flow density:

- Heat transfer at the floor surface into the room occurs in accordance with the basic characteristic curve.
- If there is no floor covering ($R_{\lambda,B} = 0$), the downward heat flow density q_u (through the floor) is assumed to be 10% of the heat flow density upwards q.
- The temperature drop $\sigma = 0$; the dependence of the characteristic curve on the temperature drop is determined by using the logarithmically determined average differential heating medium temperature $\Delta\theta_H$ [3] (see equation (1)).
- Turbulent flow : $m_H / d_i > 4000$ kg/(h.m)
- There is no lateral heat flow.

5 Documents

Information provided by the system supplier are taken as the basis for the determination of thermal performance. The following documents shall be submitted:

---

[1] National regulations can limit the temperature to a lower value

[2] Some covering materials can require lower temperatures

- Installation drawing (section) of the floor heating system covering two pipe spacings, including the external area, giving details of materials used (if necessary, the test results of the materials shall be provided).

- Technical documents for the system.

This information shall contain all necessary details for calculation which are used for installation purposes. They shall be submitted in the same form to the installer.

In the presence of a member of the testing body, a demonstration surface of approximately 2 m x 2 m shall be laid in order to establish that the construction under test represents the conventional design.

The results of the test are only applicable to the system as tested. Should any changes be made by the supplier of the system relating to any basic elements, a new test shall be necessary.

6 Calculating the heat flow density (characteristic and limit curves)

6.1 General [2],[4]

The heat flow density q at a floor surface is determined by the following parameters:

- Pipe spacing T

- Thickness s_u and heat conductivity λ_E of the layer above the pipe.

- Thermal conduction resistance $R_{\lambda,B}$ of floor covering.

- Pipe external diameter $D = d_a$, including sheathing ($D = d_M$) if necessary and the heat conductivity of the pipe λ_R and/or the sheathing λ_M. In the case of non-circular pipes, the equivalent diameter of circular pipes having the same circumference is to be calculated (the screed covering shall be used unchanged). The thickness and the thermal conduction resistance of firmly deposited barrier layers up to a thickness of 0,3 mm shall not be taken into consideration. In this case, $D = d_a$ shall be used

- Heat conducting devices, characterised by the value K_{WL} in accordance with 6.3.

- Contact between the pipes and the heat conducting devices or screed, characterised by the factor a_K.

The heat flow density is proportional to $(\Delta\theta_H)^n$

where the heating medium differential temperature is :

$$\Delta\theta_H = \frac{\theta_V - \theta_R}{\ln\dfrac{\theta_V - \theta_i}{\theta_R - \theta_i}} \qquad (1)$$

and the exponent n, for which experimental and theoretical investigations produce:

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

Within the limits of achievable accuracy, thus

$$n = 1$$

is used.

The heat flow density q is calculated using equation 3.

$$q = B \cdot \prod_i (a_i^{m_i}) \cdot \Delta\theta_H \qquad (3)$$

Where:

B is the system-dependent coefficient in W/(m²·K)

$\prod_i (a_i^{m_i})$ is the power product which links the parameters of the floor structure together (see 6.2, 6.3 and 6.4)

A distinction shall be made between systems with pipes inside the screed, systems with pipes below the screed and plane section systems. Equation (3) applies directly for usual constructions. For systems with additional devices for heat distribution, airfilled hollow sections or other components which influence the heat distribution, equation (3) is extended by a factor a_z (see clause 7), to be determined experimentally.

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

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

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

Where:

$B = B_0 = 6{,}7$ W/(m²·K) for a heat conductivity $\lambda_R = \lambda_{R,0} = 0{,}35$ W/(m.K) of the pipe and pipe wall thickness $s_R = s_{R,0} = (d_a - d_i)/2 = 0{,}002$ m.

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

For a heating cement screed with reduced humidity, $\lambda_E = 1{,}2$ W/(m.K) shall be used. This value is also applicable to levelling layers. If a different value is used, its validity is to be checked.

a_B is the floor covering factor in accordance with Table A.1; $a_B = f(\lambda_E, R_{\lambda,B})$

a_T is the spacing factor in accordance with Table A.2; $a_T = f\ (R_{\lambda,B})$

a_u is the covering factor in accordance with Table A.3; $a_u = f\ (T,\ R_{\lambda,B})$

a_D is the pipe external diameter factor in accordance with Table A.4; $a_D = f\ (T,\ R_{\lambda,B})$

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

$$m_u = 100(0{,}045 - s_u) \quad \text{applies where } s_u \geq 0{,}015\ \text{m} \tag{6}$$

$$m_D = 250(D - 0{,}020) \quad \text{applies where } 0{,}010\ \text{m} \leq D \leq 0{,}030\ \text{m} \tag{7}$$

In equations (5), (6) and (7):

T is the pipe spacing

D is the external diameter of the pipe, including sheathing where used

s_u is the thickness of the layer above the pipe

Where pipe spacing $T > 0{,}375$ m the heat flow density is approximately calculated using

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

The limit curves are calculated from the product formulation in accordance with equation (14) (see 6.5).

6.3 Systems with pipes below the screed (type B)

For these systems (see Figure A.3) the variable thickness of the screed s_u and its variable heat conductivity λ_E are represented by a factor a_u. The pipe diameter has no effect. However, the contact between the heating pipe and the heat conducting device or any other heat distribution device is an important parameter. The characteristic curve is calculated from

$$q = B \cdot a_B \cdot a_T{}^{m_T} \cdot a_u \cdot a_{WL} \cdot a_K \cdot \Delta\theta_H \tag{8}$$

where:

B $B = B_0 = 6{,}5$ W/(m2·K) under the conditions given in equation (4).

a_T is the pipe spacing factor in accordance with Table A.7; $a_T = f\ (s_u\ /\ \lambda_E)$

m_T (see equation (5)) $m_T = 1 - \frac{T}{0{,}075}$ applies where 0,050 m $\leq T \leq$0,45 m

a_u is the covering factor (see Table A.8); $a_u = f\,(s_u / \lambda_E)$

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

The following applies for characteristic value K_{WL}:

$$K_{WL} = \frac{s_{WL} \cdot \lambda_{WL} + b_u \cdot s_u \cdot \lambda_E}{0{,}125} \tag{9}$$

Whereby $b_u = f(T)$ is to be taken from Table A.9, $s_{WL} \cdot \lambda_{WL}$ is the product of the thickness and heat conductivity of the heat conducting material and $s_u \cdot \lambda_E$ is the product of the thickness and heat conductivity of the screed.

If the width L of the heat conducting device is smaller than the pipe spacing T, the determined value indicated in Table A.10 shall be corrected from

$$a_{WL} = a_{WL,L=T}$$

to

$$a_{WL} = a_{WL,L=T} - (a_{WL,L=T} - a_{WL,L=0}) \cdot \left[1 - 3{,}2(L/T) + 3{,}4(L/T)^2 - 1{,}2(L/T)^3\right] \tag{10}$$

The heat conduction device factors $a_{WL,L=T}$ and $a_{WL,L=0}$ shall be taken from Table A.10.

For $L = T$, tables with K_{WL} are directly applicable in accordance with equation (9); for $L = 0$, K_{WL} shall be constituted with $s_{WL} = 0$.

a_K is the correction factor for the contact in accordance with Table A.11; $a_K = f\,(T)$

The correction factor for the contact a_K includes the additional heat transmission resistance where there is spot or line contact only between the pipe and the heat conducting device. This depends on the manufacturing tolerances of the pipes and conducting devices as well as the care taken in installation and is therefore subject to fluctuations in individual cases. Table A.11, therefore, gives an average value for a_K.

a_B floor covering factor:

$$a_B = \frac{1}{1 + B \cdot a_u \cdot a_T^{m_T} \cdot a_{WL} \cdot a_K \cdot R_{\lambda,B} \cdot \bar{f}(T)} \tag{11}$$

with $\bar{f}(T) = 1 + 0{,}44\sqrt{T}$

The limit curves are calculated from the product formulation in accordance with equation (14) (see 6.5).

6.4 Plane section systems

The following equation applies to floors covered with heating elements

$$q = B \cdot a_B \cdot a_T{}^{m_T} \cdot a_u \cdot \Delta\theta_H \tag{12}$$

where:

B $B = B_0 = 6{,}5$ W/(m²·K) and $a_T{}^{m_T} = 1{,}06$

a_u is the covering factor in accordance with Table A.8

a_B is the floor covering factor :

$$a_B = \frac{1}{1 + B \cdot a_u \cdot a_T{}^{m_T} \cdot R_{\lambda,B}} \tag{13}$$

6.5 Limits of heat flow density

The limit curve gives the relationship between heat flow density and heating medium differential temperature where the maximum permissible surface temperature is achieved.

The limit curves are calculated from the equation

$$q_G = \varphi \cdot B_G \cdot \left[\frac{\Delta\theta_H}{\varphi}\right]^{n_G} \tag{14}$$

where:

B_G is the coefficient in accordance with Table A.5 for type A and C systems or in accordance with Table A.12 for type B systems or $B_G = 100$ W/(m²·K) for plane section systems.

n_G is the exponent in accordance with Table A.6 for types A and C systems or in accordance with Table A.13 for type B systems or $n_G = 0$ for plane section systems.

φ factor for the conversion to any values of temperatures $\theta_{F,max}$ and θ_i

$$\varphi = \left[\frac{\theta_{F,max} - \theta_i}{\Delta\theta_0}\right]^{1{,}1} \quad \text{avec} \quad \Delta\theta_0 = 9\ \text{K} \tag{15}$$

The intersection of the characteristic curve with the limit curve is calculated from

$$\Delta\theta_{H,G} = \varphi \cdot \left[\frac{B_G}{B \cdot \prod_i a_i{}^{m_i}}\right]^{\frac{1}{1-n_G}} \tag{16}$$

The limit curves for type A and C systems for $T > 0{,}375$ m are calculated according to