SLOVENSKI STANDARD
oSIST prEN 17956:2023

01-maj-2023

Sistemi za ogrevanje in hlajenje z vodo v stavbah - Razredi energijske učinkovitosti za tehnične izolacijske sisteme - Računska metoda in uporaba

Heating systems and water based cooling systems in buildings - Energy efficiency classes for technical insulation systems - Calculation method and applications

Heizungsanlagen und wassergeführte Kühlanlagen in Gebäuden - Energieeffizienzklassen für technische Dämmsysteme - Berechnungsmethoden

Systèmes de chauffage et systèmes de refroidissement hydrauliques dans les bâtiments - Classes d'efficacité énergétique pour les systèmes d'isolation technique - Méthodes et applications de calcul

Ta slovenski standard je istoveten z: **prEN 17956**

ICS:

91.120.10	Toplotna izolacija stavb	Thermal insulation of buildings
91.140.10	Sistemi centralnega ogrevanja	Central heating systems
91.140.30	Prezračevalni in klimatski sistemi	Ventilation and air-conditioning systems

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EUROPEAN STANDARD

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English Version

Heating systems and water based cooling systems in buildings - Energy efficiency classes for technical insulation systems - Calculation method and applications

Heizungsanlagen und wassergeführte Kühlanlagen in Gebäuden - Energieeffizienzklassen für technische Dämmsysteme - Berechnungsmethoden

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 228.

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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 17956:2023) has been prepared by Technical Committee CEN/TC 228 "Heating systems and water-based cooling systems in buildings", the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

Introduction

In the past, technical thermal insulation systems have been primarily designed according to operational requirements, e.g. personal protection or maximum permissible heat loss. Occasionally, the design may be based on economic aspects, which strongly depend on the assumptions for the service life, energy costs and initial investment costs.

This document creates a uniform basis with a focus on the efficient use of resources.

For this purpose, a classification method is defined for technical insulation systems. Depending on the operating temperature of the system to be insulated and its basic geometric shape, these energy efficiency classes describe a maximum permissible heat flux.

This classification is intended to create a uniform communication platform for all those involved in the operation as well as the engineering and installation of insulation systems in plant construction and technical building equipment. The energy classes serve to provide the most basic information about an insulation system in a simple way, independent of the actually applied insulation system.

1 Scope

This document covers technical insulation systems of operational installations in industry and the building services, such as pipes, ducts, vessels, equipment and built-in components.

The document contains methods for the energy efficiency classification of insulation systems for above-mentioned components with an operational temperature range of -30 °C up to 650 °C.

The document addresses plant operators, engineers of operational installations as well as the involved contractors such as insulation contractors and pipefitting contractors.

The design of safe surface temperatures for personnel protection is outside the scope of this document. This document also does not apply to heating, cooling and ventilation systems in buildings and does not apply to directly buried district heating and district cooling pipes.

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 ISO 12241, *Thermal insulation for building equipment and industrial installations - Calculation rules (ISO 12241)*

3 Terms and definitions, symbols, units and abbreviated terms

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

ISO and IEC maintain terminology 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/

3.1 Terms and definitions

3.1.1
operational installation
stationary technical installation inside or outside of buildings, which is used for and directly supports the operational purpose

3.1.2
insulation system
insulation material including all other constituent parts, e.g. cladding, vapour barrier, supporting structure

3.1.3
operating temperature
temperature with which an industrial installation is generally operated

3.1.4
ecological optimum
ecological optimum for an insulation system is dimensioned for minimum total greenhouse gas emissions over the life cycle (manufacture, use, disposal)

3.1.5
hot applications
applications where the operating temperature is above 15 °C

3.1.6
cold applications
applications where the operating temperature is below 15 °C

3.1.7
density of heat flow rate
flow of energy per unit of area per unit of time

Note 1 to entry: The unit for walls is watts per square metre (W/m²).

3.1.8
longitudinal density of heat flow rate
flow of energy per unit of length per unit of time

Note 1 to entry: The unit for round objects like pipes is watt per metre (W/m).

3.1.9
average conditions
average values, for example for temperature and wind speed, which are needed to calculate the heat loss of an insulation system throughout the year

3.1.10
indicative space requirement for an insulation system
estimated insulation thickness based on a standard reference insulation material needed to achieve the selected insulation energy efficiency class

3.2 Symbols, units and abbreviated terms

3.2.1 Symbols and units used in this document (according to ISO)

a	width of the rectangular duct section	m
b	height of the rectangular duct section	m
b_0, b_1, b_2, b_3	auxiliary energy efficiency class coefficients	–
C	energy efficiency class coefficient	
e	Euler's number	
D	external pipe diameter	m
G	geometry coefficient	-
K_1, K_2	application coefficients	–
q_l	longitudinal density of heat flow rate	W/m
q	density of heat flow rate	W/m²
ISRI	Indicative Space Requirement for Insulation system	m

t	temperature coefficient	–
W	material coefficient	–
θ_i	operating temperature (interior)	°C
θ_a	ambient temperature	°C

The following indices are used throughout this document:

X any of the energy efficiency classes A to F

3.2.2 Abbreviated terms used in this document

EEC energy efficiency class

4 Calculation method for energy efficiency classes

4.1 General

This document establishes, for a given application, the maximum allowed density of heat flow rate of an insulation system per energy efficiency class. The theoretical background of the calculation method developed in 4.2 is based on the definition of the ecological optimum extracted from the VDI 4610, Part 1 and summarized in Annex F of this document.

The calculation method for energy efficiency classes also defines the space that shall be respected and planned, in the designing phase of the operational installation, to assure enough space for the insulation system according to the selected energy class. This dimension is defined by the indicative space requirement for insulation systems, $ISRI_X$ (Step 4 in Table 1 and Table 2).

For a quick indication of the space requirement covering a selected range of pipe/duct sizes and temperatures, users of this document may refer to Annex D, Tables D.1 and D.2.

4.2 Determination of the maximum allowed density of heat flow rate

The energy efficiency classes go from A to F. Each class is defined by a maximum allowed density of heat flow rate depending on the operating temperature during the operation of the installation as well as the geometry of the component.

For an installation with an operating temperature of exactly 15 °C, no energy efficiency class is defined.

Table 1 and Table 2 define the workflow to obtain the maximum allowed density of heat flow rate of an insulation system for the selected energy efficiency class:

Table 1 is to be used for hot applications.

Table 2 is to be used for cold applications.

Table 1 — Calculation steps to determine the maximum allowed density of heat flow rate for the selected insulation energy efficiency class for hot applications

<table>
<tr>
<td rowspan="2">Step 1:
Determine the geometry coefficient, G</td>
<td>Pipes and round geometries with
D</td>
<td>Rectangular ducts [a] (Figure 1) with
$D = \frac{2 \cdot a + 2 \cdot b}{\pi}$</td>
<td rowspan="2">Walls

$G = 1,22$ m</td>
</tr>
<tr>
<td colspan="2">$G = D$

If $G > 1,22$ m then $G = 1,22$ m</td>
</tr>
<tr>
<td>Step2:
Calculate the application coefficients,
K_1, K_2</td>
<td colspan="3">Hot applications: $15°C < \theta_i \leq 650°C$
$t = \frac{\theta_i + 15}{2}$ in °C
$W = 0,0477 + 9,548 \cdot 10^{-5} \cdot t + 1,516 \cdot 10^{-7} \cdot t^2 + 3,723 \cdot 10^{-10} \cdot t^3$
$K_1 = \frac{0,14 \cdot W \cdot |\theta_i - 15|}{G^2}$ $K_2 = \frac{0,19}{G}$</td>
</tr>
<tr>
<td>Step 3:
Calculate the Energy Efficiency Class (EEC) coefficient, C_X</td>
<td colspan="3">$C_X = 0,96 + b_0 \cdot e^{b_1 \cdot K_2} \cdot K_1^{b_2 + b_3 \cdot K_2}$
where
b_0, b_1, b_2, b_3 are the auxiliary coefficients of the selected ECC X, from Table 3, e is Euler's number, equals to 2,71828</td>
</tr>
<tr>
<td>Step 4:
Calculate the Indicative Space Requirement for Insulation systems, $ISRI_X$</td>
<td colspan="3">$ISRI_X = \frac{G}{2} \cdot (C_X - 1)$ in m</td>
</tr>
<tr>
<td>Step 5:
Calculate the maximum allowed density of heat flow rate for the selected energy efficiency class X,
$q_{l,X}$ or q_X</td>
<td colspan="2">Pipes, round geometries, rectangular ducts
$q_{l,X} = \frac{2 \cdot \pi \cdot W \cdot |\theta_i - 15|}{ln\left(1 + \frac{2 \cdot ISRI_X}{D}\right)}$ in W/m</td>
<td>Walls
$q_X = \frac{W \cdot |\theta_i - 15|}{ISRI_X}$
in W/m²</td>
</tr>
<tr>
<td colspan="4">[a] Note that this document uses the concept of hydraulic diameter – a commonly used term when handling flow in non-circular tubes. The hydraulic diameter evaluates non-circular ducts as ducts of equivalent circular diameter.</td>
</tr>
</table>

Table 2 — Calculation steps to determine the maximum allowed density of heat flow rate for the selected insulation energy efficiency class for cold applications

Step			
Step 1: Determine the geometry coefficient, ***G***	Pipes and round geometries with D	Rectangular ducts [a] (Figure 1) with $D = \frac{2 \cdot a + 2 \cdot b}{\pi}$	Walls
	$G = D$ If *G* > 1,22 m then *G* = 1,22 m		$G = 1,22$ m
Step2: Calculate the application coefficients, K_1, K_2	Cold applications: $-30°C \leq \theta_i < 15°C$ $t = \frac{\theta_i + 15}{2}$ in °C $W = 0,035\,5 + 1,17 \cdot 10^{-4} \cdot t + 4,85 \cdot 10^{-8} \cdot t^2 + 5,58 \cdot 10^{-10} \cdot t^3$ $K_1 = \frac{0,06 \cdot W \cdot \lvert\theta_i - 15\rvert}{G^2}$ $K_2 = \frac{0,1}{G}$		
Step 3: Calculate the Energy Efficiency Class (EEC) coefficient, C_X	$C_X = 0,96 + b_0 \cdot e^{b_1 \cdot K_2} \cdot K_1^{b_2 + b_3 \cdot K_2}$ where b_0, b_1, b_2, b_3 are the auxiliary coefficients of the selected ECC X, from Table 3, *e* is Euler's number, equals to 2,71828		
Step 4: Calculate the Indicative Space Requirement for Insulation systems, $ISRI_X$	$ISRI_X = \frac{G}{2} \cdot (C_X - 1)$ in m		
Step 5: Calculate the maximum allowed density of heat flow rate for the selected energy efficiency class X, $q_{l,X}$ or q_X	Pipes, round geometries, rectangular ducts $q_{l,X} = \frac{2 \cdot \pi \cdot W \cdot \lvert\theta_i - 15\rvert}{ln\left(1 + \frac{2 \cdot ISRI_X}{D}\right)}$ in W/m		Walls $q_X = \frac{W \cdot \lvert\theta_i - 15\rvert}{ISRI_X}$ in W/m²

[a] Note that this document uses the concept of hydraulic diameter – a commonly used term when handling flow in non-circular tubes. The hydraulic diameter evaluates non-circular ducts as ducts of equivalent circular diameter.

Table 3 gives the auxiliary EEC coefficients for the selected energy efficiency class X to be used in Table 1 and Table 2, Step 3.