SLOVENSKI STANDARD
SIST EN 17956:2024

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Razredi energijske učinkovitosti za tehnične izolacijske sisteme - Računska metoda in uporaba

Energy efficiency classes for technical insulation systems - Calculation method and applications

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

Classes d'efficacité énergétique pour les systèmes d'isolation technique - Méthodes et applications de calcul

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Classes d'efficacité énergétique pour les systèmes d'isolation technique - Méthodes et applications de calcul

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

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European foreword

This document (EN 17956:2024) 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 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of an identical text or by endorsement, at the latest by December 2024, and conflicting national standards shall be withdrawn at the latest by December 2024.

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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.

This document creates a uniform basis for insulating technical systems 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, the calculation method for permissible heat flux and an indicative space requirement for the insulation system are specified. Energy efficiency classes are derived by the 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 efficiency classes specify in a practical way the maximum heat loss and the minimum space requirement without specifying a concrete insulation solution.

1 Scope

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

The document specifies methods for the energy efficiency classification of insulation systems for the abovementioned 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 personal protection, as well as the prevention of condensation, is outside the scope of this document.

This document also does not apply to water-based heating and cooling 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, 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

EXAMPLE Appliances, vessels, columns, tanks, steam generators, pipe systems, cold and hot water and ventilation installations, etc.

3.1.2
insulation system
insulation material including all other constituent parts

EXAMPLE Cladding, vapour barrier, supporting structure, etc.

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

Note 1 to entry: Also referred to as fluid temperature or medium temperature.

3.1.4
ecological optimum
ecological optimum for a best-case insulation system, dimensioned for minimum total greenhouse gas emissions over the life cycle

Note 1 to entry: This concerns manufacture, use and disposal.

3.1.5
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 watt per square metre (W/m^2).

3.1.6
linear density of heat flow rate
flow of energy per unit of length per unit of time

Note 1 to entry: The unit for cylindrical objects such as ducts is watt per metre (W/m).

3.1.7
average conditions
average values which are needed to calculate the heat loss of an insulation system throughout the year

Note 1 to entry: For example, ambient temperature and wind speed.

3.1.8
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/hydraulic diameter	m
F	overall conversion factor for thermal conductivity	-
G	geometry coefficient	-
h_c	surface heat transfer coefficient for convection	$W/(m^2 \cdot K)$
h_r	surface heat transfer coefficient for radiation	$W/(m^2 \cdot K)$
K_1, K_2	application coefficients	–

λ_D	design thermal conductivity	W/(m·K)
$q_{l,X}$	linear density of heat flow rate of an energy efficiency class X	W/m
q_X	density of heat flow rate of an energy efficiency class X	W/m²
$S_{l,X}$	indicative space requirement for the insulation system with an energy efficiency class X	m
θ_m	mean temperature	°C
W	material coefficient	–
θ_i	operating temperature (interior - medium)	°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 1:2018-01 and summarized in Annex F of this document.

The calculation method for energy efficiency classes also specifies the space requirements for the designing phase of the operational installation to ensure enough space for the insulation system, according to the selected energy class. This dimension is defined by the indicative space requirement for insulation systems, $S_{l,X}$ (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 G. The classes from A to F are defined by a maximum allowed density of heat flow rate depending on the operating temperature as well as the geometry of the component. Any solution with a density of heat flow rate higher than F is classified G.

For an installation with an operating temperature of exactly 15 °C, no energy efficiency class can be defined as this value is used to define the application coefficients K_1 and K_2.

Table 1 and Table 2 specify 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 applications in the operating temperature range from above 15 °C to 650 °C.

Table 2 is to be used for applications in the operating temperature range from −30 °C to below 15 °C.

Table 1 — Calculation steps to determine the maximum allowed density of heat flow rate for the selected insulation energy efficiency class for applications in the operating temperature range from above 15 °C to 650 °C

Step 1: Determine the geometry coefficient, ***G***	Pipes and round geometries with D $G = D$ If G > 1,22 m then G = 1,22 m	Rectangular ducts [a] (Figure 1) with $D = \frac{2 \cdot a + 2 \cdot b}{\pi}$	Walls $G = 1{,}22\ \text{m}$
Step2: Calculate the application coefficients, ***K*₁, *K*₂**	Operating temperature range: $15\,°C < \theta_i \leq 650\,°C$ $\theta_m = \frac{\theta_i + 15}{2}$ in °C $W = 0{,}047\,7 + 9{,}548 \cdot 10^{-5} \cdot \theta_m + 1{,}516 \cdot 10^{-7} \cdot {\theta_m}^2 + 3{,}723 \cdot 10^{-10} \cdot {\theta_m}^3$ $K_1 = \frac{0{,}14 \cdot W \cdot \lvert \theta_i - 15 \rvert}{G^2}$ $K_2 = \frac{0{,}19}{G}$		
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 EEC X, from Table 3		
Step 4: Calculate the indicative space requirement for insulation systems, $S_{I,X}$	$S_{I,X} = \frac{G}{2} \cdot (C_X - 1)$ 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 $q_{l,X} = \frac{2 \cdot \pi \cdot W \cdot \lvert \theta_i - 15 \rvert}{ln\left(1 + \frac{2 \cdot S_{I,X}}{D}\right)}$ in W/m		Walls $q_X = \frac{W \cdot \lvert \theta_i - 15 \rvert}{S_{I,X}}$ 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 2 — Calculation steps to determine the maximum allowed density of heat flow rate for the selected insulation energy efficiency class for applications in the operating temperature range from −30 °C to below 15 °C

	Pipes and round geometries with	Rectangular ducts [a] (Figure 1) with	Walls
Step 1: Determine the geometry coefficient, *G*	D	$D = \frac{2 \cdot a + 2 \cdot b}{\pi}$	
	$G = D$ If $G > 1{,}22$ m then $G = 1{,}22$ m		$G = 1{,}22$ m
Step2: Calculate the application coefficients, K_1, K_2	Operating temperature range: $-30°C \leq \theta_i < 15°C$ $\theta_{\Delta m} = \frac{\theta_i + 15}{2}$ in °C $W = 0{,}035\,5 + 1{,}17 \cdot 10^{-4} \cdot \theta_{\Delta m} + 4{,}85 \cdot 10^{-8} \cdot \theta_{\Delta m}^{2} + 5{,}58 \cdot 10^{-10} \cdot \theta_{\Delta m}^{3}$ $K_1 = \frac{0{,}06 \cdot W \cdot \lvert \theta_i - 15 \rvert}{G^2}$ $K_2 = \frac{0{,}1}{G}$		
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 EEC X, from Table 3, *e* is Euler's number		
Step 4: Calculate the indicative space requirement for insulation systems, $S_{I,X}$	$S_{I,X} = \frac{G}{2} \cdot \left(C_X - 1 \right)$ 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 $q_{l,X} = \frac{2 \cdot \pi \cdot W \cdot \lvert \theta_i - 15 \rvert}{ln\left(1 + \frac{2 \cdot S_{I,X}}{D}\right)}$ in W/m		Walls $q_X = \frac{W \cdot \lvert \theta_i - 15 \rvert}{S_{I,X}}$ 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.