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Thermal insulation for building equipment and industrial installations - Thermal transmittance - Determination of correction terms (ISO/DIS 23995:2004)

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Foreword

This document (prEN ISO 23995:2004) has been prepared by Technical Committee CEN/TC 89 "Thermal performance of buildings and building components", the secretariat of which is held by SIS, in collaboration with Technical Committee ISO/TC 163 "Thermal insulation".

This document is currently submitted to the parallel Enquiry.

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

ISO 23995 was prepared by Technical Committee CEN/TC 89, *Thermal performance of buildings and building components*, in cooperation with Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment*, Subcommittee SC 2, *Calculation methods*.

This standard is one of a series of standards on calculation methods for the design and evaluation of the thermal performance of building equipment and industrial installations.

Introduction

Results of calculations of thermal transmittance made according to ISO 12241, *Thermal insulation for building equipment and industrial installations – Calculation rules*, using design thermal conductivity, may deviate from actual heat loss since the installations generally incorporate some singular points which are not taken into account in the reference calculation methods.

To reduce this difference, the results of the calculations made according to ISO 12241, and based on design thermal conductivity (ISO 23993[1], *Thermal insulation for building equipment and industrial installations – Determination of design thermal conductivity*), shall be corrected by additional thermal transmittances (ΔU) for plane walls or by additional linear transmittance (ΔU_l) for pipes. They correspond to thermal bridges of irregular insulation related and of installation related components of the industrial installation.

[1] To be published

1 Scope

This standard gives methods to determine the correction terms for thermal transmittance and linear transmittance for pipes which shall be added to the calculated thermal transmittance, U, or linear thermal transmittance, U_l, according to ISO 12241 to obtain the total thermal transmittance U_T or $U_{T,l}$ to calculate the total heat losses for an industrial installation.

The values are valid for the temperature ranges indicated in the relevant annexes.

Excluded from the scope of the this document are wrong design of insulation system, unsuitable products and improper workmanship.

2 Normative references

The following referenced documents are indispensable for the application 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.

ISO 7345, *Thermal insulation – Physical quantities and definitions*

ISO 10211-1, *Thermal bridges in building construction – Calculation of heat flow and surface temperatures – Part 1: General calculation methods*

ISO 10211-2, *Thermal bridges in building construction – Calculation of heat flows and surface temperatures – Part 2:Linear thermal bridges*

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

ISO 14683, *Thermal bridges in building construction – Linear thermal transmittance – Simplified methods and default values*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345 and the following apply.

3.1
calculated (linear) thermal transmittance
value of the thermal transmittance calculated according to ISO 12241

3.2
total (linear) thermal transmittance
calculated thermal transmittance calculated according to ISO 12241 increased with the correction terms according to this standard

3.1 Symbols and units

Symbol	Quantity	Unit
U_{WB}	thermal transmittance of thermal bridge	W/(m²·K)
ΔU_B	additional term corresponding to installation related and irregular insulation related thermal bridges	W/(m²·K)
$\Delta_{B,l}$	additional term for linear thermal transmittance	W/(m·K)
U_T	total thermal transmittance incorporating the relevant corrections	W/(m²·K)
$U_{T,l}$	total linear thermal transmittance incorporating the relevant corrections	W/(m·K)
z or y	correction term for irregular insulation–related thermal bridges	dimensionless
z^* or y^*	correction term for installations related thermal bridges	dimensionless

4 Determination of total thermal transmittances

The thermal transmittance, U, for plane walls and the linear thermal transmittance U_l for pipes shall be calculated according to ISO 12241.

After this calculation, the values of the thermal transmittances U and U_l shall be increased by the values of ΔU or ΔU_l to take into account influences of either irregular installation related or insulation system related thermal bridges which have not been considered in ISO 12241 for the calculation of the total heat loss.

For plane walls the total thermal transmittance U_T shall be determined by:

$$U_T = U + \Delta U_B \quad (1)$$

and for pipes the total linear thermal transmittance $U_{T,l}$ shall be determined by

$$U_{T,l} = U_l + \Delta U_{B,l} \quad (2)$$

5 Calculation rules for the additional terms

5.1 General

The effect of installation related thermal bridges, such as supports, valves and flanges and irregular insulation related thermal bridges such as convection barriers and end pieces shall be taken into account by adding a term ΔU_B or $\Delta U_{B,l}$ to the previously calculated thermal transmittance U or U_l.

Plant-related and irregular insulation related thermal bridges shall be taken into account using calculated thermal transmittance U_{WB} of thermal bridges or equivalent lengths for pipes in the form of supplementary values y and y^* or z and z^*.

5.2 Determination of the influence of thermal bridges

5.2.1 General

The ΔU_B-value for calculating the heat transfer over thermal bridges of an industrial installation with plane walls shall be calculated as follows:

$$\Delta U_B = U \left[\sum_{j=1}^{n} z_j + \sum_{j=1}^{m} z_j^* \right] \quad (3)$$

where

U is the thermal transmittance of the insulation in accordance with ISO 12241;
z is the correction term for irregular insulation-related thermal bridges;
z^* is the correction term for installation related thermal bridges.

The $\Delta U_{B,l}$-value for calculating the heat loss over the thermal bridges of an industrial installation with pipes shall be calculated as follows:

$$\Delta U_{B,l} = U \left[\sum_{j=1}^{n} y_j + \sum_{j=1}^{m} y_j^* \right] \quad (4)$$

where

U_l is the linear thermal transmittance of the insulation in accordance with ISO 12241;
y is the correction term for linear thermal transmittance caused by irregular insulation related to singular points;
y^* is the correction term for linear thermal transmittance caused by installation related to singular points.

The correction terms z and z^* or y and y^* depend, among other things, on the size of the heat flow via the thermal bridge and the frequency of occurrence of the thermal bridges in the industrial installation. They shall therefore be specially determined as required for each industrial plant in accordance with the following clauses and identified separately as

- irregularly occurring insulation-related thermal bridges (z or y) and
- installation related thermal bridges (z^* or y^*)

by using the equations in 5.2.2 and 5.2.3.

5.2.2 Calculation of correction terms for plane walls

The thermal transmittance U_{WB} of thermal bridges shall be calculated in accordance with ISO 10211. If the thermal transmittance for the thermal bridge is known, the correction terms z or z^* shall be determined from the following equations:

$$z = \frac{U_{WB} A_{WB}}{U A} n \quad (5)$$

$$z^* = \frac{U_{WB} A_{WB}}{U A} n \quad (6)$$

where

U_{WB} is the thermal transmittance of the thermal bridge, irregular insulation related or installation related, in W/(m²·K);

A_{WB} is the area of cross section of the thermal bridge, irregular insulation related or installation related, in m^2;
n is the number of equal irregular thermal bridges, irregular insulation related or installation related;
A is the total heat transferring area of the plane walls of the industrial installation, in m^2.

5.2.3 Calculation of correction terms for pipes

The thermal transmittance U_{WB} of thermal bridges shall be calculated according to ISO 10211. If the thermal transmittance U_{WB} for the thermal bridge is known the correction terms y or y^* shall be determined from the following equations:

$$y = \frac{U_{WB}\, A_{WB}}{U_l\, l} n \tag{7}$$

$$y^* = \frac{U_{WB}\, A_{WB}}{U_l\, l} n \tag{8}$$

where

U_{WB} is the thermal transmittance of the thermal bridge, irregular insulation related or installation related, in $W/(m^2 \cdot K)$;
A_{WB} is the area of cross section of the thermal bridge, irregular insulation related or installation related, in m^2;
n is the number of equal irregular thermal bridges, irregular insulation related or installation related;
l is the total pipe length, in m.

or if the thermal bridge is characterised by an equivalent length Δl:

$$y = \frac{\Delta l}{l} n \tag{9}$$

$$y^* = \frac{\Delta l}{l} n \tag{7}$$

where

l is the total equivalent length, in m.

Equivalent lengths Δl for flanges and armatures and estimated z^*-values for pipe suspensions are given in Annex A.

Annex A
(normative)

Thermal bridges

Additional ΔU_B caused by insulation-related thermal bridges such as:

- bearing and support structure for pipe coverings, vessels, boilers;
- separate, spring-mounted web;
- through web made from flat steel or round bar;
- other fixings.

shall be calculated in accordance with:

- ISO 10211-1,
- ISO 10211-2, or
- ISO 14683.

Tabulated values of ΔU_B may be used when existing and relevant.

For plant-related thermal bridges such as flanges, fittings, pipe suspensions, ΔU_B shall be assessed by an increase of the pipe length, called equivalent length Δl.

The equivalent length Δl for some common cases is given in Table A.1.

Table A.1 — Plant-related "thermal bridges"

1	*Flanges for pressure stages PN 25 – PN 100*	Equivalent length Δl* m		
1.1	Uninsulated for pipes	50 – 100 °C	150 – 300 °C	400 – 500 °C
1.1.1	in buildings at 20 °C			
	DN 50	3 - 5	5 - 11	9 - 15
	100	4 - 7	7 - 16	13 - 16
	150	4 - 9	7 - 17	17 - 30
	200	5 - 11	10 - 26	20 - 37
	300	6 - 16	12 - 37	25 - 57
	400	9 - 16	15 - 36	33 - 56
	500	10 – 16	17 - 36	37 - 57
1.1.2	in the open air at 0 °C			
	DN 50	7 - 11	9 - 16	12 - 19
	100	9 - 14	13 - 23	18 - 28
	150	11 - 18	14 - 29	22 - 37
	200	13 - 24	18 - 38	27 - 46
	300	16 - 32	21 - 54	32 - 69
	400	22 - 31	28 - 53	44 - 68
	500	25 – 32	31 - 52	48 – 69