SLOVENSKI STANDARD
SIST EN 674:1999

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Steklo v stavbah - Določanje toplotne prehodnosti (U vrednost) - Metoda z vročo ploščo

Glass in building - Determination of thermal transmittance (U value) - Guarded hot plate method

Glas im Bauwesen - Bestimmung des Wärmedurchgangskoeffizienten (U-Wert) - Verfahren mit dem Plattengerät

Verre dans la construction - Détermination du coefficient de transmission thermique, U - Méthode de l'anneau de garde

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ICS:

81.040.20	Steklo v gradbeništvu	Glass in building

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EN 674

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English version

Glass in building - Determination of thermal transmittance (*U* value) - Guarded hot plate method

Verre dans la construction - Détermination du coefficient de transmission thermique, U - Méthode de l'anneau de garde

Glas im Bauwesen - Bestimmung des Wärmedurchgangskoeffizienten (U-Wert) - Verfahren mit dem Plattengerät

This European Standard was approved by CEN on 8 October 1997.

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This European Standard exists 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.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 129 "Glass in building", the secretariat of which is held by IBN.

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of an identical text or by endorsement, at the latest by May 1998, and conflicting national standards shall be withdrawn at the latest by May 1998.

CEN/TC 129/WG9 "Light and energy transmission , thermal insulation" prepared a working draft based on the document ISO/DIS 10291 "Glass in building - Measuring method for the determination of the thermal transmittance of multiple glazing (U value) - Guarded hot plate method", document that was prepared by ISO/TC 160, "Glass in building".

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.

1 Scope

This European Standard specifies a measurement method to determine the thermal transmittance of glazing with flat and parallel surfaces. Structured surfaces, e.g. patterned glass, can be considered to be flat.

This European Standard applies to multiple glazing with outer panes which are not transparent to far infrared radiation, which is the case for soda lime silicate glass products (called hereafter soda lime glass), borosilicate glass and glass ceramics. Internal elements may be far infrared transparent.

The procedure specified in this European Standard determines the *U* value[1)] (thermal transmittance) in the central area of glazing. The edge effects, due to the thermal bridge through the spacer of a sealed glazing unit or through the window frame are not included. Furthermore energy transfer due to solar radiation is not taken into account.

The document for the calculation of the overall *U* value of windows, doors and shutters (see A.1) gives normative reference to the *U* value evaluated for the glazing components according to this standard.

A vertical position of the glazing is specified.

U values evaluated according to the present standard are used for product comparison as well as for other purposes , in particular for predicting:

- heat loss through glazing;
- conduction heat gains in summer;
- condensation on glazing surfaces;
- the effects of the absorbed solar radiation in determining the solar factor (see A.2).

Reference should be made to A.3, A.4 or other European Standards dealing with heat loss calculations for the application of glazing *U* values determined by this standard.

The determination of the thermal transmittance is performed for conditions which correspond to the average situation for glazing in practice.

2 Normative references

This European Standard as appropriate incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revision 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.

ISO 8302:1991 Thermal insulation - Determination of steady-state thermal resistance and related properties - Guarded hot plate apparatus

EN 673 Glass in building - Determination of thermal transmittance (*U* value) - Calculation method

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1) In some countries the symbol *k* has been used hitherto

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 *U* value: Parameter of glazing which characterizes the heat transfer through the central part of the glazing , i.e. without edge effects, and states the steady-state density of heat transfer rate per temperature difference between the environmental temperatures on each side. The *U* value is given in watts per square metre kelvin [W/(m^2·K)].

3.2 declared value: *U* value obtained under standardized boundary conditions (see 10.2).

4 Basic formula

The *U* value depends on the thermal resistance of the multiple glazing and on the external and internal surface heat transfer coefficients according to the relation:

$$\frac{1}{U} = R + \frac{1}{h_e} + \frac{1}{h_i} \qquad (1)$$

where:

R is the thermal resistance of the multiple glazing in square metres kelvins per watt $\left[(m^2 \cdot K)/W\right]$

h_e is the external surface heat transfer coefficient in watts per square metre kelvin $\left[W/(m^2 \cdot K)\right]$

h_i is the internal surface heat transfer coefficient in watts per square metre kelvin $\left[W/(m^2 \cdot K)\right]$

According to this standard the surface to surface thermal resistance is determined by measurements taken using the guarded hot plate method. Thereupon the declared value is determined according to equation [1] with the values for the internal and external heat transfer coefficients specified in 10.2.

5 Brief outline of the measuring procedure

The surface to surface thermal resistance of the multiple glazing is determined by means of the guarded hot plate method laid down in ISO 8302. The recommendations of that standard shall be complied with except for variations contained in this standard and for variations resulting from the special structure of the glazing.
Within the present context further requirements are necessary, viz the size of the test specimens and the performance of the measurements are laid down to meet special requirements for measuring multiple glazing (see clauses 6 to 12).

6 Test apparatus

For the measurement of the thermal resistance of the specimen the two specimen apparatus is used. Figure 1 gives a general outline of this apparatus including special requirements for the measurement of multiple glazing.

A square flat plate assembly consisting of a heater and metal surface plates and called the heating unit is sandwiched between two nearly identical specimens.

The thermal flux is transferred through the specimens to separate square isothermal flat assemblies called the cooling units.

The heating unit consists of a separate central metering section, where the unidirectional constant heat flux can be established, surrounded by a guard section separated by a narrow gap. The metering section has dimensions of 500 mm x 500 mm. The cooling units have surface dimensions as large as those of the heating unit, including the guard heater.

To ensure sufficient contact between the specimens and the adjacent surface plates, rubber sponge sheets in the quality of natural rubber with a thickness of about 3 mm shall be used.

A minimum of 3 equally spaced thermocouples shall be positioned on the specimen diagonal on each side to determine the average surface temperatures. Such thermocouples shall have a thickness not exceeding 0,2 mm; the junctions shall be flattened so as not to exceed 0,2 mm and a contact material (e.g. zinc oxide loaded silicon grease or metal tape) shall be used to insure a good thermal contact between the junction and the specimen.

The specimens shall be of such a size as to completely cover the heating unit surface. Additional edge insulation and/or auxiliary guard sections are required as stated in ISO 8302:1991.

The glass layers of multiple glazing in contact with the apparatus make critical the correct detection of imbalance across the gap due to the high thermal conductivity of the glass. The installation of imbalance sensors as indicated in figure 4b) of ISO 8302:1991 is most probably the only way of detecting with acceptable accuracy the actual imbalance through the gap when testing multiple glazing, see 2.1.1.3 to 2.1.1.5 of ISO 8302:1991. When a guarded hot plate is intended for tests on multiple glazing, the imbalance error shall be evaluated according to 2.2.1 of ISO 8302:1991, using the thermal conductivity of the glass, i.e. 1 W/(m · K), as the specimen thermal conductivity. If the resulting calculated imbalance error is larger than 1% (instead of the 0,5% required by 2.1.4.1.1 of ISO 8302:1991), then the imbalance error shall be assessed using the experimental procedure of 2.4.4 of ISO 8302:1991. If the 1% limit is still exceeded, the gap design and the imbalance detection system shall be reviewed before attempting any test on multiple glazing.

7 Dimensions of the specimens

The specimens shall be square and have dimensions of preferably 800 mm x 800 mm with a maximum spread ranging from 750 mm x 750 mm to 850 mm x 850 mm.

The two specimens needed for the measurement shall be as identical as possible. The difference in thickness between the two specimens measured at the edges shall not be more than 2%.

The surfaces of the specimens shall be flat and parallel.

Specimen sizes down to 450 mm x 450 mm may be used if it can be shown that no convection occurs in the gas space and that the errors occuring are not greater than those allowed for the 800 mm x 800 mm arrangement.

8 Preparation of the specimens

The sum of the bowing or dishing of the outer panes in the central area of each specimen shall not exceed 0,5 mm. The control of bowing or dishing effects is performed by cooling down the specimens to 10 °C until isothermal equilibrium is reached and by measuring immediately before the specimens are positioned in the test apparatus for the measurement.

In the case of excessive bowing a correction of the thickness of the specimens in the central area may be performed by a corresponding pressure change. In the case of excessive dishing such a correction for gas fillings except air is only allowed if the needed correction (by introducing a small volume of air) does not exceed 0,5 mm.

9 Performance of the measurements

The measurements shall be taken with the specimens in a vertical position.

The measurements shall be performed at a mean temperature of each specimen of (10 ± 0,5) °C. The mean temperature difference between the hot and the cold surface of the specimens shall be (15 ± 0,5) K.

10 Evaluation of the results

10.1 Thermal resistance of the multiple glazing

The thermal resistance R is calculated according to the equation:

$$R = \frac{2A(T_1 - T_2)}{\Phi} \qquad m^2 \cdot K/W \qquad (2)$$

where:

Φ is the average power supplied to the central section of the heating unit in watts (W);

T_1 is the average hot side temperature of the specimens in kelvins (K);

T_2 is the average cold side temperature of the specimens in kelvins (K);

A is the metering area in square metres (m^2).

10.2 *U* Value

The declared U value is calculated according to equation (1).

For multiple glazing without a coating having an emissivity lower than 0,837 on the outer surfaces, the following standardized values for the surface heat transfer coefficients are used:

- internal heat transfer coefficient: $h_i = 8$ W/($m^2 \cdot$ K)

- external heat transfer coefficient: $h_e = 23$ W/($m^2 \cdot$ K)

NOTE 1: The reciprocal $1/h_i$ is 0,13 $m^2 \cdot$ K/W and $1/h_e$ is 0,04 $m^2 \cdot$ K/W expressed to two decimal figures.

For a multiple glazing with a coating having an emissivity lower than 0,837 on the surface adjacent to the inner room, the standardized value of h_i is modified according to the equation:

$$h_i = 3,6 + 4,4\frac{\varepsilon}{0,837} \qquad W/(m^2 \cdot K) \qquad (3)$$

where:

ε is the corrected emissivity of the surface;

0,837 is the corrected emissivity of uncoated soda lime silicate glass, borosilicate glass and glass ceramic.