SLOVENSKI STANDARD
SIST EN 675:1999

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Steklo v stavbah - Določ evanje toplotne prehodnosti (U vrednost) - Metoda toplotnega pretoka

Glass in building - Determination of thermal transmittance (U value) - Heat flow meter method

Glas im Bauwesen - Bestimmung des Wärmedurchgangskoeffizienten (U-Wert) - Wärmestrommesser-Verfahren

Verre dans la construction - Détermination du coefficient de transmission thermique, U - Méthode du fluxmetre

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ICS:

81.040.20	Steklo v gradbeništvu	Glass in building

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EUROPEAN STANDARD
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EN 675

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Descriptors: glazing, window glass, thermal insulation, rules of calculation, heat transfer coefficient, measurements, transparency, infrared radiation

English version

Glass in building - Determination of thermal transmittance (*U* value) - Heat flow meter method

Verre dans la construction - Détermination du coefficient de transmission thermique, U - Méthode du fluxmètre

Glas im Bauwesen - Bestimmung des Wärmedurchgangskoeffizienten (U-Wert) - Wärmestrommesser-Verfahren

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

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.

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 10293 "Glass in building - Determination of steady-state *U* values (thermal transmittance) of multiple glazing - Heat flow meter 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 procedure to determine the thermal transmittance of glazing with flat and parallel surfaces. Structured surfaces , e.g. patterned glass, may 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 can 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.
For the purposes of product comparison, a vertical position of the glazing is specified (see clause 10).
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 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 tha latest edition of the publication referred to applies.

ISO 8301	Thermal insulation - Determination of steady-state thermal resistance and related properties - Heat flow meter apparatus.
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

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

3 Definitions

For the purposes of the 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 11.2)

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 $\left[W / \left(m^2 \cdot K\right)\right]$

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

According to this standard the surface to surface thermal resistance is determined by measurements taken using the heat flow meter method. Thereupon the declared *U* value is determined according to equation [1] with the values for the internal and external heat transfer coefficients specified in 11.2.

5 Brief outline of the measuring procedure

The surface to surface thermal resistance of the multiple glazing is determined by means of the heat flow meter method laid down in ISO 8301. 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 specimen.
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 13).

6 Test apparatus

For the measurement of the thermal resistance of the specimen the single-specimen apparatus with symmetrical configuration or a double specimen apparatus as shown in figures 1 and 2 is used.

The single-specimen apparatus consists of a heating and a cooling unit between which the specimen or a reference sample for the calibration of the apparatus is sandwiched.The cooling unit has surface dimensions as large as those of the heating unit.

A heat flow meter is positioned in the center of the hot plate surface and the cold plate surface. These heat flow meters face each other on either sides of the specimen or the reference sample. On each side of the heat flow meters a thin natural or synthetic foam rubber sheet is placed to ensure sufficient thermal contact. Surface contact is obtained by applying pressure. The foam rubber sheets have the same dimensions as the surface area of the heating unit.

The double-specimen apparatus consists of a heating unit and two outer cooling units. The heating unit is sandwiched between the specimen to be measured and a control sample. For calibration a reference sample shall be introduced at the position of the specimen. On each side of the reference sample/specimen and the control sample heat flow meters are placed. On each side of the heat flow meters a thin foam rubber sheet is placed to ensure sufficient thermal contact. The surface dimensions of all elements and the positioning of the heat flow meters in the central area of the assembly are the same as for the single specimen apparatus.

For both apparatus the heating unit shall be of such a size as to completely cover the surface of the reference sample/specimen and in the case of the double apparatus of the control sample. Heat losses from the outer edges of the heat flow meter apparatus shall be restricted by edge insulation or by controlling the surrounding air temperature or by both.

For both apparatus the metering area of the heat flow meters shall have a circular or square shape and a minimum size of 75 cm^2. Its maximum size shall lie within an area of 50 cm x 50 cm. The metering area shall further be surrounded by a protective zone consisting of the same core material in the same thickness (with a tolerance of ± 0,1 mm) covering the whole sample area (see figures 1 and 2).

Thermocouples are mounted in pairs. They are positioned to face each other and shall have direct contact to the surfaces of the reference sample/specimen and in the case of the double apparatus the control sample.

At least three thermocouple positions shall be chosen, one positioned in the center of the metering area of the heat flow meters and two others diametrically opposite in a distance of 2/3 from the center of the metering area to its perimeter. Additional thermocouples may be arranged in such a way that an optimum cover of the metering area is achieved.

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.

7 Calibration of the test apparatus

The heat flow meter method is a relative measuring method since the ratio of the thermal resistance of the specimen to that of a reference sample is evaluated. The thermal resistance of the reference sample shall be determined separately in accordance with ISO 8302:1991 (Guarded hot plate apparatus). As a reference sample a homogeneous, non hygroscopic material with flat and parallel surfaces, with a heat resistance comparable to that of the specimen to be measured shall be used.

The heat flow density, Φ, in watts transferred through the heat flow meter is computed from the voltage V (in volt) generated and the mean temperature T_m (in kelvin) of the heat flow meter metering area according to the equation (2):

$$\Phi = (C_1 + C_2 T_m) \cdot V \quad W/m^2 \qquad (2)$$

where the constants C1 and C2 of the heat flow meter shall be determined by calibration using a reference sample.

Control of the equipment is done in the following way:

- when measurements are performed the calibration of both apparatus is done by measuring the reference sample with appropriate regularity.
- when measurements are performed using the double specimen apparatus the control sample gives an immediate control whether a general calibration shift of the apparatus occurs.

8 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 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. For example possible errors due to lateral heat flow through the glass of the specimen shall be carefully controlled.

For specimen sizes less than 800 mm x 800 mm the maximum allowed metering area of the heat flow meter (see clause 6) shall be chosen in such a way that on all sides an edge area of the specimen in a width of at least 100 mm is not covered by the metering area.

9 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.

10 Performance of the measurements

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

However measurements may also be performed for other angles of inclination, in particular for a horizontal position of the specimen. Such an inclination and furthermore the direction of heat flow (upward and downward) shall be indicated in the test report.

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.