BRITISH STANDARD

BS EN ISO 14438:2002

Glass in building — Determination of energy balance value — Calculation method

The European Standard EN 14438:2002 has the status of a British Standard

ICS 81.040.20

National foreword

This British Standard is the official English language version of EN ISO 14438:2002. It is identical with ISO 14438:2002.

The UK participation in its preparation was entrusted by Technical Committee B/520, Glass and glazing in building, to Subcommittee B/520/4, Properties and glazing methods, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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Glass in building - Determination of energy balance value - Calculation method (ISO 14438:2002)

Verre dans la construction - Détermination de la valeur du bilan énergétique - Méthode de calcul (ISO 14438:2002)

Glas im Bauwesen - Bestimmung des Energiebilanz-Wertes - Berechnungsverfahren (ISO 14438:2002)

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Foreword

This document (EN ISO 14438:2002) has been prepared by Technical Committee CEN/TC 129 "Glass in building", the secretariat of which is held by IBN, in collaboration with Technical Committee ISO/TC 160 "Glass in building".

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of an identical text or by endorsement, at the latest by December 2002, and conflicting national standards shall be withdrawn at the latest by December 2002.

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, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

A first Formal Vote took place within CEN as prEN 14026 between 2000-10-19 and 2000-12-19.

Annexes A and B are informative.

This standard includes a Bibliography.

1 Scope

This European Standard specifies a calculation method to determine the energy balance value of glazing. This European Standard applies to transparent materials such as glass and combinations of glass used to glaze windows in buildings.

This method is intended to evaluate the balance of heat loss and useful heat gain by solar radiation entering the building through the glazing for a given period by means of an average rate of loss (or gain) of heat called the energy balance value.

The method enables producers to compare the performance of their glazing products. The energy balance value should not be used for energy use or heating capacity calculations in buildings.

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 revisions 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 (including amendments).

EN 410 Glass in building - Determination of luminous and solar characteristics of glazing

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

EN 674 Glass in building - Determination of thermal transmittance (U value) - Guarded hot plate method

EN 675 Glass in building - Determination of thermal transmittance (U value) - Heat flow meter method

EN 832 Thermal performance of buildings - Calculation of energy use for heating - Residential buildings

3 Symbols

D	degree days	K·24 h
η	utility factor	
H	unobstructed incident solar radiation	kWh/m^2
g	total solar energy transmittance (solar factor)	
U	thermal transmittance (*U* value)	$W/(m^2 \cdot K)$
f	factor due to glazing maintenance and shadow effects	
S	function of *H* and *D* characterising a given region	$W/(m^2 \cdot K)$
E	energy balance value	$W/(m^2 \cdot K)$

Subscripts

p	period of application

4 Basic formula

The energy balance value, E, for a given period is calculated according to the following equation:

$$E = U - \frac{\eta \cdot g \cdot f \cdot H_p}{D_p} \tag{1}$$

where:

U is the U value of the glazing;

η is the utility factor;

f is the factor due to glazing maintenance and shadow effects;

g is the glazing total solar energy transmittance (solar factor);

H_p is the unobstructed incident solar radiation during the given period;

D_p is the degree day total for the given period.

NOTE An example of calculation is given in annex B.

5 Basic material properties

5.1 *U* Value (thermal transmittance)

The U value of the glazing is determined by calculation, in accordance with EN 673 or measurement in accordance with EN 674 or EN 675.

5.2 Utility factor, η

The utility factor for a building or space in a building is the ratio of the useful heat gains, which displace the functional heating over a defined period, to the total heat gains during the period.

The utility factor is essentially a property of the building design.

The utility factor cannot exceed unity. Its precise value depends on the ability of the building and the control of its heating systems to displace its functional heating load while maintaining desirable temperatures inside.

The utility factor is dependent on the period chosen and the length of the period.

Its value for typical constructions such as windows in buildings lies between 0,4 and 0,8 for the winter heating period and it can be determined experimentally or by calculation in accordance with EN 832. For purposes of comparison of glazing products a utility factor of 0,6 shall be used.

5.3 Glazing total solar energy transmittance (solar factor), *g*

This is the total transmission of solar heat through the glazing, and is the sum of the direct transmittance of solar radiation and the amount of absorbed radiation which is convected and re-radiated to the interior.

The total solar energy transmittance shall be determined in accordance with EN 410.

5.4 Factor due to glazing maintenance and shadow effects, *f*

This factor is an allowance for accumulated dirt on the glazing surface and shading effects. For vertical or near vertical (±15°) surfaces the value 0,8 shall be used for comparison of glazing products.

6 Solar radiation incident, H_p

The amount of unobstructed solar radiation is described by the factor H_p which is the amount of solar radiation in kWh/m^2 incident upon the vertical glazing surface during the whole period under consideration.

Data for selected sites are exemplified in annex A.

NOTE Data for sites in Europe are found in [1] of Bibliography.

7 Degree day data, D_p

Degree day units are computed as the difference between the base temperature and the daily average outside temperature. One unit is accumulated for each degree kelvin the average temperature is below the base temperature. Negative values are discarded. This is done for each day of the heating period and summed.

Degree day data are calculated for the local national conditions. Official statistics are published in most countries. The base temperature is the internal design control temperature and shall be defined for the period under consideration. For purposes of comparison a base temperature of 18 °C shall be used.

The value used in the equation shall be the total number of degree days (in kelvins · 24 h) for the period under consideration. Examples are given in annex A.

8 Period of application, *p*

The method of this standard may be used for evaluating the energy balance value of glazing for any chosen period.

For purposes of comparison the period is the "heating season", i.e. the whole period in the months during which functional heating is used in the building. Examples are given in annex A.

9 Principal values and presentation

For the evaluation of the energy balance value (E) of glazing which is used for comparative purposes identical underlying assumptions shall be made.

All the underlying assumptions shall be stated and data prescribed in this standard shall be used.

Statement of underlying assumptions:

- location of use;
- orientation of glazing;
- source of degree day data.

If values of the utility factor and glazing maintenance factor different from 0,6 and 0,8 respectively are used for purposes other than for comparison of products, this shall be stated.

Any publication of energy balance value shall be accompanied by a statement, that the evaluation is based on the full potential incident solar radiation. Any external obstruction which overshadows the window tends to increase the energy balance value. Therefore, in addition to a statement of the underlying assumptions the following complementary statement shall be made:

"This evaluation is applicable only for unobstructed glazing".

The energy balance value shall be expressed in $W/(m^2 \cdot K)$ rounded to one decimal figure. If the second decimal is five, it shall be rounded to the higher values.

EXAMPLE 1 1,53 becomes 1,5

EXAMPLE 2 1,55 becomes 1,6

EXAMPLE 3 1,549 becomes 1,5

10 Alternative simplification of principal values and presentation

The basic formula can be simplified as follows:

$$E = U - g \cdot S \tag{2}$$

where:

$$S = \frac{\eta \cdot f \cdot H_\mathrm{p}}{D_\mathrm{p}} \tag{3}$$

"*S*" may be ascribed values corresponding to a region or a country, where the region or country does not extend over a widely diverse climatic range. For each region or country "deemed to satisfy" values of *S* for the principal orientations are used to characterise the climate, period of application and utility factor of the incident solar radiation as exemplified in annex B.

Annex A
(informative)

Examples of climatic data *p*, *D*p and *H*p

Table A.1 - Duration of heating season, degree day totals for base temperatures of 18 °C and solar radiation incident on vertical surfaces for selected sites

Location	Heating season (Duration inclusive)	Degree day total, D_p (K·24 h)	Solar radiation, H_p (kWh/m^2)		
			North	East/West	South
Belgium (Uccle)	Sept/May	2900	202	350	505
Denmark (Copenhagen)	Sept/May	2936	100	225	420
France					
Zone H1 (Trappes)	Sept/May	2625	230	410	590
Zone H2 (Carpentras)	Oct/May	2167	235	520	720
Zone H3 (Nice)	Nov/April	1542	150	360	630
Germany					
(Hamburg)	Sept/May	3267	195	348	505
(Berlin)	Sept/May	3335	203	358	518
(Munich)	Sept/May	3568	242	446	649
Holland (De Bilt)	Sept/May	2935	205	358	522
Italy					
(Milan)	Oct/March	2159	107	196	346
(Rome)	Nov/March	1401	110	239	442
(Messina)	Nov/March	844	85	191	373
UK (South) (London) (Thames Valley) (Midlands)	Sept/May	2700	200	347	510
UK (North)	Sept/May	3000	197	354	497
UK (Scotland)	Sept/May	3200	176	303	452
Japan					
(Sapporo)	Sept/June	3757	175	443	709
(Niigata)	Oct/April	2313	124	223	364
(Tokyo)	Nov/April	1599	102	228	440
(Kagoshima)	Nov/April	1200	93	281	533

Annex B
(informative)

Examples of calculation of the energy balance value

B.1 Example of calculation from the climatic data D_p and H_p

Table B.1 - Examples of climatic data for a given country, from Table A.1

Heating season (Duration inclusive)	Degree day total, D_p (K·24 h)	Solar radiation, H_p (kWh/m2)		
		North	East/West	South
Sept/May	2900	202	350	505
NOTE The numerical values ascribed in the table above are intended to illustrate the calculation and application of the principle and are not constructed to be similar or typical of any particular region or country.				

Example of calculation of the energy balance value for a conventional double glazing (air filling, no low-e coating).

U value is 2,9 W/(m^2·K)

g is 0,75

The orientation is south

The standardised values for η and *f* are 0,6 and 0,8 respectively.

The energy balance value *E* is calculated according to formula (1) as follows:

$$E = U - \frac{\eta \cdot g \cdot f \cdot H_p}{D_p} \quad \text{(B.1)}$$

$$= 2{,}9[\mathrm{W/(m^2 \cdot K)}] - \frac{0{,}6 \cdot 0{,}75 \cdot 0{,}8 \cdot 505[\mathrm{kWh/m^2}]}{2900[\mathrm{K}] \cdot 24[\mathrm{h}]}$$

$$= \left[2{,}9 - \frac{0{,}6 \cdot 0{,}75 \cdot 0{,}8 \cdot 505 \cdot 1000}{2900 \cdot 24}\right] \quad [\mathrm{W/(m^2 \cdot K)}]$$

= 0,288 W/(m2·K) rounded to 0,3 W/(m2·K) in accordance with clause 9.

B.2 Example of calculation from 'deemed to satisfy' *S* values for a given region or country

Table B.2 - Examples of deemed to satisfy *S* values for a given region or country

	"Deemed to satisfy" *S* values for computing the energy balance value W/(m^2·K)		
ORIENTATION	North	East or West	South
	1,9	2,5	3,2
NOTE The numerical values ascribed in the table above are intended to illustrate the calculation and application of the principle and are not constructed to be similar or typical of any particular region or country.			

EXAMPLE 1

Example of calculation of the energy balance value for a conventional double glazing (air filling, no low-e-coating).

U value is 2,9 W/(m^2·K)

g is 0,75

The energy balance value is calculated as follows:

$E = 2,9 - 0,75\ S$

The following results are obtained for each orientation:

Orientation	North	East or West	South
E	1,5	1,0	0,5

EXAMPLE 2

Example of calculation of the energy balance value for a double glazing with a low-e-coating and argon gas filling on the basis of *S* values in Table B.2.

U value is 1,4 W/(m^2·K)

g is 0,65

The energy balance value is calculated as follows:

$E = 1,4 - 0,65\ S$

The following results are obtained for each orientation:

Orientation	North	East or West	South
E	0,2	-0,2[1)]	-0,7[1)]

[1)] As the solar gains are higher than the losses the energy balance value becomes negative.

Bibliography

[1] "European Solar Radiation Atlas Volume II: Global and Diffuse Radiation on Vertical and Inclined Surfaces", Edited by W. Palz, Commission of European Communities (1984), EUR 9345

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