White Paper

A guide to the assessment of thermal performance of Aluminium Products

Building Regulations **Document L**

Conservation of Fuel and Power

June 2022

Smart Architectural Aluminium

CONTENTS

INTRODUCTION

Building regulations document L covers the energy efficiency of building. This document summarises the areas of relevance to the fenestration industry, from the most recent publications of standards.

Highlighting the various routes to prove compliance, with an overview of calculation methods and example calculations.

The thermal performances of various Smart Systems are summarised in the appendix.

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Smart Systems

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Conservation of Fuel and Power

Recent changes in the building regulations are being driven by the commitment for the Government to continually improve thermal performance of buildings.

The building regulations part L are sub-divided into Volume 1 dwellings and Volume 2 commercial. Within these documents are different limiting U Values setting minimum performance requirements and the calculations methods to prove compliance.

Copies of the approved documents to building regulations can be downloaded from:

https://www.gov.uk/housing-local-and-community/building-regulation

Compliance Methods

New Buildings

New building are based on fabric limiting values and target Building CO_2 calculations based on a notional buildings. The limiting values for windows and doors is 1.6W/m²K giving building designers the flexibility to improve different building elements to achieve overall building targets.

The overall notional building CO_2 targets have increased:

- SAP10 New Domestic
- SBEM New Commercial.

	2010	15th June 2022
L1A New Dwellings – SAP10 Standard Assessment Procedure		
Windows	1.4	1.2
Glazed Doors	1.4	1.2
Panel Doors	1.0	1.0
L2A New Commercial - SBEM Simplified Building Energy Model		
Windows	1.6	1.4
Doors	2.2	1.9

Notional building specification prepared as a guide for all the building fabric, which if followed achieves compliance for new buildings.

As this is only a notional building specification different performances can be used as long as the overall building archives the performance required. For example the SAP notional building also proposes 0.18W/m² for walls, upgrading the performance of walls allows offsetting the performance of the windows upto the limiting value.

SAP10
https://files.bregroup.com/SAP/SAP%2010.2%20-%2017-12-2021.pdf

SBEM
https://www.uk-ncm.org.uk/filelibrary/NCM_Modelling_Guide_2021_Edition_England_15Dec2021.pdf

Compliance Methods

Limiting Values

	2010	15th June 2022
L1A New Dwellings		
Window/Doors	2.0	1.6
Rooflight	2.0	2.2
L1B Existing Dwellings		
Window	1.6 or Band C	1.4 or Band B
Rooflight	1.6 or Band C	2.2
Doors with greater than 60% of internal face glazed	1.8 or Band E	1.4 or Band C
Other doors	1.8 or Band E	1.4 or Band B
L2A New Commercial		
Windows/Doors	2.2	1.6
Rooflight	2.2	2.2
High usage entrance doors	3.5	3.0
L2B Existing Commercial		
Windows in buildings similar to dwellings	1.6 or Band C	1.6 or Band B
Windows, doors and roof windows	1.8	1.6
Rooflight.	1.8	2.2
High usage entrance doors	3.5	3.0

Calculation Methods

The fenestration **calculation methods** to prove compliance have changed with the tightening of the rules for use of Indicative and Centre Pane methods. The calculated U Values can be calculated to BS EN 14351-1 permit CE Marking to prove compliance to the UK building regulations. For domestic windows ECO Labels combine the thermal parameters to creating a window energy rating, the methodology for window energy ratings is included in the 2010 regulations.

CE Marking is included in the regulations referencing CEN window to BS EN 14351-1 providing a system method for calculating the U Value. CE Marking can be used as benchmark to compare similar products for U Value g value and air permeability.

ECO Labels simplifies the performance data to a single value, combined to provide an energy balance of losses and gains. This is based on a typical climate data to the UK and provides a comparison tool between different products.

Indicative U Value. The use of BRE's Standard Assessment Procedures are now restricted to mainly residential buildings, only applying to commercial buildings where the building is domestic in character, such as student accommodation.

Centre Pane of 1.2 provided compliance for all replacement windows in the 2006 regulations. This option is restricted to where there is a need to maintain the external appearance of the building. In these circumstances the replacement windows should meet a centre pane of 1.2W/m²K alternatively single glaze windows should be supplemented with a low e secondary glazing.

Hot box testing and Simulations

BS EN ISO 12567-1 BS EN ISO 10077-1 & 2

The hot box test is a physical measurement of the actual heat transfer through a particular window configuration. Based on a standard design the heat transfer is measured in a libratory 'hot box'. Hot box testing to prove compliance can be prohibitively when considering design variations.

Hot Box test provides an accurate performance, however the results cannot be used for any other sample or variant i.e. change a sash or any other part of the window make-up and a new hot box test is required to assess the thermal performance each specification variation. Finite element simulations to BS EN 10077-2, can be used in the absence of Hot Box testing; this uses numerical software packages to simulate the physical heat transfers. A simulation in accordance with BR443 can also be used to prove compliance to the UK building regulations.

UKCA and CE Marking

BS EN 14351-1

The Harmonised European standard allows general performance declarations for Windows and Doors to a common format throughout Europe. Providing commonality to the methodology and performance declarations from different countries allow free trade across Europe.

The thermal performance from the European standard can be from testing or simulation to a standard CEN Window configurations detailed BS EN14351-1. Thermal Simulation software uses finite elements to calculate the conduction and radiation of the framing sections and area weighted with the performance.

Window Energy Rating

WER window energy rating bands (Domestic Windows Only)
The ratings are classified into bands A-G representing bands of WER Ratings kWh/m²/yr. Windows with a net heat loss have BFRC rating bands B-G windows with an A rating indicating a net inflow of heat, warming the property.
Window energy rating are based on the energy balance of the losses through the window offset against the solar heat gains through the window. The calculations are always on standard designs and based on typical climate data for the UK. Window energy ratings are intended as a comparator tool and the actual heat losses on the window will depend on the location design of window and climate.

Only applies domestic buildings L1b refurbishment only.

WER may also apply to commercial refurbishment, if the building is domestic in character. For example, student accommodation, care homes and similar

Standard Assessment Procedure

SAP2009 Table6e
The indicative method calculates typical thermal performance of windows, doors, and roof lights. This calculation takes into account the thermal performance of the frame based on the window material thermal break size combined with thermal performance of the glass.

The BRE's Standard Assessment Procedure is now only a valid calculation method for domestic buildings Volume 1.

SAP 2010 may also apply to commercial, if the building is domestic in character. For example, student accommodation, care homes and similar

Glass centre pane

Centre Pane < 1.2W/m²K
For replacement windows only it was possible to claim compliance with replacement domestic by simply certifying or proving that the window is glazed with glazing with a 'centre of glass' U value < 1.2 irrespective of frame type.

Only applies to replacement windows and doors where there is a need to maintain the external appearance of the building and replacement windows unable to meet the requirement.

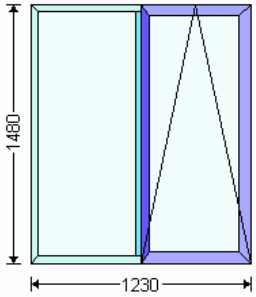
U Value Calculation

U Value of Window

The U value for a window can be calculated by summing the area weighted heat loss though the window.

- Frame
- Glass
- Glass Edge

For the purposes of UK Building regulation this is standard window defined in BR443 or in BS EN14351-1.



Specification:
Outerframe
ETC4110
Vent
ETC4120
Transom
ETC4130

Frame

Heat loss through the frame is calculated by multiplying the areas by the U value of the individual parts of the window see table right.

Heat Loss Frame **0.8635 W/K**

	U Value W/m²K	Area m²	Qf W/K
Outerframe	1.595	0.1090	0.1739
Mullion	2.227	0.0398	0.0887
Ventframe	2.344	0.1794	0.4205
Mullion +Vent	2.227	0.0818	0.1822
Frame Overall	2.110	0.4101	**0.8653**

Glass

Heat loss though the glass, is calculated by the Centre Pane (U value) of the glass multiplied by the visible glazed area.

Heat Loss Glass **1.738 W/K**

	Centre Pane W/m²K	Area m²	Qg W/K
Glass Unit	1.0	1.410	**1.410**

Glass Edge

At the edge of the glass, the spacer bar has a different thermal performance to the centre of the glass. The edge spacer effect can be calculated by an edge effect coefficient ψ multiplied by the linear perimeter of the Lψ glass.

Heat Loss Glass Edge **0.263 W/K**

	Centre Pane W/m²K	Len m	Qg W/K
Spacer Bar	0.035	7.528	**0.263**

Overall U Value

The overall U Value for the System can be calculated.

Overall U Value **1.4 W/m²K**

$$U_{Window} = \frac{\text{Total Heat Losses}}{\text{Window Area}}$$

$$= \frac{0.8635 + 1.410 + 0.263}{1.230 \times 1.480}$$

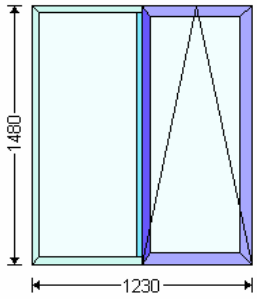
$$U_{Window} = \mathbf{1.39\ W/m^2K}$$

Window Energy Rating Calculation

Window Energy Rating

The Window Energy Rating WER is calculated from.

- U Value
- g Value
- Air Leakage



Heat Loss (U Value)

The heat lost through the window for a typical year in the UK.

68.5 x U_{Window}

	W/m²K	UK WER Factor	Heat Losses kWHr/m²Year
Heat Loss	1.681	68.5	115.148

Heat Loss (Air Leakage)

Where AL air leakage though the window in m³/h.m² at 50Pa pressure difference.

1.13025 x AL

	AL	UK WER Factor	Heat Losses kWHr/m²Year
Air Leakage	0	1.13025	0

Solar Gain (g Value)

The solar gain of the window is calculated from the g value of the glass multiplied by the visible area of glazing.

196.7 x (1-f)x g_{glass}
196.7 x (0.795)x 0.74

	g_{Window}	UK WER Factor	Solar Gains kWHr/m²Year
Solar Gains	0.5883	196.7	115.719

WER Value

The annual energy balance for the window can be calculated from the Solar Gains offset against the Heat Losses:
115.719 – 115.148

Window Energy Rating
+ 0.4kWh/m²Year.

The window energy band is assigned based on the typical heat balance.

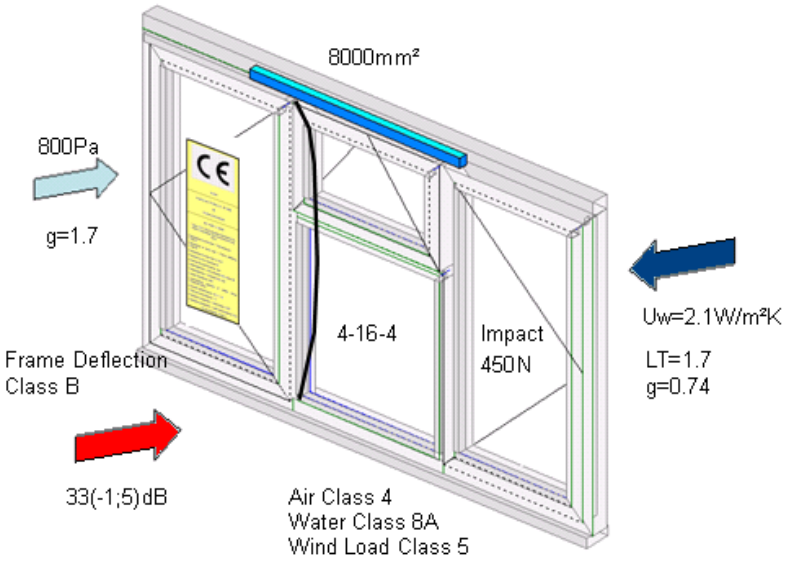
Window Energy Band
BAND A

WER Band	**WER** (kWh/m²Year)
A	0
B	0 to -10
C	-10 to -20
D	-20 to -30
E	-30 to -50
F	-50 to -70
G	-70 or more

UKCA and CE Marking

Applies to L1a L1b L2a L2b

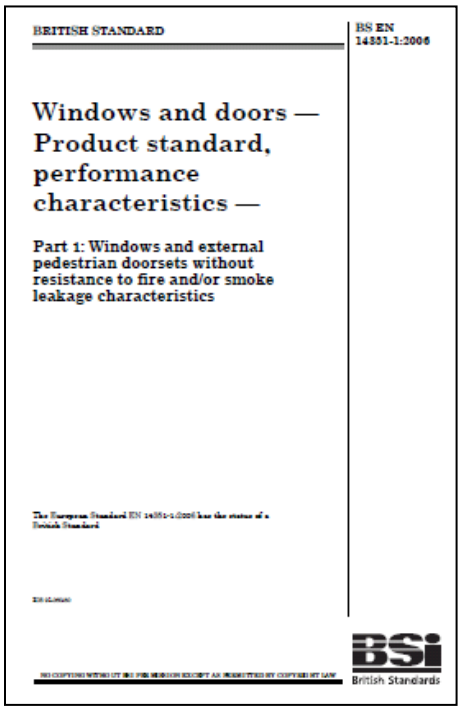
UKCA Marking cover varied construction products, the harmonised standard for windows and doors is implemented BS EN 14351-1, this cover many performance aspects including weather, impact and acoustics performance including calculations for the thermal characteristics.



BS EN 14351-1 Windows and Door Product Standard

BS EN 14351-1 allows for clear comparisons between the performances from different suppliers allowing informed choices to be made on all characteristics and to select the highest performing products.

U Value calculation to BS EN 14351-1 is based on CEN windows and can be used to comply with the U Value requirements for commercial and domestic applications. WER are suited to refurbishment domestic CE Marking U Values are suited to new buildings and commercial buildings. This allows for the overall energy in new buildings to be calculated through SBEM or SAP calculations including allowances for overheating.

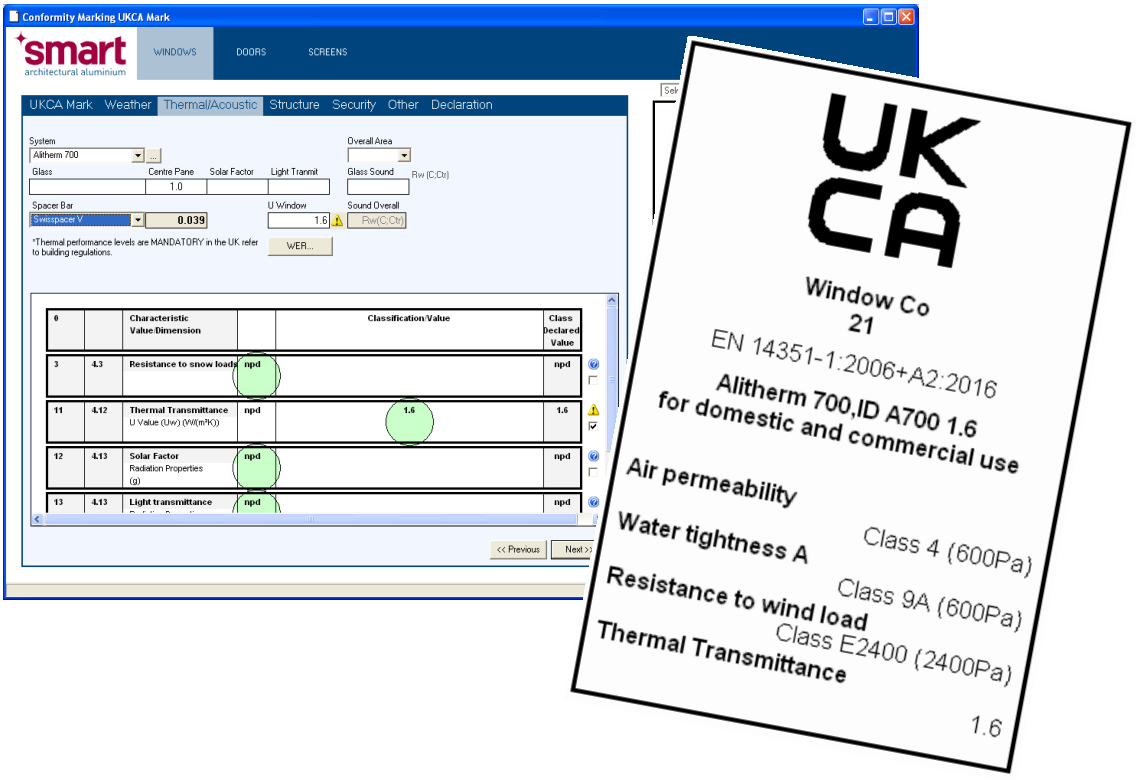

BRITISH STANDARD

BS EN 14351-1:2006

Windows and doors — Product standard, performance characteristics —

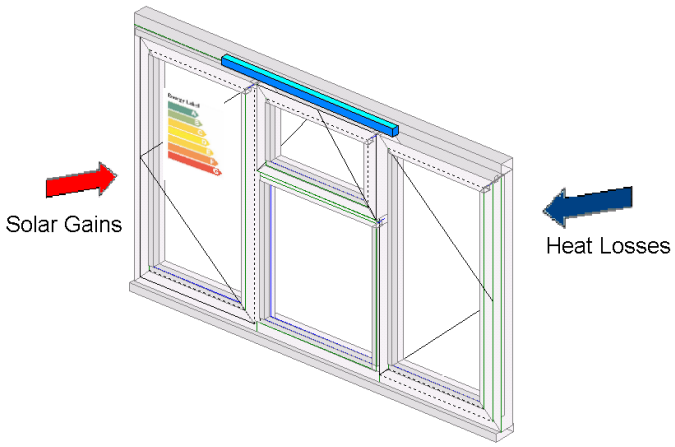
Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics

BSI British Standards



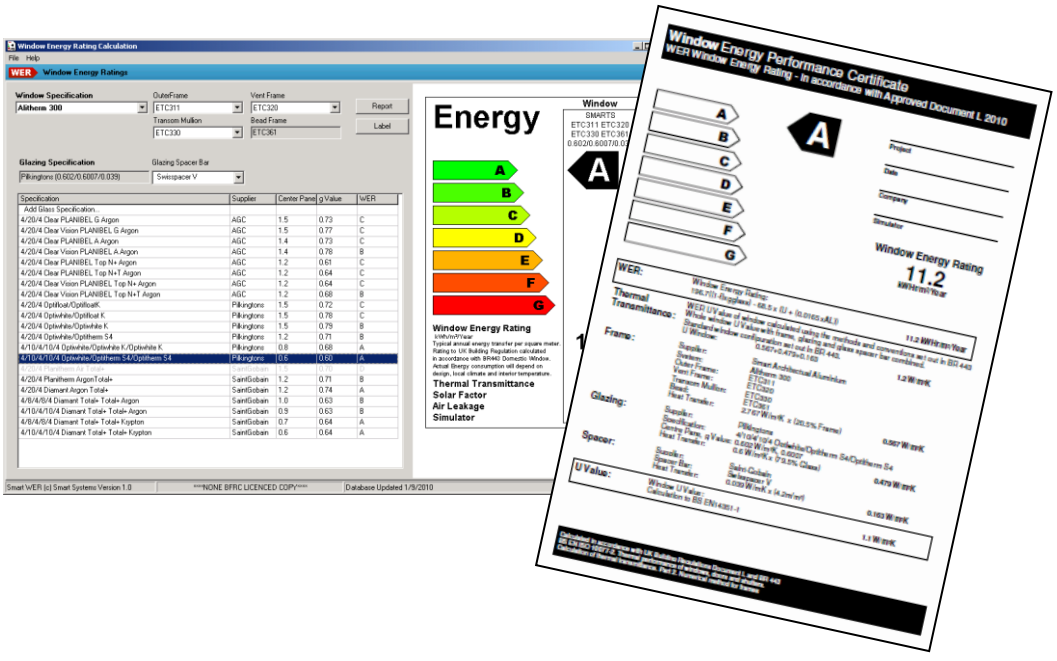
Window Energy Ratings

Window Energy Ratings calculate the "energy balance" of a typical window by combining the heat losses and offset against heat gains due to the sun.



The resulting energy balance, the difference between the gains and losses is the Window Energy Rating expressed in kWh/m² per Year. Window with high solar gains can completely offset the heat losses from the window resulting in a windows which is a net heat contributor to the property.

The values used to calculate the energy balance are based on typical values of sunshine and climate for the UK for a typical window. This actual window configuration including the glass specification can be modelled by a Smarts Dealer to provide a detailed energy report and WER label.



Understanding the ratings

The ratings are from A to G with A being most efficient and G rated windows losing the most amount of heat. Band A is a window where the solar gains are larger than the heat losses, band B to G the window will lose heat. The energy balance is calculated for a typical year in the UK and calculates the energy in kWh per square metre of window.

The effective cost for the typical window would depend on the cost of heating and number of windows. The following table shows typical annual savings based on the cost of gas heating for different sized properties.

Typical contribution of windows to annual heating bill

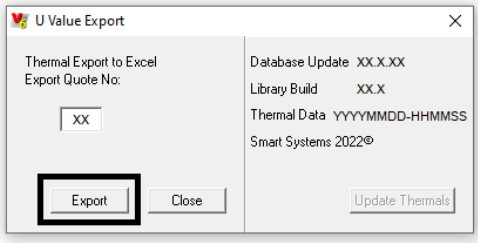
WER (kWh/m²Year)	Rating	**Window** 1m x 1m	**Flat** 6.9m²	**Terraced** 12.7m²	**Semi** 16.9m²	**Detached** 23.7m²
0	A	£0	£0	£0	£0	£0
0 to -10	B	£0.40	£3	£5	£7	£9
-10 to -20	C	£0.80	£6	£10	£13	£19
-20 to -30	D	£1.20	£9	£15	£20	£28
-30 to -50	E	£2.00	£14	£25	£34	£47
-50 to -70	F	£2.80	£20	£36	£47	£66
-70 or more	G	£2.80+	£20+	£36+	£47+	£66+
Double Glazed PVCu Installed Windows in 2002		£4.23	£29	£54	£72	£100

[1]Source GGF Energy Saving Calculator Based on Gas Heating
Heating costs Gas 0.04£/KWh, Electric 0.083£/KWh, Oil 0.061£/KWh Oil, Solid Fuel 0.027£/KWh. Double Glazed PVCu in 2002 with DGU with 20mm spacer bar commercial domestic

Example
A detached house with PVCu window 8 years old replaced with C Rated Windows Aluminium the heat losses would drop from £100 per year to £19 saving £81 per year.

Export U Value to Excel

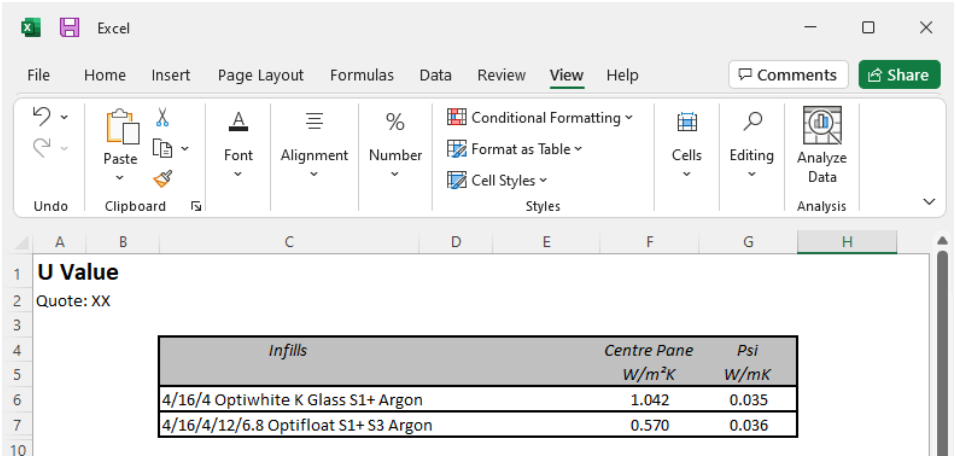
To export the Thermal data click the **'U button'** on ToolBar at the top of V6. Enter the Quote number then click Export.



This will create an Excel spreadsheet with U Value summary on the front sheet and the U value for the items on following sheets which can be accessed from the Tabs at the bottom.

Entering Glass Data

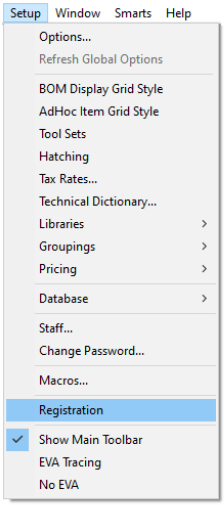
Enter the glass performance in the infills section of the spreadsheet. You should enter the **'Centre Pane'** and **'Psi Value'** for the glass, this will then update the U value.

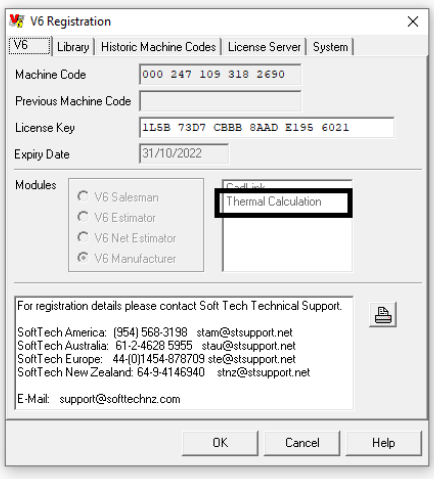


The U values of the sections are in the Index Tab. If the combination of profiles does not have a U value saved in the database it will have **npd** – no performance data. Email technical@smartsystems.co.uk to obtain the Uf section values.

V6 Licence Key – Enabling Thermal Calculation

You may need to update your time lock key to enable Thermal Calculation. This can be checked by clicking the Setup menu and registration.
If enabled Thermal Calculation will appear in the white text box as shown. If Thermal Calculation is not shown you will need to update your Licence Key.
To obtain an updated licence key email you can your machine code to:-
V6support@smartsystems.co.uk

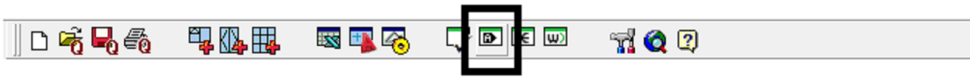


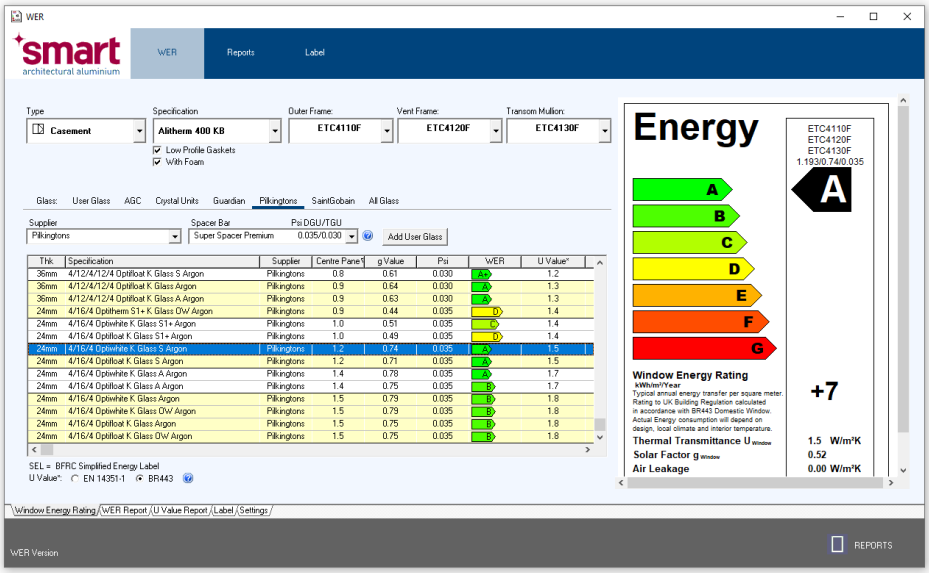


Note: After enabling you will need to force a resave to the quote for the thermal data be saved.

Energy Rating and U Value Report

To generate Energy Ratings and U Value reports click the **'A Button'** on the Toolbar at the top of V6. Select the Type Specification and profiles of the window or door from the top of the Energy Rating Calculator.





Under the profile spec lists glass performance data.

Select the Spacer Bar and **'Psi Value'** from Spacer Bar box**.**

To add customised glass click the 'Add User Glass' button and enter the 'Centre Pane' and 'g-value' into the Glass Specification box

After selecting select the specification click on the WER or U value Tab to generate Energy Rating or U Value reports.

Glazing Data

For U Values the thermal performance **'Centre Pane'** of the glass is required. In addition to the **'Centre Pane'** Energy ratings consider the heating effect from sunlight based on the **'g-Value'** of the glass.

Glass Centre Pane

The **'Centre Pane'** is the measurement of energy conductivity through the middle of a pane of glass whether it is single glazed, double glazed or triple glazed, etc. It does not consider anything at the edge of the glass such as the spacer bar or window frame..

g-Value (Solar Transmittance)

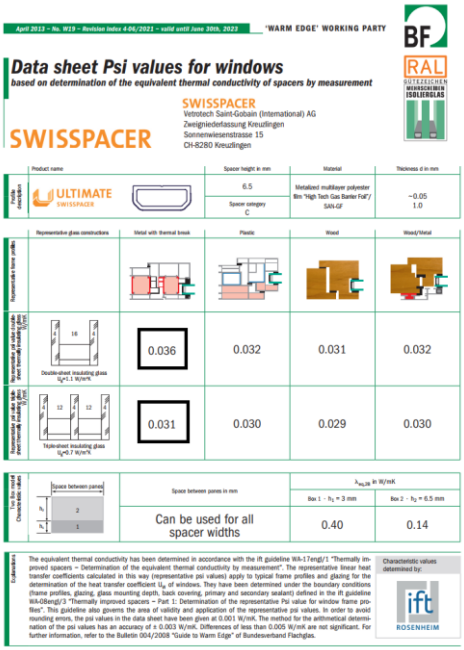
The **'g-value'** is a measure of how much solar heat (infrared radiation) is allowed in through a particular part of a building. A low g-value indicates that a window lets through a low percentage of the solar heat. This should not be confused with LT or Light Transmittance which is the fraction of visible light directly transmitted through the glass.

Glass Datasheets

Glass suppliers have software to generate datasheets for different specification of glass. The following links access the different supplier calculators. Example of glass datasheets are included in the appendix.

Spacer Bar - Psi Value

At the edge of the double glazing and triple glazing there is some extra heat loss because of the spacer bar at the edge of the glass. The spacer bar is not as good an insulator as the 'Centre of the glass and the **'Psi value'** represents this additional heat loss.


'WARM EDGE' WORKING PARTY

Data sheet Psi values for windows

based on determination of the equivalent thermal conductivity of spacers by measurement

SWISSPACER

SWISSPACER
Vetrotech Saint-Gobain (International) AG
Zweigniederlassung Kreuzlingen
Sonnenwiesenstrasse 15
CH-8280 Kreuzlingen

Product name	Spacer height in mm	Material	Thickness d in mm
ULTIMATE SWISSPACER	6.5	Metallized multilayer polyester film "High Tech Gas Barrier Foil", SAN-GF	~0.05 1.0

Spacer category C

Representative glass constructions	Metal with thermal break	Plastic	Wood	Wood/Metal
Double-sheet insulating glass U_g=1.1 W/m²K	0.036	0.032	0.031	0.032
Triple-sheet insulating glass U_g=0.7 W/m²K	0.031	0.030	0.029	0.030

Space between panes in mm	$\lambda_{eq,ins}$ in W/mK	
	Box 1 - h_1 = 3 mm	Box 2 - h_2 = 6.5 mm
Can be used for all spacer widths	0.40	0.14

The equivalent thermal conductivity has been determined in accordance with the ift guideline WA-17engl/1 "Thermally improved spacers – Determination of the equivalent thermal conductivity by measurement". The representative linear heat transfer coefficients calculated in this way (representative psi values) apply to typical frame profiles and glazing for the determination of the heat transfer coefficient U_W of windows. They have been determined under the boundary conditions (frame profiles, glazing, glass mounting depth, back covering, primary and secondary sealant) defined in the ift guideline WA-08engl/3 "Thermally improved spacers – Part 1: Determination of the representative Psi value for window frame profiles". This guideline also governs the area of validity and application of the representative psi values. In order to avoid rounding errors, the psi values in the data sheet have been given at 0.001 W/mK. The method for the arithmetical determination of the psi values has an accuracy of ± 0.003 W/mK. Differences of less than 0.005 W/mK are not significant. For further information, refer to the Bulletin 004/2008 "Guide to Warm Edge" of Bundesverband Flachglas.

Characteristic values determined by: ift ROSENHEIM

Spacer Bar Datasheets

Spacer Bar datasheets can be obtained from Bundesverband Flachglas. The indicative Psi value depends on frame materials and if the glass is double or triple glazed. Triple glazed the Psi values heat losse are slightly lower than for double glazed. To access datasheets you can use the link below.
https://www.bundesverband-flachglas.de/en/downloads/bf-datenblaetter-fenster

Spacer bar Psi adjustments

The values on the datasheet are based on 4mm glass for different thickness the below adjustments should be made.
Outer pane: Per mm thicker/thinner than 4 mm addition/deduction of 0.001 W/(m2K)
Inner pane: Per mm thicker/thinner than 4 mm addition/deduction of 0.002 W/(m2K)
(The glass thickness of the middle pane in triple-glazed structures is not relevant.)
i.e. 4/16/6.8 is 3mm thicker in the inner pane and the Psi value should have 0.006 added.

Appendix

Example of glass datasheets are included in the appendix

AGC	https://www.agc-yourglass.com/
Guardian	https://www.guardianglass.com/gb/en/tools-and-resources/tools/glass-analytics
Pilkingtons	https://spectrum.pilkington.com/
Saint Gobain	https://calumenlive.com/en/home

AGC – Your Glass

https://www.agc-yourglass.com/

AGC

Calculated by Anthony Murray Calculated on 27/05/2022 Country Great Britain

① 4 mm Planibel Clearlite Annealed ② 16 mm Argon 90% ③ 4 mm Planibel A pos.3 Annealed

Glass performance data simulation

Light properties - EN 410

Light transmittance : τv [%]	73
External light reflection : ρv [%]	17
Internal light reflection : ρvi [%]	15
Colour rendering index : Ra [%]	98

Energy properties - EN 410

Total solar energy transmittance : g [%]	75
External energy reflection : ρe [%]	17
Internal energy reflection : ρei [%]	15
Direct energy transmission : τe [%]	61
Energy absorption glass 1 : αe1 [%]	6
Energy absorption glass 2 : αe2 [%]	16
Total energy absorption : αe [%]	22
Shading coefficient : SC	0.86
UV transmission : τuv [%]	38
Selectivity	0.97

Thermal properties - EN 673

Thermal transmittance (vertical glazing) : U value [W/(m².K)]	1.4

Acoustic properties

Direct airborne sound reduction - EN 12758 : Rw (C;Ctr) [dB] 1	30 (-1;-4)

Safety properties

Resistance to fire - EN 13501-2	NPD
Reaction to fire - EN 13501-1	NPD
Bullet resistance - EN 1063	NPD
Burglar resistance - EN 356	NPD
Pendulum body impact resistance - EN 12600	NPD / NPD
Explosion resistance - EN 13541	NPD

Thickness and weight

Nominal thickness : [mm]	24.0
Weight : [kg/m²]	20

1. The sound reduction indexes correspond to glazing with dimensions 1230 mm by 1480 mm according to EN ISO 10140-3 and are tested in laboratory conditions. In-situ performances may vary according to the effective glazing dimensions, supporting system, installation, environment, noise sources etc. The accuracy of the given indexes is +/- 1 dB.

INISMa member of EMMA

Glass Configurator
Calculation software verified by INISMa
EN 410 and EN 673
Report n° 2018B COU 35741

Guardian – Glass Analytics

https://www.guardianglass.com/gb/en/tools-and-resources/tools/glass-analytics

GUARDIAN SUNGUARD | PERFORMANCE CALCULATOR

04.May.2022
By Cole, Kevin

KIWA confirms to have verified the calculation engine of the software **Guardian Performance Calculator 4.1** to be compliant to EN 410 and EN 673.

New Project 09

Make-up Name	Glass 1 & Coating	Glass 2 & Coating	Visible Light			Solar Energy				Thermal Properties
			Transmittance	Reflectance		Transmittance	Reflectance	Solar Factor (g%)	Secondary Heat Transfer (Q_i)	U-Value
			Visible (τ_V %)	ρ_V % out	ρ_V % in	Solar (τ_E %)	ρ_E % out			U_0 W/m²-K [3 Decimals]
Default Make-up 01	**Guardian ExtraClear (CE)**	**ClimaGuard® Neutral 1.0 (CE) on Guardian ExtraClear (CE)**	**73.2**	**13.8**	**12.9**	**40.8**	**37.3**	**52.9**	**12.1**	**1.042**

Calculation Standard: EN 410:2011 / EN 673:2011

Default Make-up 01

Outdoors

GLASS 1	Guardian ExtraClear (CE) Thickness = 4mm	#1 ----- #2 -----
GAP 1	10% Air, 90% Argon, 16mm	
GLASS 2	Guardian ExtraClear (CE) Thickness = 4mm	#3 ClimaGuard® Neutral 1.0 (CE) #4 -----

Total Unit (Nominal) = 24 mm — Slope = 90°

Estimated Nominal Glazing Weight: 19.19 kg/m²

Indoors

Pilkington – Spectrum

https://spectrum.pilkington.com/

PILKINGTON

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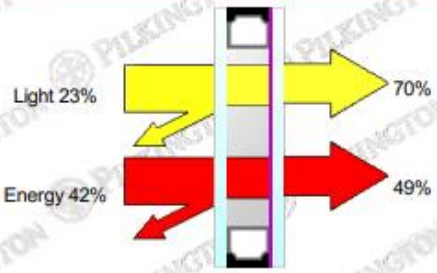

DESCRIPTION

Position	Product	Process	Thickness (nominal) mm	Weight kg/m²
Pilkington **Insulight™** Therm				
Glass 1	Pilkington **Optifloat™** Clear	Annealed	4.0	
Cavity 1	Argon (90%)		16.0	
Glass 2	Pilkington **Optitherm™** S1 Plus	Annealed	4.0	
Product Code	4-16Ar-		24.0	20.00

PERFORMANCE

Light		
Transmittance	LT	70%
	UV %	35%
Reflectance Out	LR out	23%
Reflectance In	LR in	24%

Performance Code	
U_g-value/Light/Energy	1.04 / 70 / 49
Ra	95

The values of some of characteristics are displayed as NPD. This stands for No Performance Determined.

Energy		
Direct Transmittance	ET	43%
Reflectance	ER	42%
Absorptance	EA	15%
Total Transmittance	g	49%
Shading Coefficient Total		0.56
Shading Coefficient Shortwave		0.5
Sound Reduction	R_w (C;C_{tr}) dB	31 (-2; -5)
Thermal Transmittance	W/m²K	1.04

Pilkington Spectrum allows you to combine a wide range of products available from Pilkington and determine their key properties such as light transmittance, g value and U value. The program includes restrictions that prevent some combinations being selected that may be considered unwise or impractical. Even with these restrictions, it is still possible to create product combinations that may not be available from your supplier. Please check with your supplier that your chosen product combination is possible, available in the sizes required and in a timescale appropriate to your project. Furthermore, it is essential that you check that your product combination is appropriate for satisfying local, regional, national and other project-specific requirements.

Calculations are made according to EN standards 410 and 673/12898

Pilkington Spectrum Version UK:7.3.1 27/05/2022

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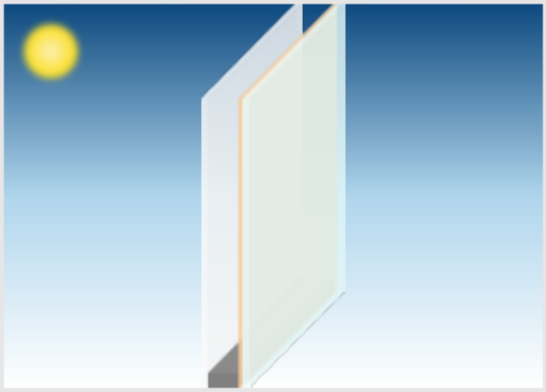
Saint Gobain – Calumen

https://calumenlive.com/en/home

SAINT-GOBAIN

Calumen III 1.21



Pane 1	DIAMANT (4 mm)
Cavity 1	ARGON (90%) / AIR (10%) / 16 mm
Pane 2	PLANITHERM TOTAL+ FG PLANICLEAR (4 mm)

LUMINOUS FACTORS — CIE (15-2004)

Light transmission (TL %)	79.7 %
Outdoor reflection (RLe %)	13.1 %
Indoor (RLi %)	12.2 %

SOLAR FACTORS — EN410 (2011-04)

Solar factor (g)	0.7455
Shading Coefficient (SC)	0.8569

COLOR RENDERING — CIE (15-2004)

Transmission (Ra)	99.2
Reflection (Ra)	90.4

BURGLAR RESIST — EN356

Result :	NPD

ENERGY FACTORS — EN410 (2011-04)

Transmission (Te)	66 %
Reflection (Ree)	21.5 %
Indoor (Rei)	20.6 %
Absorption (AE1)	2.6 %
Absorption (AE2)	10 %

THERMAL TRANSMISSION — EN673 (2011-04)

Ug 0° related to vertical position	1.193 W/m².K

MANUFACTURING SIZES

Nominal thickness	24.0 mm
Weight	20.0 kg/m²

PENDULUM RESISTANCE — EN12600

Result :	NPD

Thermal Performance

Designer Door

Thermal Simulation BS EN IS0 10077-2
BS EN 14351-1

U Value W/m²K	Door Reference	
1.4	DM0001	Amersham
1.4	DM0002	Ashwell
1.3	DM0003	Bloomsbury
1.4	DM0004	Broadstone
1.3	DM0005	Canonbury
1.4	DM0006	Clifton
1.3	DM0007	Eastleigh
1.4	DM0008	Falmouth
1.3	DM0009	Hambleton
1.4	DM0010	Highgate
1.4	DM0011	Kingsbridge
1.4	DM0012	Kensington
1.4	DM0013	Lymington
1.4	DM0014	Marlborough
1.4	DM0015	Oakham
1.5	DM0016	Pembroke
1.4	DM0017	Mayfair
1.5	DM0018	Purbeck
1.5	DM0019	Rushcliffe
1.4	DM0020	Pimlico
1.3	DM0021	Sherbourne
1.5	DM0022	Richmond
1.5	DM0023	Shipston
1.3	DM0024	Teddington
1.4	DM0025	Twickenham
1.3	DM0026	Winchester
1.3	DM0027	Woodbridge
1.4	DM0028	Westbury
1.5	DM0029	Amersham 2
1.5	DM0030	Oakham 2
1.3	DM0031	Oxford
1.5	DM0032	Amersham 3
1.3	DM0033	Highgate
1.3	DM0034	Ledbury
1.3	DM0037	Malton
1.3	DM0041	Oxford 2
1.3	DM9000	Amesbury

U Value W/m²K	Door Reference	
1.7	DT0001	Greenway
1.7	DT0002	Elberry
1.9	DT0003	Edwardian
1.8	DT0004	Georgian
1.8	DT0005	Regency
1.8	DT0006	Victorian
1.6	DT0007	Windsor
1.4	DT0008	Coleford
1.3	DT0009	Axbridge
1.4	DT0010	Churchill
1.4	DT0011	Purton
1.3	DT0012	Somerton
2.1	DT0013	Edwardian 2
1.3	DT0014	Ashcott
2.0	DT0015	Regency 2
2.1	DT0016	Victorian 2
2.1	DT0023	Elberry 2
1.3	DT0024	Elberry 3
1.4	DT0025	Edwardian 3
1.3	DT0026	Edwardian 4
2.1	DT0027	Georgian 2
1.4	DT0028	Georgian 3
1.3	DT0029	Georgian 4
1.5	DT0030	Regency 3
1.3	DT0031	Regency 4
1.3	DT0032	Victorian 3

System Thermal Performance.
Calculation in accordance with BR443, Thermal transmittance of system from numerical method of simulations, BS EN IS0 10077-2
[1] Thermal Transmittance of glazing (Centre Pane) to be determined in accordance with EN 673, EN 674 or EN675.
[2] Spacer Bar Data to be Calculated in accordance with ift-Guidelines WA-08 'Determination of representative values for profile sections of windows
[3] Calculated overall thermal performance to BS EN ISO 1007-1 configuration to EN 14351-1 Annex E as per UK 2010 Building Regulations.
•①L1B dependent on g value of glazing windows may also be compliant with energy rating calculation

Thermal Performance

Orangery

Thermal Simulation BS EN IS0 10077-2
BS EN 14351-1

		U Value							
Centre Pane	W	1000	1000	1000	1000	1000	2000	2000	2000
	L	2000	2500	3000	3500	4000	3000	3500	4000
0.5		**1.2**	**1.2**	**1.2**	**1.2**	**1.1**	**1.0**	**1.0**	**0.9**
0.6		**1.3**	**1.3**	**1.2**	**1.2**	**1.2**	**1.1**	**1.0**	**1.0**
0.7		**1.4**	**1.3**	**1.3**	**1.3**	**1.3**	**1.2**	**1.1**	**1.1**
0.8		**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.2**	**1.2**	**1.2**
0.9		1.5	**1.5**	**1.4**	**1.4**	**1.4**	**1.3**	**1.3**	**1.3**
1.0		1.6	1.5	1.5	1.5	1.5	**1.4**	**1.4**	**1.3**
1.1		1.6	1.6	1.6	1.6	1.6	**1.5**	**1.4**	**1.4**
1.2		1.7	1.7	1.6	1.6	1.6	1.5	1.5	1.5
1.3		1.8	1.7	1.7	1.7	1.7	1.6	1.6	1.6
1.4		1.8	1.8	1.8	1.8	1.8	1.7	1.7	1.7
1.5		1.9	1.9	1.9	1.8	1.8	1.8	1.7	1.7
1.6		1.9	1.9	1.9	1.9	1.9	1.8	1.8	1.8
1.7		2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9
1.8		2.1	2.1	2.1	2.0	2.0	2.0	2.0	2.0
1.9		2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.0
2.0		2.2	2.2	2.2	2.2	2.2	2.1	2.1	2.1

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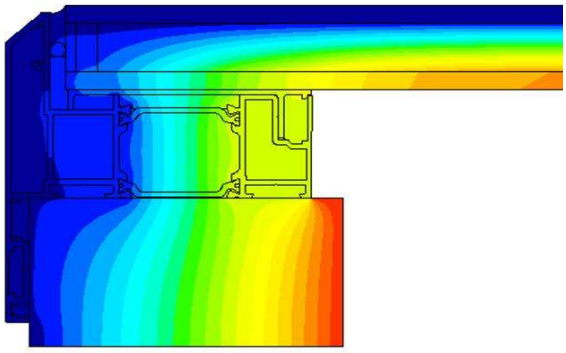
•①L1B dependent on g value of glazing windows may also be compliant with energy rating calculation

Thermal Performance

Rooflight

Thermal Simulation BS EN IS0 10077-2
BS EN 14351-1

		U Value			
Centre Pane	W	1000	1000	1000	1500
	L	1000	1500	2000	1500
0.5		1.0	0.8	0.9	0.8
0.6		1.1	0.9	0.9	0.9
0.7		1.2	1.0	1.0	0.9
0.8		1.2	1.1	1.1	1.0
0.9		1.3	1.2	1.2	1.1
1.0		1.4	1.2	1.3	1.2
1.1		1.4	1.3	1.3	1.3
1.2		1.5	1.4	1.4	1.4
1.3		1.6	1.5	1.5	1.5
1.4		1.6	1.6	1.6	1.6
1.5		1.7	1.7	1.7	1.6
1.6		1.8	1.7	1.8	1.7
1.7		1.8	1.8	1.8	1.8
1.8		1.9	1.9	1.9	1.9
1.9		2.0	2.0	2.0	2.0
2.0		2.0	2.1	2.1	2.1



System Thermal Performance.
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[1] Thermal Transmittance of glazing (Centre Pane) to be determined in accordance with EN 673, EN 674 or EN675.
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[3] Calculated overall thermal performance to BS EN ISO 1007-1 configuration to EN 14351-1 Annex E as per UK 2010 Building Regulations.
•①L1B dependent on g value of glazing windows may also be compliant with energy rating calculation

References

[1] The Building Regulations: Approved Documents
[2] *SAP: The BRE's Standard Assessment Procedure for Energy Rating of Dwellings*,
[3] Conventions for U Value Calculations, BRE443

Calculation Methods

BS EN ISO 6946* Thermal performance of buildings and building components – Thermal resistance and thermal transmittance – Calculation method
BS EN ISO 10077-1* Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 1: Simplified methods
BS EN ISO 10077-2 Thermal performance of windows, doors and shutters – Calculation of thermal transmittance – Part 2: Numerical methods for frames
EN 13947 Thermal performance of curtain walling – Calculation of thermal transmittance

Measurement methods

BS EN ISO 12567-1 Thermal performance of windows and doors – Determination of thermal transmittance by hot box method – Part 1: Complete windows and doors
BS EN ISO 12567-2 Thermal performance of windows and doors – Determination of thermal transmittance by hot box method – Part 2: Roof windows and other projecting Windows

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White Paper
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