



CERTIFIED SIMULATOR
No. 039



Calculation for Thermal Transmittance of PVCU Windows

In Accordance with
BS EN ISO 10077-2:2012

U Value Simulation by Physibel Bisco 10.0w

Client

The Residence Collection
Window Widgets (2006) Limited
Unit C
Quedgeley West Business Park
Bristol Road
Gloucester
GL2 4PA

Date

17th July 2016

Report

R9_027

Window Profile

R7 frame, flush casement sash
Reinforced Frame

Insulated Glazing Unit

44mm unit size

4·16·4·16·4 configuration

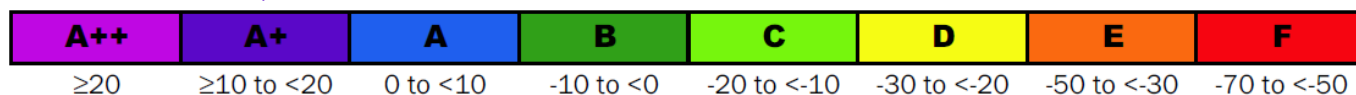
4mm Planiclear · 16mm Argon (90%) · 4mm Planitherm Total+ · 16mm Argon (90%) ·
4mm Planitherm Total+

Spacer Bar

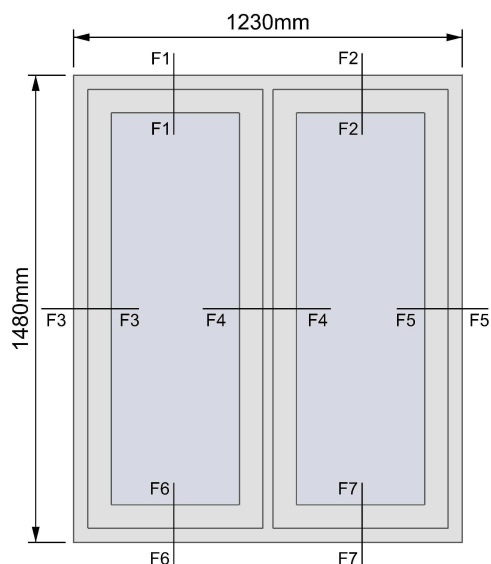
Swisspacer Ultimate

Simulation Result Summary

Window U Value	Window g Value	L Factor	Energy Rating	Label Index
0.84	0.33	0.01	13.91	14

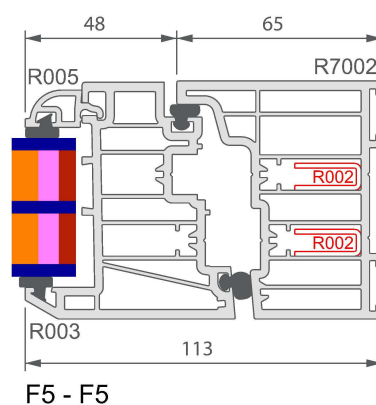
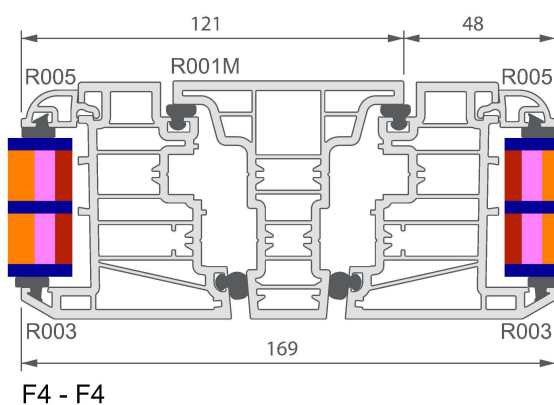
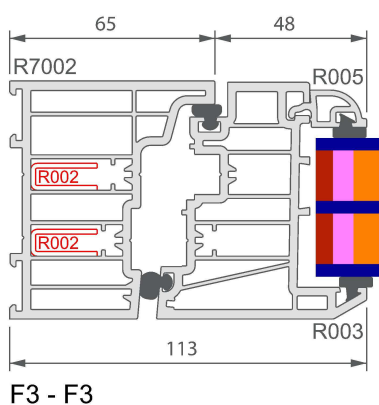
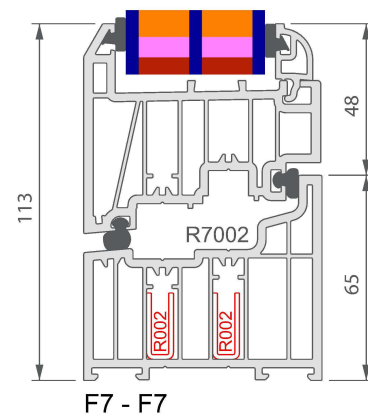
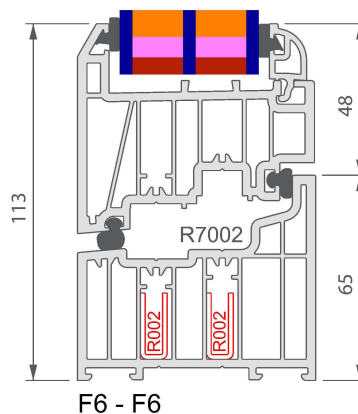
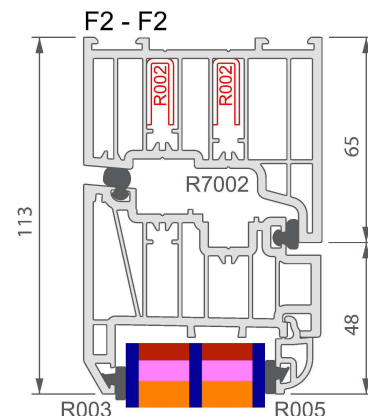
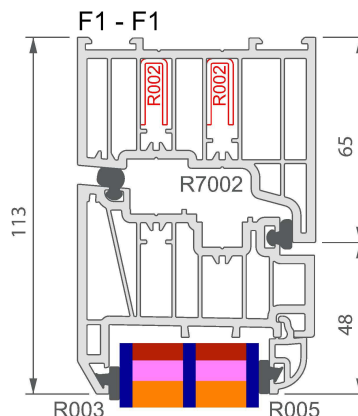


Window Profile



R7

Standard Frame
Flush Casement Sash
Triple Glazed





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No. 039

R9_027



Glass Unit Specification

Calumen® II 1.3.1
30 January 2015
Data base : SGG UK

Glazing design



	First glazing	Second glazing	Third glazing
Gas		Argon 90% 16.00mm	Argon 90% 16.00mm
Coating		PLANITHERM TOTAL+	PLANITHERM TOTAL+
First glass	PLANICLEAR 4.00mm	PLANICLEAR 4.00mm	PLANICLEAR 4.00mm
Coating			
Layer			
Coating			
Second glass			
Coating			

Manufacturing sizes

Nominal thickness : **44.0 mm**
Weight : **30.0 kg/m²**

Luminous factors (EN410-2011) : (D65 2°)

Transmittance : **72 %**
Outdoor reflectance : **16 %**
Indoor reflectance : **16 %**

Energy factors (EN410-2011) :

Transmittance : **52 %**
Outdoor reflectance : **25 %**
Indoor reflectance : **25 %**
Absorptance A1 : **6 %**
Absorptance A2 : **11 %**
Absorptance A3 : **6 %**

Solar factors (EN410-2011) :

g : **0.63**
Shading coefficient : **0.72**

Thermal transmission (EN673-2011) : - 0° related to vertical position

Ug : **0.6 W/(m².K)**



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CALUMEN® II is a simulation software to calculate key performance of glass such as light transmission, solar factor or thermal insulation coefficient. Computed values are indicative and subject to change. They can not be used to guarantee performance of the products.

These values are calculated according to EN410-2011 and EN673-2011 standards. Tolerances are defined according to EN 1096-4 or ISO9050-2003 standards. Nevertheless, user must check the feasibility of the associated products, in particular in terms of thickness and colour.

Furthermore, it is his responsibility to check that the resulting combination of glazing meets regulatory requirements at national, local or regional level.

Calculation rules and functional extent of Calumen II have been validated by TÜV Rheinland Quality Standard 440000-11-000000



• Calculation software
verified
• EN 410 and EN 673

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Glass Unit Specification (cont...)

Version 12 18/06/2015. Calculations according to BS EN 673:2011

Number of spaces		2	
Glazing orientation		Vertical	
Resistivity panes	1	m·K/W	
Outside		Spaces	
		1	2
		P a n e 1	P a n e 2
		90%	90%
		P a n e 3	
		Gas	Gas
		Argon	Argon
Thickness (mm)	4.0	16	4.0
Normal emissivity		0.89	0.05
$\sum d_j \cdot r_j =$	0.012	Uncoated	Uncoated

For uncoated surfaces input 0.89 for normal emissivity, which corresponds to a corrected emissivity of 0.837

External, R_{se}	0.04	$(m^2 \cdot K)/W$
Internal, R_{si}	0.13	$(m^2 \cdot K)/W$
Iteration number	U value	$\sum 1/h_s$
	$W/(m^2 \cdot K)$	$(m^2 \cdot K)/W$
1	0.622	1.42542
2	0.622	1.42542

λ_{eff}	ΔT
$W/(mK)$	
0.0224	7.5
0.0224	7.5

λ_{eff}	ΔT
$W/(mK)$	
0.0224	7.5
0.0224	7.5

Spacer Bar Datasheet

April 2013 – No.19 – Revision index 0

'WARM EDGE' WORKING PARTY



Data sheet Psi values for windows

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

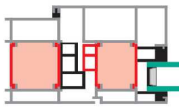
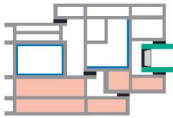
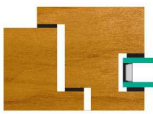
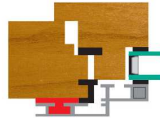
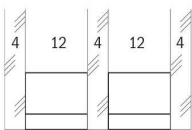
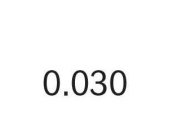
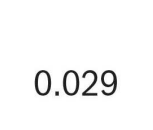
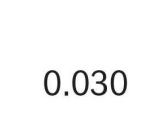
SWISSPACER®

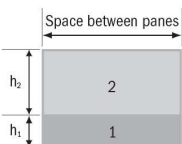
Vetrotech Saint-Gobain (International) AG
Zweigniederlassung Kreuzlingen
Sonnenwiesenstrasse 15
CH-8280 Kreuzlingen

SWISSPACER®



	Product name	Spacer height in mm	Material	Thickness d in mm
Cross-section	 Ultimate SWISSPACER	6.5	Plastic / Multilayer – polyester coated film “High Tech Gas Barrier Foil”	1.0 0.097

Representative frame profile	Metal with thermal break	Plastic	Wood	Wood / Metal
Representative psi value double-sheet thermally insulating glass W/mK	 0.036	 0.032	 0.031	 0.032
Representative psi value triple-sheet thermally insulating glass W/mK	 0.031	 0.030	 0.029	 0.030

Two Box model Characteristic values	Space between panes in mm	$\lambda_{eq,2B}$ 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

Explanations

The equivalent thermal conductivity has been determined in accordance with the ift guideline WA-17/1 “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 UW 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-08/2 “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 “Compass ‘Warm Edge’ for Windows” of Bundesverband Flachglas.

Ermittlung der Kennwerte durch:

Hochschule **Rosenheim**
University of Applied Sciences





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Air Permeability Test Results
BS 6375-1:2009 / BS EN 1026:2000
Exova Warringtonfire Test Report No. WIL335987
Report Date 19th May 2014

Test Pressure (Pa)	Air permeability per unit length			
	Positive (m ³ /h.m)	Negative (m ³ /h.m)	Average (m ³ /h.m)	Simulation it relates to
50	0.33	0.31	0.32	R9_027
100	0.52	0.51	0.52	
150	0.68	0.68	0.68	
200	0.82	0.81	0.82	
250	0.96	0.94	0.95	
300	1.08	1.07	1.07	
450	1.42	2.03	1.72	
600	1.74	5.35	3.55	



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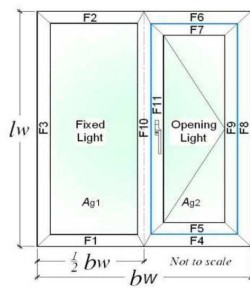
Component Material Specifications

Component	Material	Thermal Conductivity (W/mK)	Authority	Simulation it relates to
Framing	PVCU	0.17	EN 12524	R9_027
Glazing bead	PVCU	0.17	EN 12524	
Reinforcement	Steel	0.50	EN 12524	
Gasket/weatherseal	Q-Ion	0.06	Manufacturers stated value	
Glass	Saint Gobain	1.00	EN 12524	

Spacer bar

Swisspacer Ultimate	Plastic/multi-layer polyester coated film	0.14	WA-17/1 BF datasheet 19	R9_027
Secondary seal Depth 3.0mm	Butyl	0.24	EN 12524	

Calculation Spreadsheet



Sample Style:
Casement

Fixed Light / Side Hung

Blue line illustrates opening light length (air leakage)

Frame offset: **No**

Nominal 4mm etc to 0DP , others 1DP			
Glazing dimensions and properties:			
Thickness of pane 1	4	mm	
Pane 1/2 distance	16	mm	
Gas fill (1/2)	Argon 90%		
Thickness of pane 2	4	mm	
Complete next 3 cells for TG IGU			
Pane 2/3 distance	4	mm	
Gas fill (2/3)	Argon 90%		
Thickness of pane 3	4.0	mm	
Glazing Trans. - 3DP	U_g	0.622	W/(m ² ·K)
g-value - 2DP	$g_{\perp}$	0.63	

Thermal transmittance of window from hot box test		
$U_w - 2DP$		W/(m ² ·K)

Window Dimensions:		Area	
Section	Length (m)	Width (m)	No gasket (m ²)
Fixed Light	1.2540	0.4415	0.5536
Opening light	1.2540	0.3935	0.4934
Total glazing, A_g			1.0471
Frame	(m)	(m)	(m ²)
F1	0.6150	0.1130	0.0597
F2	0.6150	0.1130	0.0597
F3	1.4800	0.1130	0.1645
F4	0.6150	0.0650	0.0359
F5	0.4895	0.0480	0.0212
F6	0.6150	0.0650	0.0359
F7	0.4895	0.0480	0.0212
F8	1.4800	0.0650	0.0920
F9	1.3500	0.0480	0.0625
F10	1.4800	0.1210	0.1683
F11	1.3500	0.0480	0.0625
Total Frame			0.7733
Total Window, A_w			1.8204
Percentage fixed light glass area			30.41%
Percentage opening light glass area			27.11%
Percentage glass area (total)			57.52%

Solar Factor, g-value:		F_w	0.9
		g_w	0.33

U_{window}	No bars; or attached bars	0.84	W/(m ² ·K)
	Single cross bar in IGU	0.9	
	Multiple cross bar in IGU	1.0	
	Glazing bar (Georgian bar)	1.2	

BFRC Rating kWh/(m ² ·yr)	Label index	EWER Rating Scale	Window Rating
≥10		A+	A+
0 to <10		A	
-10 to <0		B	
-20 to <-10		C	
-30 to <-20		D	
-50 to <-30		E	
-70 to <-50		F	

Report Number: **R9_027** Issue No 22.1: 11/03/2013
Report Date: **13th Feb 2016**
Project Details: **R7/R3/R1M/R4_4mmPlaniclear_16mmArgon_4mmTotal+_16mmArgon_4mmTotal+ Swiss Ultimate (3mm Butyl)**

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Input Values:

Yellow input, green intermediary, blue finals X' DP is no. of decimal places to enter

Parameter	Symbol	Units
Total window height 0DP	I_w	1480 mm
Total window width 0DP	b_w	1230 mm

Frame dimensions:		Frame width, b_f (mm)	Gasket protrusion, b_{gf} (mm)	Frame & gasket widths (mm)	
All frame values round to nearest 1mm, gaskets to 1DP	F1 fixed sill	113		113.0	Total
	F2 fixed head	113		113.0	
	F3 fixed jamb	113		113.0	
F4 + F5 sash sill	F4 fixed sash sill	65	n/a	65.0	113.0
	F5 moving sash sill	48		48.0	
F6 + F7 sash head	F6 fixed sash head	65	n/a	65.0	113.0
	F7 moving sash head	48		48.0	
F8 + F9 sash jamb	F8 Fixed sash jamb	65	n/a	65.0	113.0
	F9 moving sash jamb	48		48.0	
F10 + F11 mullion	F10 fixed mullion	121		121.0	169.0
	F11 moving mullion	48		48.0	
Total gasket area			0	m ²	

Where a U_w value from hot box testing is available, no $L_{f,2D}$ or $L_{\psi,2D}$ values need to be entered					
Frame conductance:		All L values to 4DP . All b values to 0DP			
		$W/(m^2 \cdot K)$	b_p (mm)	$W/(m^2 \cdot K)$	b_g (mm)
F1 fixed sill	$L_{f,2D}$	0.2520	200	0.2577	200
F2 fixed head		0.2520	200	0.2577	200
F3 fixed jamb		0.2520	200	0.2577	200
F4 + F5 sash sill		0.2520	200	0.2577	200
F6 + F7 sash head		0.2520	200	0.2577	200
F8 + F9 sash jamb		0.2520	200	0.2577	200
F10 + F11 mullion		0.4528	400	0.4641	400

Frame:	Frame width, b_f (m)	Frame U-value, U_f (W/(m ² ·K))	Frame areas, A_f (m ²)	Frame heat flow, H_U (W/K)	near trans, (W/(m·K))	Linear length, l_g (m)	Junction heat flow, H_{ψ} (W/K)
F1 fixed sill	0.1130	0.5978	0.0597	0.0357	0.0658	0.4415	0.0290
F2 fixed head	0.1130	0.5978	0.0597	0.0357	0.0658	0.4415	0.0290
F3 fixed jamb	0.1130	0.5978	0.1545	0.0923	0.0658	1.2540	0.0825
F4 + F5 sash sill	0.1130	0.5978	0.0571	0.0341	0.0658	0.3935	0.0259
F6 + F7 sash head	0.1130	0.5978	0.0571	0.0341	0.0658	0.3935	0.0259
F8 + F9 sash jamb	0.1130	0.5978	0.1545	0.0923	0.0658	1.2540	0.0825
F10 + F11 mullion	0.1690	0.4964	0.2308	0.1146	0.1314	1.2540	0.1648
Totals		0.7733	0.4389			Total	0.4395

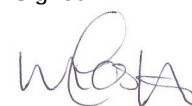
Air Leakage loss:			
Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - 2DP		0.32	m ³ /(m·h)
Opening light length	3.6790 m	Total air leakage	1.177 m ³ /h
L_{50}	0.65 m ³ /(m ² ·h)	Heat loss = 0.0165 L_{50}	0.01 W/(m ² ·K)

Other parameters needed for calculation, taken from simulations:			
$\lambda_p =$	0.035 W/(m·K)	$R_{se} =$	0.04 m ² ·K/W
$R_p =$	0.9143 m ² ·K/W	$R_{tot} =$	1.0843 m ² ·K/W
$d_p = d_g =$	0.032 m	$R_{se} =$	0.13 m ² ·K/W
		$U_p =$	0.9223 W/(m ² ·K)

BFRC Rating =		
218.6g _{window} - 68.5 x (U_{window} + Effective L_{50}) =		13.91
Climate zone is:		UK
Thermal transmittance, W/(m ² ·K)	U_{window}	0.8
Solar factor	g_{window}	0.33
Window air leakage heat loss, W/(m ² ·K)	L_{factor}	0.01



Signed...



BFRC Certified
Simulator **039**

M. Castle