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
24th September 2016

Report
R9_024

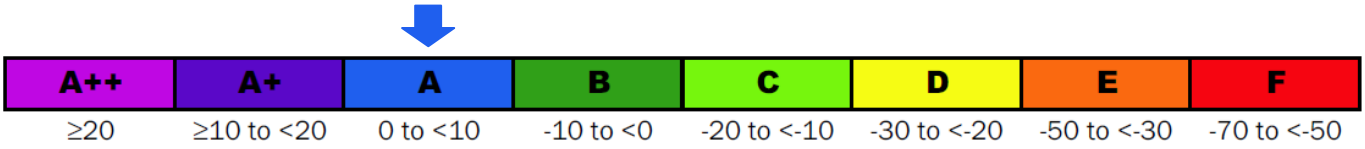
Window Profile
R7 frame, flush casement sash
Reinforced Frame

Insulated Glazing Unit
28mm unit size
4·20·4 configuration
4mm Diamant · 20mm Argon (90%) · 4mm Planitherm Total+

Spacer Bar
Swisspacer Ultimate

Simulation Result Summary

Window U Value	Window g Value	L Factor	Energy Rating	Label Index
1.23	0.39	0.01	0.31	0



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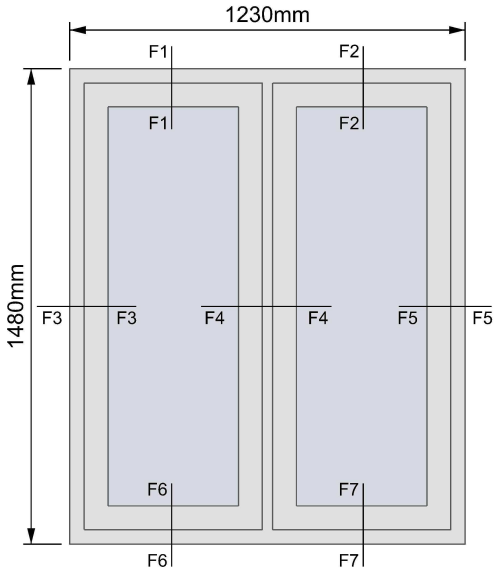
THE RESIDENCE COLLECTION

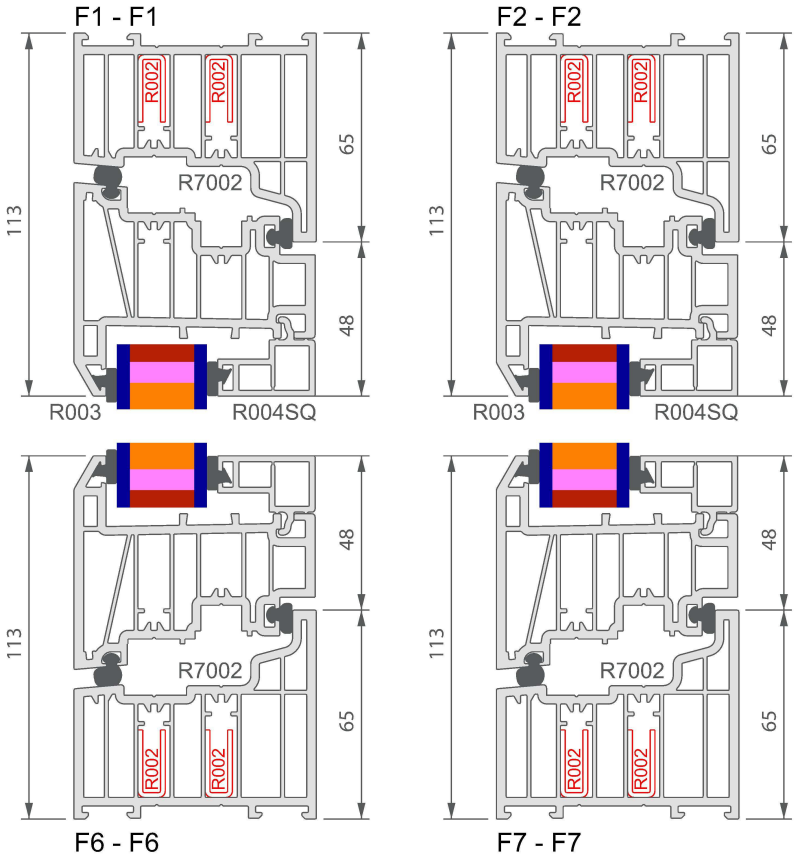
R9_024

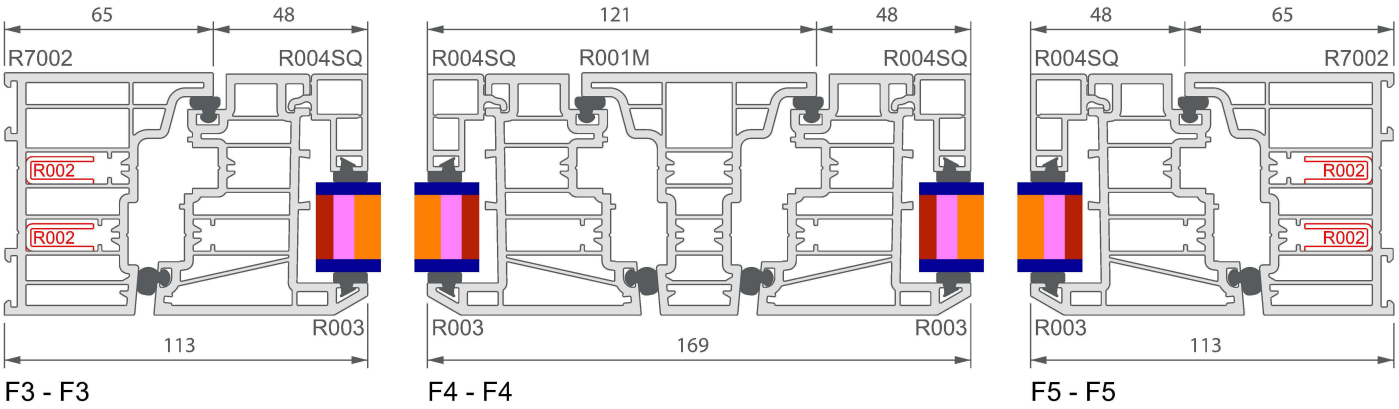


R7

Standard Frame
Flush Casement Sash
Double Glazed

Window Profile





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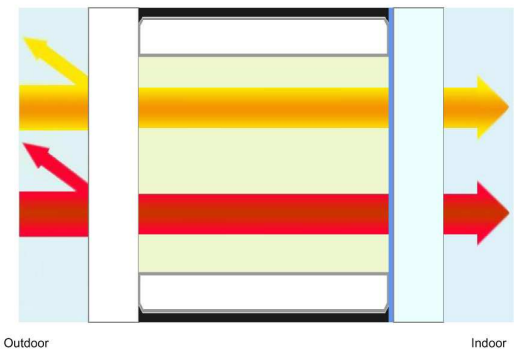
R9_024

Glass Unit Specification

Calumen® II 1.3.0
05 December 2014
Data base : SGG UK

SAINT-GOBAIN

Glazing design



	First glazing	Second glazing
Gas		Argon 90% 20.00mm
Coating		PLANITHERM TOTAL+
First glass	DIAMANT 4.00mm	PLANICLEAR 4.00mm
Coating		
Layer		
Coating		
Second glass		
Coating		

Manufacturing sizes

Nominal thickness :	**28.0**	**mm**
Weight :	**20.0**	**kg/m²**

Luminous factors (EN410-2011)

Transmittance :	**81**	**%**
Outdoor reflectance :	**12**	**%**
Indoor reflectance :	**13**	**%**

Energy factors (EN410-2011)

Transmittance :	**66**	**%**
Outdoor reflectance :	**21**	**%**
Indoor reflectance :	**20**	**%**
Absorptance A1 :	**3**	**%**
Absorptance A2 :	**10**	**%**

Solar factors (EN410-2011)

g :	**0.75**
Shading coefficient :	**0.86**

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

Ug :	**1.2**	**W/(m².K)**

Calumen II

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R9_024

Glass Unit Specification (cont…)

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

Number of spaces
1

Spaces 1

Glazing orientation		
	Vertical	
Resistivity panes	1	m·K/W

Outside

	Pane 1		Pane 2
		Gas	
		Argon	
Thickness (mm)	4.0	20	4.0
Normal emissivity		0.89	0.05
$\sum d_j \cdot r_j$=	0.008		

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	$\sum 1/h_s$	λeff	ΔT
	W/(m²·K)	(m²·K)/W	W/(mK)	
1	1.219	0.64228	0.0311	15
2	1.219	0.64228	0.0311	15

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THE RESIDENCE COLLECTION

R9_024

Spacer Bar Datasheet

April 2013 – No.19 – Revision index 0

'WARM EDGE' WORKING PARTY

BF

RAL GÜTEZEICHEN MEHRSCHEIBEN ISOLIERGLAS

Data sheet Psi values for windows

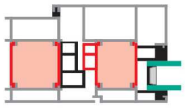
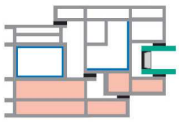
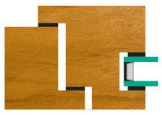
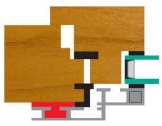
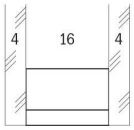
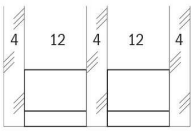
based on determination of the equivalent thermal conductivity of spacers by measurement

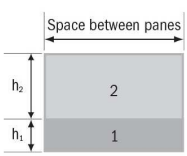
SWISSPACER®

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

		Metal with thermal break	Plastic	Wood	Wood / Metal
Representative frame profile					
Representative psi value double-sheet thermally insulating glass W/mK	 Double-sheet insulating glass U_g=1.1 W/m²K	0.036	0.032	0.031	0.032
Representative psi value triple-sheet thermally insulating glass W/mK	 Triple-sheet insulating glass U_g=0.7 W/m²K	0.031	0.030	0.029	0.030

		Space between panes in mm	$\lambda_{eq,2B}$ in W/mK	
			Box 1 · h_1 = 3 mm	Box 2 · h_2 = 6.5 mm
Two Box model Characteristic values		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
ift ROSENHEIM

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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_024
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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R9_024

Component Material Specifications

Component	Material	Thermal Conductivity (W/mK)	Authority	Simulation it relates to
Framing	PVCU	0.17	EN 12524	R9_024
Glazing bead	PVCU	0.17	EN 12524	
Reinforcement	Steel	0.50	EN 12524	
Gasket/weatherseal	Q-lon	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_024
Secondary seal Depth 3.0mm	Butyl	0.24	EN 12524	

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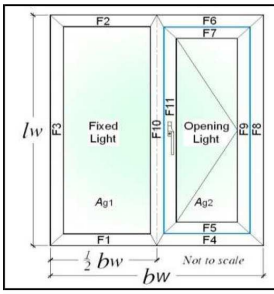
Calculation Spreadsheet



Sample Style:
Casement

Fixed Light / Side Hung

Blue line illustrates opening light length (air leakage)

Report Number: R9_024
Report Date: 23rd July 2016
Project Details: R7/R3/R1M/R4SQ_4mmDiamant_20mmArgon_4mmTotal+ with Swiss Ultimate (3.0mm Butyl)

Issue No 22.2: *22/10/2015*

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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***	l_w	1480	mm
Total window width ***0DP***	b_w	1230	mm

Frame offset:	No

Nominal 4mm etc to ***0DP***, others ***1DP***

Glazing dimensions and properties:			
Thickness of pane 1		4	mm
Pane 1/2 distance		20	mm
Gas fill (1/2)		Argon 90%	
Thickness of pane 2		4	mm
Complete next 3 cells for TG IGU			
Pane 2/3 distance			mm
Gas fill (2/3)			
Thickness of pane 3			mm
Glazing Trans. - ***3DP***	U_g	1.219	W/(m²·K)
g-value - ***2DP***	$g_\perp$	0.75	

Thermal transmittance of window from hot box test		
U_w - *2DP*		W/(m²·K)

Frame dimensions:	(b_f)	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	
	F2 fixed head	**113**		113.0	
	F3 fixed jamb	**113**		113.0	Total
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

Window Dimensions:			Area	
Section	Length (m)	Width (m)	No gasket (m^2)	With gasket (m^2)
Fixed Light	1.2540	0.4415	0.5536	0.5536
Opening light	1.2540	0.3935	0.4934	0.4934
Total glazing, A_g			1.0471	1.0471
Frame	(m)	(m)	(m^2)	(m^2)
F1	0.6150	0.1130	0.0597	0.0597
F2	0.6150	0.1130	0.0597	0.0597
F3	1.4800	0.1130	0.1545	0.1545
F4	0.6150	0.0650	0.0359	0.0359
F5	0.4895	0.0480	0.0212	0.0212
F6	0.6150	0.0650	0.0359	0.0359
F7	0.4895	0.0480	0.0212	0.0212
F8	1.4800	0.0650	0.0920	0.0920
F9	1.3500	0.0480	0.0625	0.0625
F10	1.4800	0.1210	0.1683	0.1683
F11	1.3500	0.0480	0.0625	0.0625
Total Frame			0.7733	0.7733
Total Window, A_w			1.8204	1.8204
Percentage fixed light glass area			30.41%	30.41%
Percentage opening light glass area			27.11%	27.11%
Percentage glass area (total)			57.52%	57.52%

Where a *Uw* 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***			
	$L_f{}^{2D}$ W/(m·K)	b_f (mm)	$L_\psi{}^{2D}$ W/(m·K)	b_g (mm)
F1 fixed sill	**0.3239**	**200**	**0.3830**	**200**
F2 fixed head	**0.3239**	200	**0.3830**	200
F3 fixed jamb	**0.3239**	200	**0.3830**	200
F4 + F5 sash sill	**0.3239**	200	**0.3830**	200
F6 + F7 sash head	**0.3239**	200	**0.3830**	200
F8 + F9 sash jamb	**0.3239**	200	**0.3830**	200
F10 + F11 mullion	**0.5962**	400	**0.7145**	400

Frame: Section	Frame width, b_f (m)	Frame U-value, U_f (W/(m²·K))	Frame areas, A_f (m^2)	Frame heat flow, HU (W/K)	Linear trans, Ψ (W/(m·K))	Linear length, l_g (m)	Junction heat flow, HΨ (W/K)
F1 fixed sill	0.1130	1.0417	0.0597	0.0622	0.0215	0.4415	0.0095
F2 fixed head	0.1130	1.0417	0.0597	0.0622	0.0215	0.4415	0.0095
F3 fixed jamb	0.1130	1.0417	0.1545	0.1609	0.0215	1.2540	0.0269
F4 + F5 sash sill	0.1130	1.0417	0.0571	0.0595	0.0215	0.3935	0.0085
F6 + F7 sash head	0.1130	1.0417	0.0571	0.0595	0.0215	0.3935	0.0085
F8 + F9 sash jamb	0.1130	1.0417	0.1545	0.1609	0.0215	1.2540	0.0269
F10 + F11 mullion	0.1690	1.0877	0.2308	0.2511	0.0431	1.2540	0.0540
		Totals	0.7733	0.8162		Total	0.1438

Other parameters needed for calculation, taken from simulations:						$d_p = d_g$ =	0.028	m
λ_p =	0.035	W/(m·K)	R_{se} =	0.04	m^2·K /W	R_{se} =	0.13	m^2·K /W
R_p =	0.8000	m^2·K /W	R_{tot} =	0.9700	m^2·K /W	U_p =	1.0309	W/(m²·K)

Solar Factor, *g*-value:	F_w	0.9
	g_w	0.39

U_{window}			
	No bars; or attached bars	1.23	W/(m²·K)
	Single cross bar in IGU	1.3	
	Multiple cross bar in IGU	1.4	
	Glazing bar (Georgian bar)	1.6	

Air Leakage loss:				
Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - ***2DP***				0.32 m³/(m·h)
Opening light length	3.6790	m	Total air leakage	1.177 m^3/h
L_{50}	0.65	$m^3/(m^2 \cdot h)$	Heat loss = 0.0165 L_{50}	0.01 W/(m²·K)

Energy Window
Energy Index
0
Window Rating
A

BFRC Rating
kWh/(m²·yr)

≥20	A	++
>10 to 20	A	+
0 to <10	A	✓
-10 to <0	B	
-20 to <-10	C	
-30 to <-20	D	
-50 to <-30	E	

BFRC Rating =	
218.6g_{window} - 68.5 x (U_{window} + Effective L_{50}) =	**0.31**
Climate zone is:	**UK**

Thermal transmittance, W/(m²·K)	U_{window}	**1.2**
Solar factor	g_{window}	**0.39**
Window air leakage heat loss, W/(m²·K)	L_{factor}	**0.01**

Simulator Name: M Castle

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BFRC Certified Simulator No 039

Signed…

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