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Calculation of Thermal Transmittance

Report in Accordance with BS EN ISO 10077-1:2017

Thermal Performance of Windows, Doors & Shutters

CONFIDENTIAL

Report reference:	U25-008-8A
Prepared for:	Bereco Ltd Unit 5 Aspen Court Centurion Business Park Rotherham, S60 1FB
Project:	Flush French Door – Opening Out
Issued by:	Sue Peatey
Issue date:	9 April 2025

20057

Any opinions and interpretations expressed in this report are outside the scope of UKAS accreditation.

The results in this report relate only to the products calculated and technical drawings received and do not necessarily relate to samples from the production line of the above named company. This report does not constitute in any way a warranty or representation to the performance or quality of the said product. The above named company has supplied all technical specifications. BFRC and its representatives accept no liability for misuse of this report.

1 Introduction

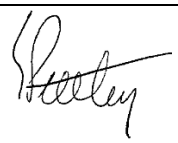
This document details the thermal performance calculation of the door configuration as detailed below.

The results in this report relate only to the simulated specimen using the drawings and specification received.

The frame profile results detailed below are provided by computer simulation using LBL software program THERM 5.2 and validated against proofs in Annex I (I1 to I10) of BS EN ISO 10077-2:2017.

The frame profile results detailed below are provided from methods contained in BS EN ISO 10077-1:2017 and in accordance with thermal transmittance requirements detailed in BS EN 14351-1:2006 +A1:2010. Cavities are calculated in accordance with BS EN ISO 10077-2 section 6.4.3 Treatment of cavities using the single equivalent thermal conductivity method.

2.0 Authorisation

Report Issued By:	Sue Peatey Technical Officer	
Report Checked By:	Richard Bate Technical Director	

3 Results

3.1 U-Value

The thermal performance of the door (U_W) in accordance with EN ISO 10077-1:2017 is:

1.3 W/m²K

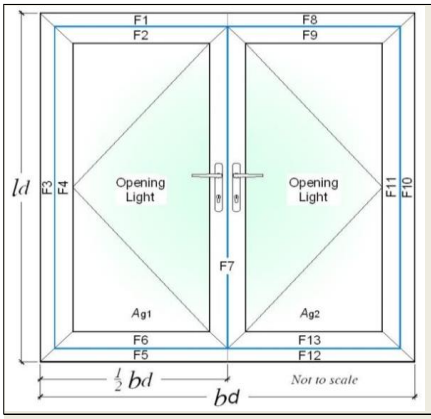
3.2 Frame thermal transmittance and linear thermal transmittance (in accordance with BS EN ISO 10077-1: 2017)

Frame Profile	Frame Thermal Transmittance (U_f)	Linear Thermal Transmittance (ψ)
Head	1.3 W/m²K	0.046 W/m.K
Threshold	1.7 W/m²K	0.046 W/m.K
Jamb	1.3 W/m²K	0.046 W/m.K
Meeting Stile	1.3 W/m²K	0.092 W/m.K

3.3 Centre pane U-Value of glazing calculated in accordance with BS EN 673: 2011

Glazing unit	Centre pane U-value (U_g)
Unit thickness = 32.8mm Outer pane = 6.4mm St Gobain Planiclear Cavity = 20mm 90% Argon Inner pane = 6.4mm St Gobain Planitherm One Spacer bar = St Gobain Swisspacer Advance	1.1 W/m^2K

4. U-value calculations



Sample Style: **French Door**

Report Number:	U25-008-8
Report Date:	11 March 2025
Project Details:	Flush French Door

Issue 1.0: *15/01/2025*

This spreadsheet is the property of BFRC and is not valid unless approved by BFRC testing

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

Parameter	*Symbol*		*Units*
Total door height ***0DP***	l_d	2725	mm
Total door width ***0DP***	b_d	2500	mm

Frame offset: **No**

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

Glazing dimensions and properties:		
Thickness of pane 1	**6.4**	mm
Pane 1/2 distance	**20**	mm
Gas fill (1/2)	**Argon 90%**	
Thickness of pane 2	**6.4**	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	**1.065**	W/(m²·K)
g -value - ***2DP*** $g_\perp$	**0.46**	

Thermal transmittance of door from hot box test

$U_{d\text{ - }2dp}$ = W/(m²·K)

Frame dimensions: All frame values to nearest 1mm, gaskets to 1DP	Frame heights, (b_f)	Without gasket (mm)	Gasket protrusion (mm)	With gasket (mm)	Total (mm)
F1 + F2 left head rail	F1 left fixed head	**66**	n/a	66.0	148.4
	F2 left opening head	**82**	**0.4**	82.4	
F3 + F4 left jamb	F3 left fixed jamb	**66**	n/a	66.0	148.4
	F4 left opening jamb	**82**	**0.4**	82.4	
F5 +F6 left threshold	F5 left fixed threshold	**63**	n/a	63.0	231.4
	F6 left opening threshold	**168**	**0.4**	168.4	
F7 Meeting Stile	F7 Meeting Stile	**190**	**0.4**	190.8	
			0.4		
F8 + F9 right head rail	F8 right fixed head	**66**	n/a	66.0	148.4
	F9 right opening head	**82**	**0.4**	82.4	
F10 + F11 right jamb	F10 right fixed jamb	**66**	n/a	66.0	148.4
	F11 right opening jamb	**82**	**0.4**	82.4	
F12 + F13 right threshold	F12 right fixed threshold	**63**	n/a	63.0	231.4
	F13 right opening threshold	**168**	**0.4**	168.4	
			Total gasket area	0.0053635	m²

Door Dimensions:			Area	
Section	Length (m)	Width (m)	No gasket (m^2)	With gasket (m^2)
Left Opening light	2.3460	1.0070	2.3624	2.3597
Right Opening light	2.3460	1.0070	2.3624	2.3597
		Total glazing, A_g	4.7248	4.7195
Frame	(m)	(m)	(m^2)	(m^2)
F1	1.2500	0.0660	0.0803	0.0803
F2	1.1840	0.0820	0.0898	0.0902
F3	2.7250	0.0660	0.1756	0.1756
F4	2.5960	0.0820	0.2026	0.2036
F5	1.2500	0.0630	0.0767	0.0767
F6	1.1840	0.1680	0.1840	0.1844
F7	2.5960	0.1900	0.4695	0.4714
F8	1.2500	0.0660	0.0803	0.0803
F9	1.1840	0.0820	0.0898	0.0902
F10	2.7250	0.0660	0.1756	0.1756
F11	2.5960	0.0820	0.2026	0.2036
F12	1.2500	0.0630	0.0767	0.0767
F13	1.1840	0.1680	0.1840	0.1844
		Total Frame	2.0877	2.0930
		Total door, A_d	6.8125	6.8125
		Percentage left light glass area	34.68%	34.64%
		Percentage right light glass area	34.68%	34.64%
		Percentage glass area (total)	69.36%	69.28%
Solar Factor, *g* -value:			F_d	0.9
			g_d	0.29

Where a U_d value from hot box testing is available, no L_f^{2D} or L_ψ^{2D} values need to be entered

Frame conductance:	All *L* values to ***4DP***. All b values to ***0DP***				
	W/(m·K)	b_p (mm)		W/(m·K)	b_ψ (mm)
F1 + F2 left head rail	**0.3636**	**190**		**0.4400**	**190**
F3 + F4 left jamb	**0.3633**	190		**0.4397**	190
F5 +F6 left threshold	**0.5705**	190		**0.6471**	190
F7 Meeting Stile	**0.5916**	380		**0.7448**	380
F8 + F9 right head rail	**0.3636**	190		**0.4400**	190
F10 + F11 right jamb	**0.3633**	190		**0.4397**	190
F12 + F13 right threshold	**0.5705**	190		**0.6471**	190

L_f^{2D} L_ψ^{2D}

Frame: Section	Frame width, b_f (m)	Frame U-value, U_f (W/(m²·K))	Frame ares (no gaskets), A_f (m^2)	Frame heat flow, HU (W/K)	Linear trans, Ψ (W/(m·K))	Linear length, l_g (m)	Junction heat flow, $H\psi$ (W/K)
F1 + F2 left head rail	0.1480	1.2972	0.1702	0.2207	0.0457	1.0070	0.0460
F3 + F4 left jamb	0.1480	1.2952	0.3782	0.4899	0.0457	2.3460	0.1071
F5 +F6 left threshold	0.2310	1.7268	0.2607	0.4502	0.0459	1.0070	0.0462
F7 Meeting Stile	0.1900	1.3072	0.4695	0.6137	0.0917	2.3460	0.2152
F8 + F9 right head rail	0.1480	1.2972	0.1702	0.2207	0.0457	1.0070	0.0460
F10 + F11 right jamb	0.1480	1.2952	0.3782	0.4899	0.0457	2.3460	0.1071
F12 + F13 right threshold	0.2310	1.7268	0.2607	0.4502	0.0459	1.0070	0.0462
		Totals	2.0877	2.9353		Total	0.6138

Other parameters needed for calculation, taken from simulations:

$d_p = d_g$ = 0.0328 m

λ_p = 0.035 W/(m·K) R_{se} = 0.04 m²·K /W R_{se} = 0.13 m²·K /W

R_p = 0.9371 m²·K /W R_{tot} = 1.1071 m²·K /W U_p = 0.9032 W/(m²·K)

U_{door}		
	No bars; or attached bars	**1.26**
	Single cross bar in IGU	**1.4**
	Multiple cross bar in IGU	**1.5**
	Glazing bar (Georgian bar)	**1.7**

W/(m²·K)

Thermal transmittance, W/(m²·K)	U_{door}	**1.3**
Solar factor	g_{door}	**0.29**

Simulator Name: **Sue Peatey**

BFRC Certified Simulator No **S166**

Figure 1. Cross section drawing, including dimensions, of door.

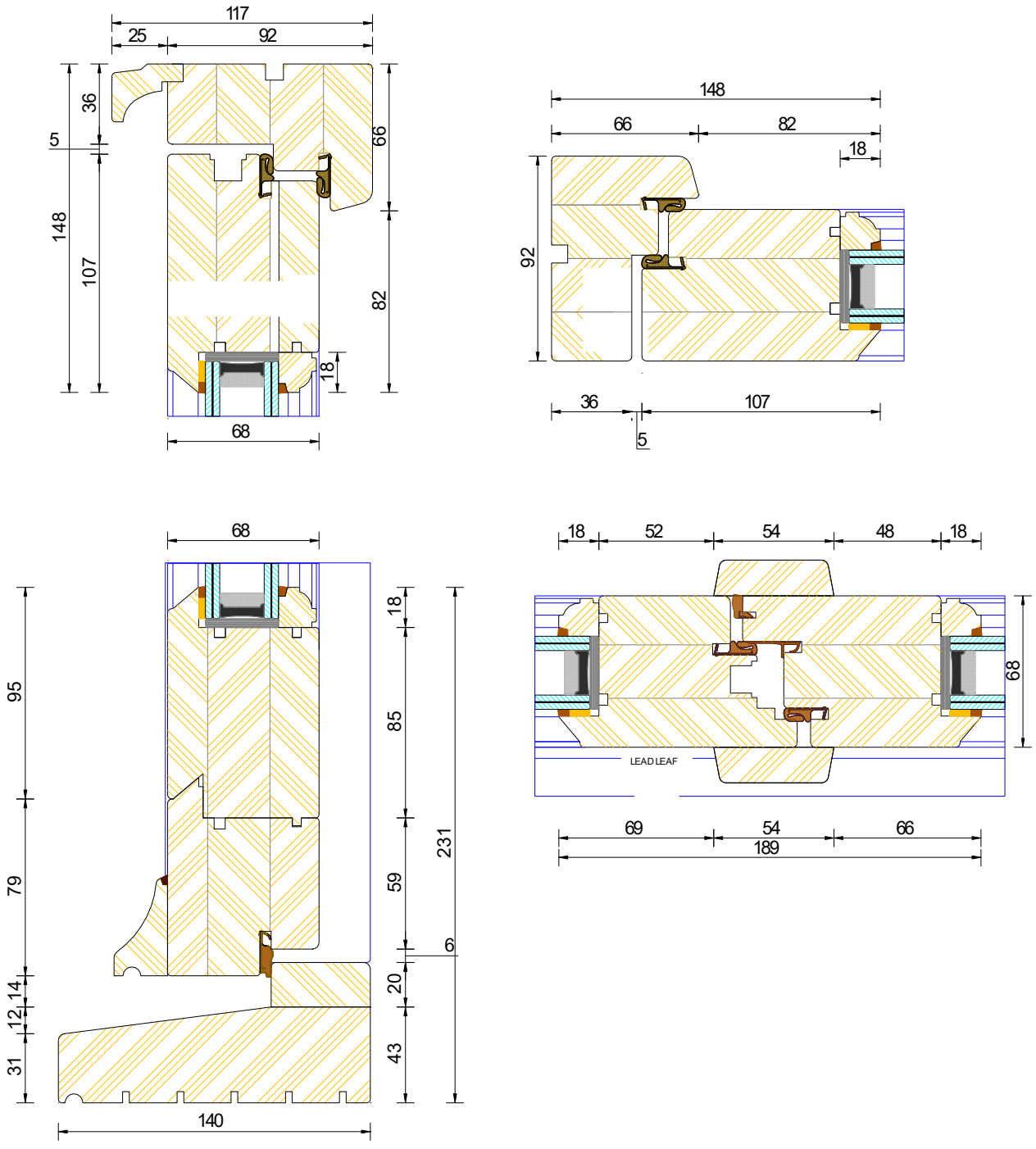
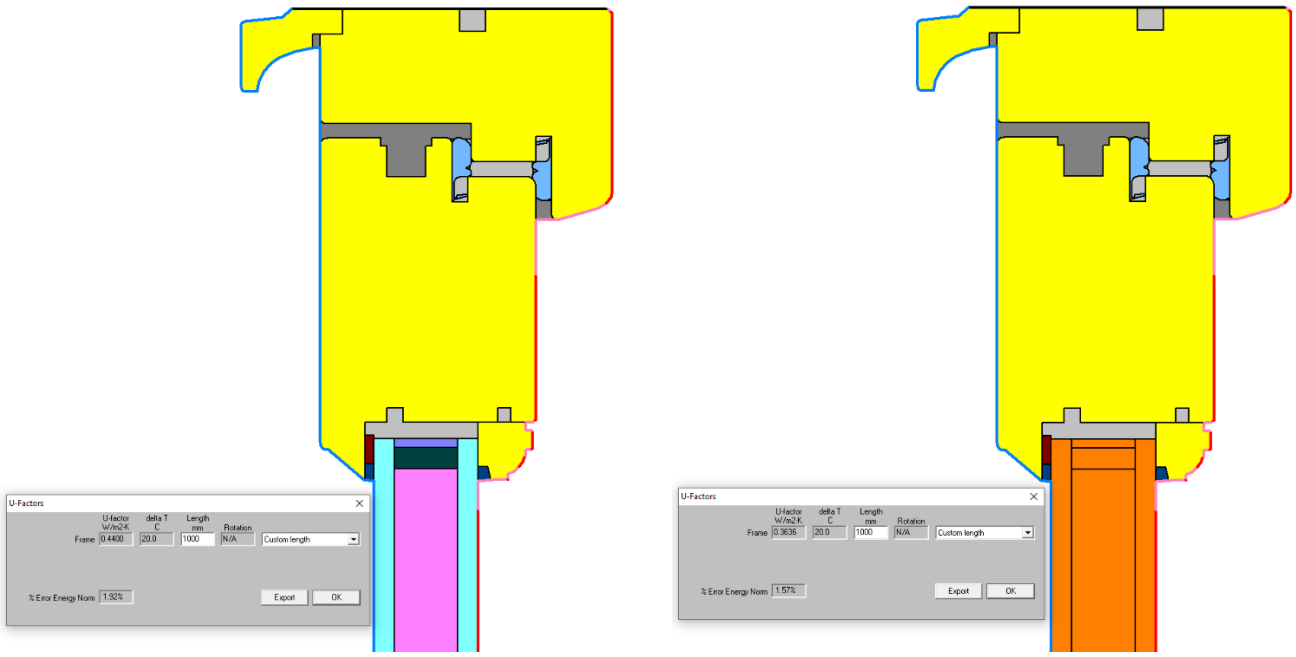


Figure 2. Simulation of head profile

External Environment
R_{si} Normal = 0.04 m^2K/W
R_{si} Reduced = 0.04 m^2K/W
Temperature = 0 ^0C

Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C

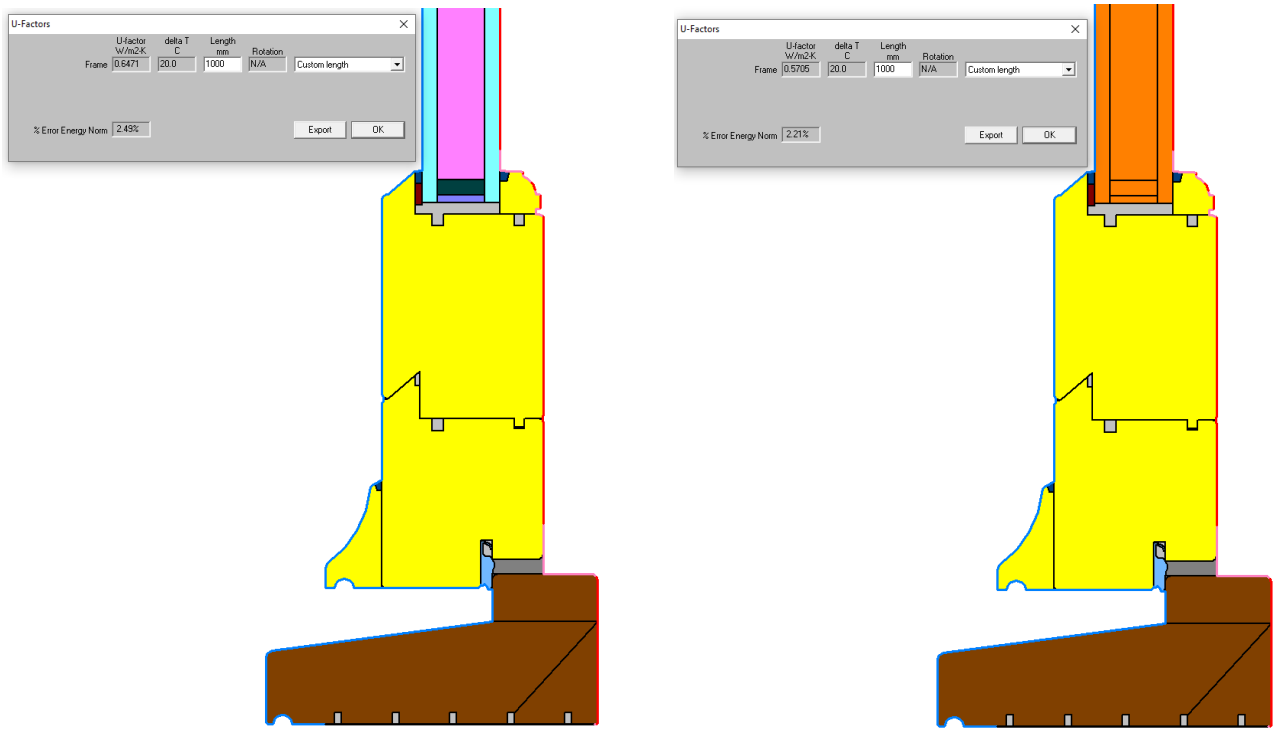


Quad Tree Mesh Parameter 9

Figure 3. Simulation of threshold profile.

External Environment
R_{si} Normal = 0.04 m^2K/W
R_{si} Reduced = 0.04 m^2K/W
Temperature = 0 ^0C

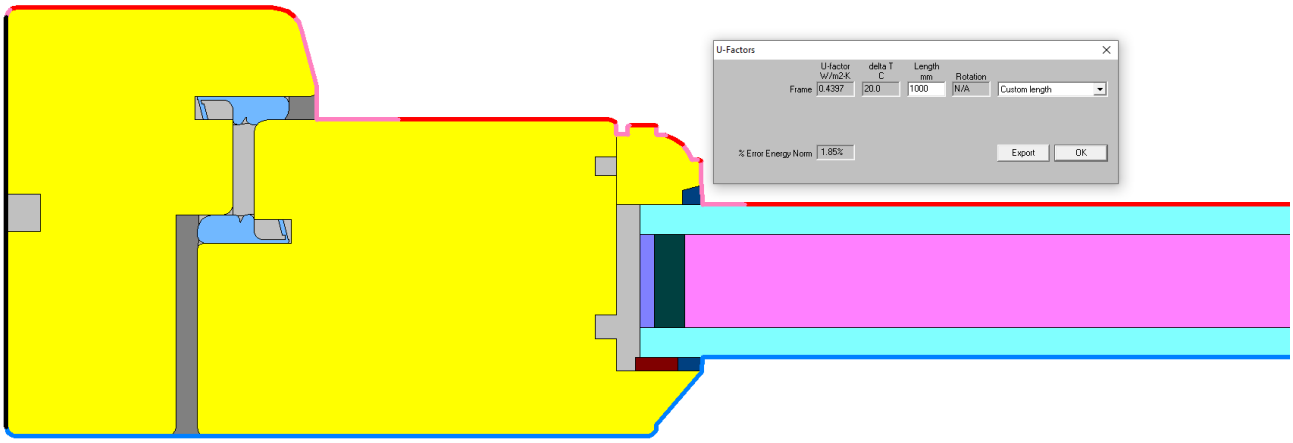
Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C

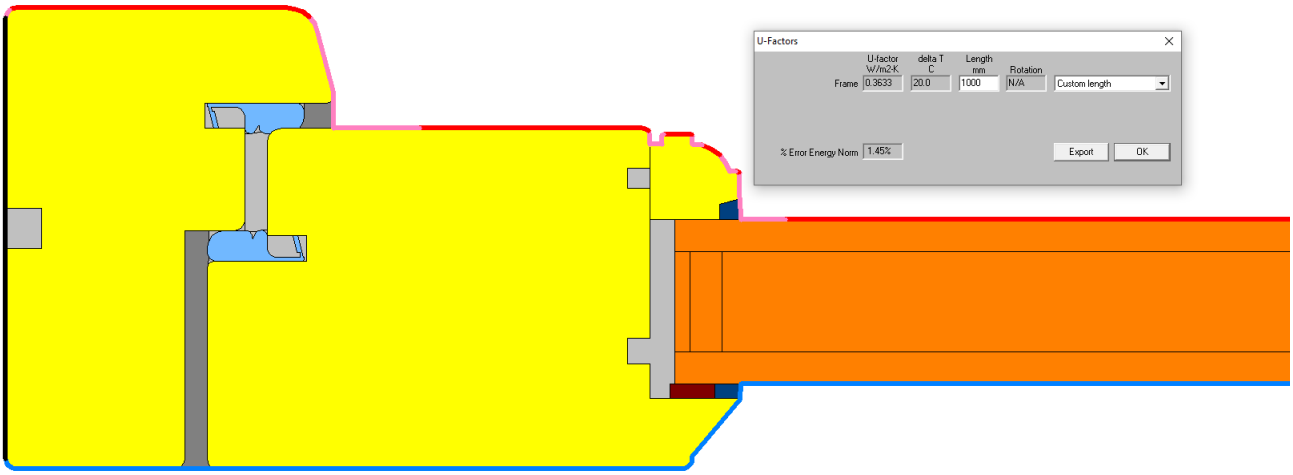


Quad Tree Mesh Parameter 9

Figure 4. Simulation of jamb profile.

Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C



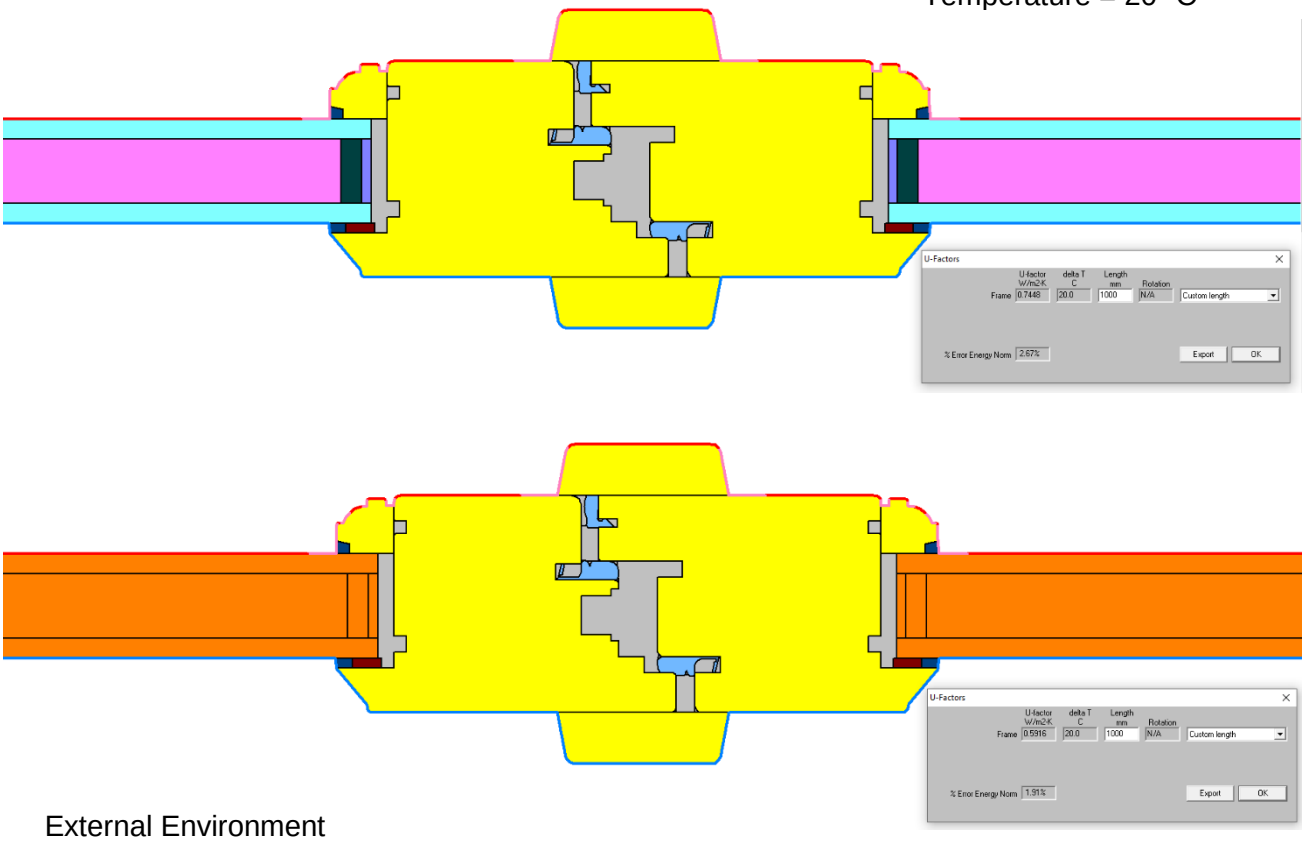


External Environment
R_{si} Normal = 0.04 m^2K/W
R_{si} Reduced = 0.04 m^2K/W
Temperature = 0 ^0C

Quad Tree Mesh Parameter 9

Figure 5. Simulation of meeting stile profile.

Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C



External Environment
R_{si} Normal = 0.04 m^2K/W
R_{si} Reduced = 0.04 m^2K/W
Temperature = 0 ^0C

Quad Tree Mesh Parameter 9

Key To Figures

	Material	Thermal Conductivity W/(m.K)	Source
	Softwood	0.13	Annex D of BS 10077-2
	Hardwood	0.18	Annex D of BS 10077-2
	Soda Lime Glass	1.0	Annex D of BS 10077-2
	EPDM	0.25	Annex D of BS 10077-2
	Swisspacer Advance	0.29	BF Datasheet W24 (see page 13)
	Polysulfide/Polyurethane	0.4	Annex D of BS 10077-2
	Silicone	0.35	Annex D of BS 10077-2
	Polyurethane foam	0.05	Table 3 of BS 10456
	Insulation panel	0.035	Annex D of BS 10077-2

Glazing unit 6.4-20-6.4 Low E 0.01 uncorrected 90% argon 10% air filled

BTF 01 Issue 0, September 2023. Calculations according to BS EN 673:2011

Number of spaces
1

Spaces			1			
Glazing orientation	Vertical					
Resistivity panes	1	m·K/W	Pane 1	90%	Pane 2	Pane 3
	Outside					
				Gas		Gas
				Argon		
	Thickness (mm)		6.4	20	6.4	
	Normal emissivity			0.89	0.01	
	$\sum d_j \cdot r_j$ =	0.0128		Uncoated		

Calculate

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	λeff	ΔT
	$W/(m^2 \cdot K)$	$(m^2 \cdot K)/W$	W/(mK)		W/(mK)	
1	1.065	0.75659	0.0264	15		
2	1.065	0.75659	0.0264	15		

G-Value Data

Calumen

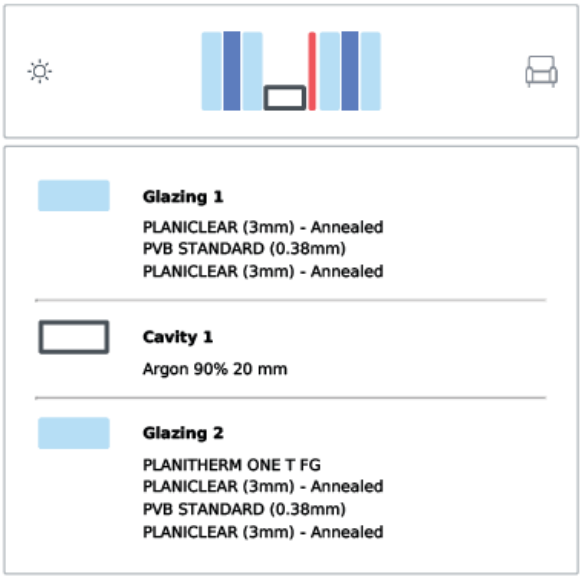
SAINT-GOBAIN

33.1 (20 Argon 90) 33.1

Coating: PLANITHERM ONE T FG #5

Computed by: Sue Peatey | Computed on: 03/03/2025 | Product catalog: United Kingdom | Norms: EN410:2011

Glazing type



Glazing 1
PLANICLEAR (3mm) - Annealed
PVB STANDARD (0.38mm)
PLANICLEAR (3mm) - Annealed

Cavity 1
Argon 90% 20 mm

Glazing 2
PLANITHERM ONE T FG
PLANICLEAR (3mm) - Annealed
PVB STANDARD (0.38mm)
PLANICLEAR (3mm) - Annealed

Simulated performance datas

Luminous Factors	**CIE015:2018**
Light Transmittance (TL)	66%
Outdoor Reflectance (RLe)	25%
Indoor Reflectance (RLi)	25%
Energy Factors	**EN410:2011**
Transmittance (TE)	39%
Outdoor Reflectance (Ree)	37%
Indoor Reflectance (Rei)	35%
Absorptance A1 (AE1)	17%
Absorptance A2 (AE2)	7%
Solar Factors	**EN410:2011**
Solar Factor (g)	0.46
Shading Coefficient (SC)	0.53
Thermal Transmission	**EN673:2011**
Ug	1.1 W/(m2.K)
Angle relative to the vertical	0°
Acoustics	**EN 12758**
Acoustic simulated values	
Rw (C;Ctr)	37 (-3; -7) dB
Ra	34 dB
Ra,tr	30 dB
STC (ASTM E413)	37
OITC (ASTM E1332)	26
Color Rendering	**CIE015:2018**
Transmission (Ra)	96.5
Reflection (Ra)	95.8
Safety Class	**EN12600**
Pendulum Body Resistance	2B2/2B2
Anti-Burglary	**EN356**
Burglar Resistance	NPD
Manufacturing Sizes	
Nominal Thickness	32.8 mm
Weight	31 kg/m²
Sustainability	
Carbon footprint	
The value is calculated regarding the composition computed based on the standard EN 15804+A2 (2019)	
Global Warming Potential (GWP) – A1-A3	**EN 15804+A2 (2019)**
(kg, CO_2 eq./m²) European average	54

BFRC TESTING

Conductivity of Spacer

August 2014 – No. W24 – Revision index 7-01/2025 – valid until June 30th, 2025 'WARM EDGE' WORKING PARTY

Data sheet Psi values for windows

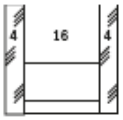
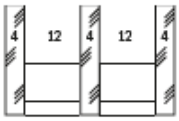
based on determination of the equivalent thermal conductivity of spacers by measurement

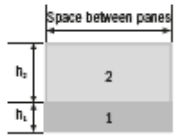
swisspacer SAINT-GOBAIN

swisspacer

SWISSPACER
Vetrotech Saint-Gobain (International) AG
Industriestrasse 8
CH-8574 Lengwil

	Product name	Spacer height h in mm	Material	Thickness d in mm
Profile description	ADVANCE 	6.5 Spacer category C	Thermally improved aluminium foil / SAN-GF	– 0.02 1.0

	Representative glass constructions	Metal with thermal break	Plastic	Wood	Wood/Metal
Representative frame profiles					
Representative psi value double-sheet thermally insulating glass W/mK	 Double-sheet insulating glass U_g=1.1 W/m²K	0.047	0.039	0.039	0.042
Representative psi value triple-sheet thermally insulating glass W/mK	 Triple-sheet insulating glass U_g=0.7 W/m²K	0.042	0.037	0.037	0.040

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	0.29

Explanations

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