BFRC, Unit A2, Access 442, Silkin Way, Hadley Park East, Telford TF1 6QX
enquiries@bfrc.org
+44 (0) 20 7403 9200

Calculation of Thermal Transmittance

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

Thermal Performance of Windows, Doors & Shutters

CONFIDENTIAL

Report reference:	U25-008-11A
Prepared for:	Bereco Ltd Unit 5 Aspen Court Centurion Business Park Rotherham, S60 1FB
Project:	Opening Out Bi-Fold Doorset
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

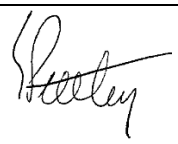
This document details the thermal performance calculation of the door configuration as detailed below.

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)

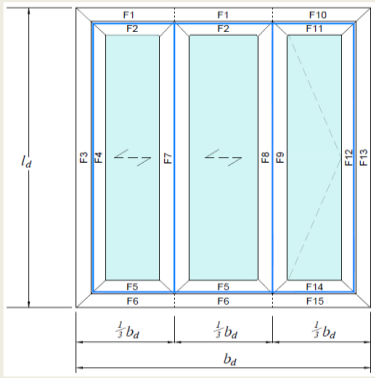
Frame Profile	Frame Thermal Transmittance (U_f)	Linear Thermal Transmittance (ψ)
Head	1.4 W/m²K	0.046 W/m.K
Jambs	1.3 W/m²K	0.046 W/m.K
Threshold	1.5 W/m²K	0.046 W/m.K
Meeting Stile	1.4 W/m²K	0.092 W/m.K

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: Bifolding door



Report Number:	U25-008-11	Issue 1.0: *15/01/2025*
Report Date:	26 March 2025	
Project Details:	Opening Out Bi-Fold Door.	

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
$U_{d\ -\ 2DP}$ — W/(m²·K)

Frame dimensions: All frame values to nearest mm, gaskets to nearest 0.1mm

		Frame height, b_f (mm)	Gasket protrusion, b_{gf} (mm)	Frame with gasket (mm)	Total frame (mm)
F1 + F2 L&M head rail	F1 left fixed head	**95**	n/a	95.0	174
	F2 left opening head	**79**	**0.4**	79.4	
F3 + F4 left jamb	F3 left fixed jamb	**61**	n/a	61.0	137
	F4 left opening jamb	**76**	**0.4**	76.4	
F5 + F6 L&M threshold	F5 left opening threshold	**138**	**0.4**	138.4	201
	F6 left fixed threshold	**63**	n/a	63.0	
F7 Meeting Stile	F7 Meeting Stile	**184**	**0.4**	184.8	
			0.4		
F8 + F9 Meeting stile	F8 bi-fold opener	**90**	**0.4**	90.4	184
	F9 opener	**94**	**0.4**	94.4	
F10 + F11 right head rail	F10 right fixed head	**95**	n/a	95.0	174
	F11 right opening head	**79**	**0.4**	79.4	
F12 + F13 right jamb	F12 right opening jamb	**76**	**0.4**	76.4	137
	F13 right fixed jamb	**61**	n/a	61.0	
F14 + F15 R threshold	F14 right opening threshold	**138**	**0.4**	138.4	201
	F15 right fixed threshold	**63**	n/a	63.0	
Recession depth	F6 & F15:	**0**	n/a		
Total gasket area			0.0071245	m²	

Door Dimensions:

Section	Length (m)	Width (m)	Area: No gasket (for U-value) (m²)	Area: With gasket (for g-value) (m²)
Left Sliding light	2.3500	0.6043	1.4202	1.4178
Middle Sliding light	2.3500	0.6513	1.5306	1.5282
Right Opening light	2.3500	0.6023	1.4155	1.4131
Total glazing, A_g			4.3663	4.3592
Frame	(m)	(m)	(m²)	(m²)
F1	1.6667	0.0950	0.1554	0.1554
F2	1.6057	0.0790	0.1130	0.1135
F3	2.7250	0.0610	0.1614	0.1614
F4	2.5670	0.0760	0.1868	0.1878
F5	1.6057	0.1380	0.1974	0.1979
F6	1.6667	0.0630	0.1031	0.1031
F7	2.5670	0.1840	0.4524	0.4542
F8	2.5670	0.0900	0.2213	0.2222
F9	2.5670	0.0940	0.2311	0.2320
F10	0.8333	0.0950	0.0763	0.0763
F11	0.7723	0.0790	0.0543	0.0545
F12	2.5670	0.0760	0.1868	0.1878
F13	2.7250	0.0610	0.1614	0.1614
F14	0.7723	0.1380	0.0949	0.0951
F15	0.8333	0.0630	0.0506	0.0506
Total Frame			2.4462	2.4533
Total door, Ad			6.8125	6.8125
Percentage left light glass area			20.85%	20.81%
Percentage middle light glass area			22.47%	22.43%
Percentage right light glass area			20.78%	20.74%
Percentage glass area (total)			64.09%	63.99%

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***

	L_f^{2D} W/(m·K)	b_p (mm)	L_ψ^{2D} W/(m·K)	b_g (mm)
F1 + F2 L&M head rail	**0.4135**	**190**	**0.4898**	**190**
F3 + F4 left jamb	**0.3504**	190	**0.4267**	190
F5 + F6 L&M threshold	**0.4714**	190	**0.5484**	190
F7 Meeting Stile	**0.6030**	380	**0.7563**	380
F8 + F9 Meeting stile	**0.6030**	380	**0.7563**	380
F10 + F11 right head rail	**0.4135**	190	**0.4898**	190
F12 + F13 right jamb	**0.3504**	190	**0.4267**	190
F14 + F15 R threshold	**0.4714**	190	**0.5484**	190

Frame:

Section	Frame widths (no gaskets), B_f (m)	Frame U-value, U_f (W/(m²·K))	Frame areas (no gaskets), A_f (m²)	Frame heat flow, HU (W/K)	Linear trans, Ψ (W/(m·K))	Linear length, l_g (m)	Junction Heat flow, HΨ (W/K)
F1 + F2 L&M head rail	0.1740	1.3902	0.2685	0.3732	0.0456	1.2557	0.0572
F3 + F4 left jamb	0.1370	1.3050	0.3483	0.4545	0.0456	2.3500	0.1071
F5 + F6 L&M threshold	0.2010	1.4915	0.3005	0.4482	0.0463	1.2557	0.0581
F7 Meeting Stile	0.1840	1.4118	0.4524	0.6387	0.0918	2.3500	0.2158
F8 + F9 Meeting stile	0.1840	1.4118	0.4524	0.6387	0.0918	2.3500	0.2158
F10 + F11 right head rail	0.1740	1.3902	0.1306	0.1815	0.0456	0.6023	0.0274
F12 + F13 right jamb	0.1370	1.3050	0.3483	0.4545	0.0456	2.3500	0.1071
F14 + F15 R threshold	0.2010	1.4915	0.1454	0.2169	0.0463	0.6023	0.0279
		Totals	2.4462	3.4061		Total	0.8163

Other parameters: Panel thickness, $d_p = d_g$ = 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)

Solar Factor, *g* -value:

F_d	0.9
g_d	0.26

U_{door}		W/(m²·K)
	No bars; or attached bars	**1.30**
	Single cross bar in IGU	**1.4**
	Multiple cross bar in IGU	**1.5**
	Glazing bar (Georgian bar)	**1.7**

Thermal transmittance, W/(m²·K)	U_{door}	**1.3**
Solar factor	g_{door}	**0.26**

BFRC Certified Simulator No

Simulator Name: Sue Peatey — **S166**

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

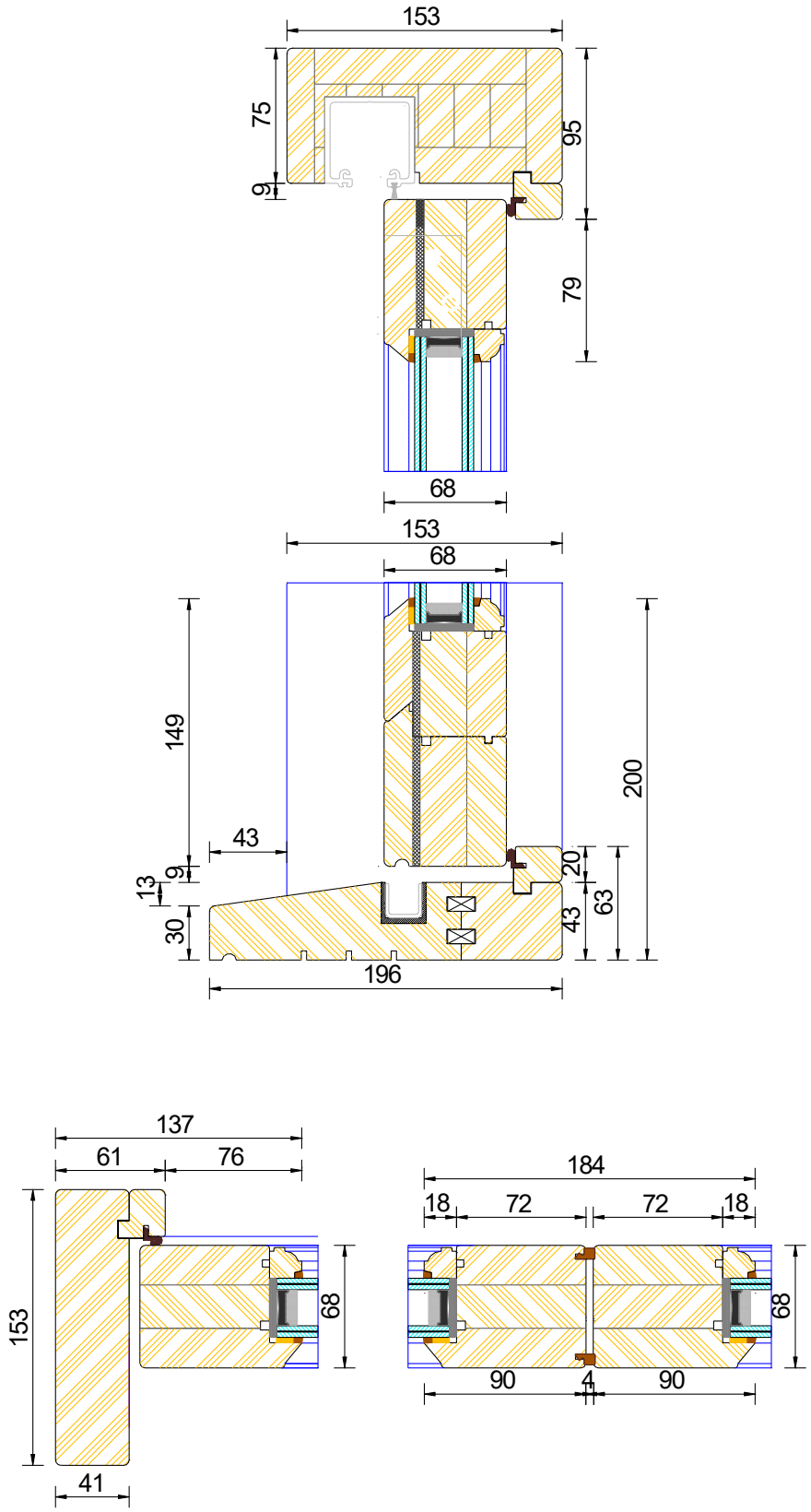
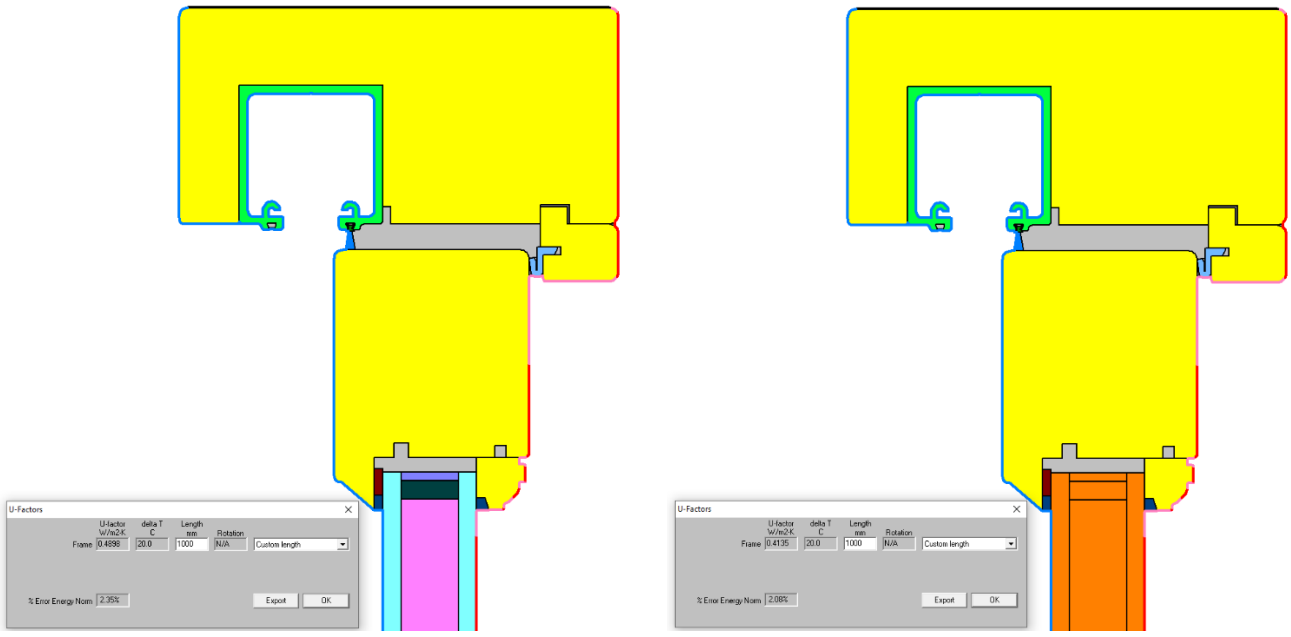


Figure 2. Simulation of head profile

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



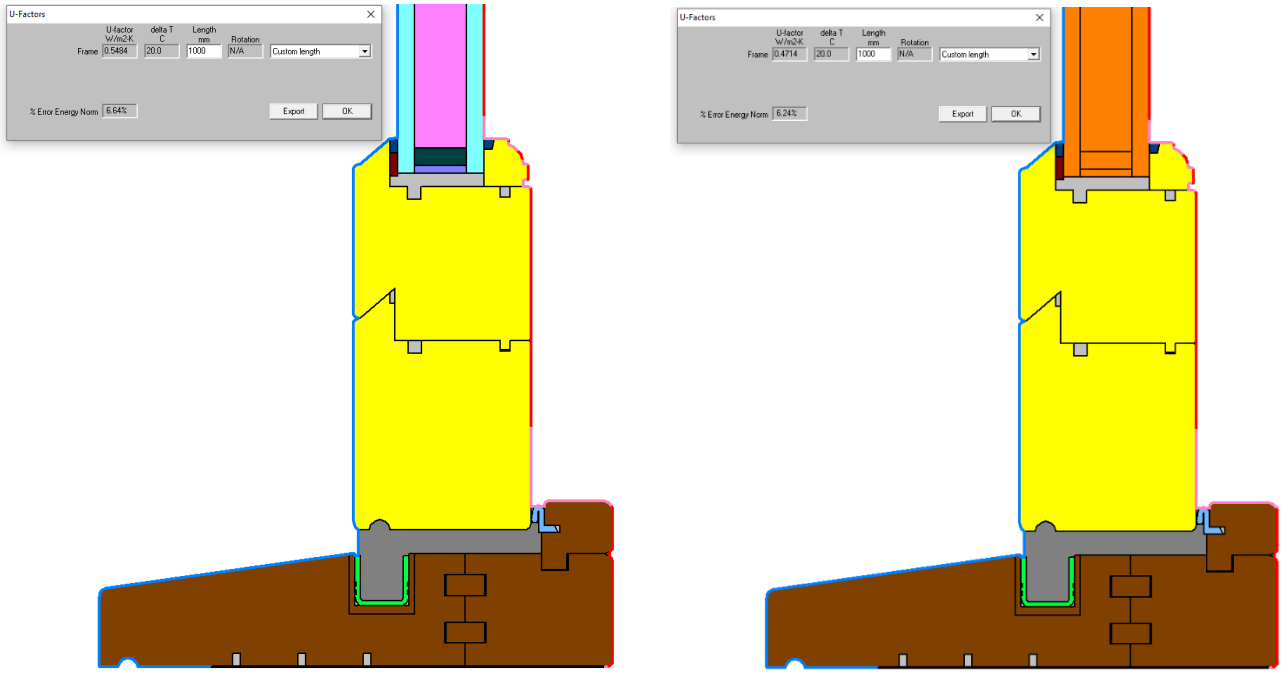
Quad Tree Mesh Parameter 9

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

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

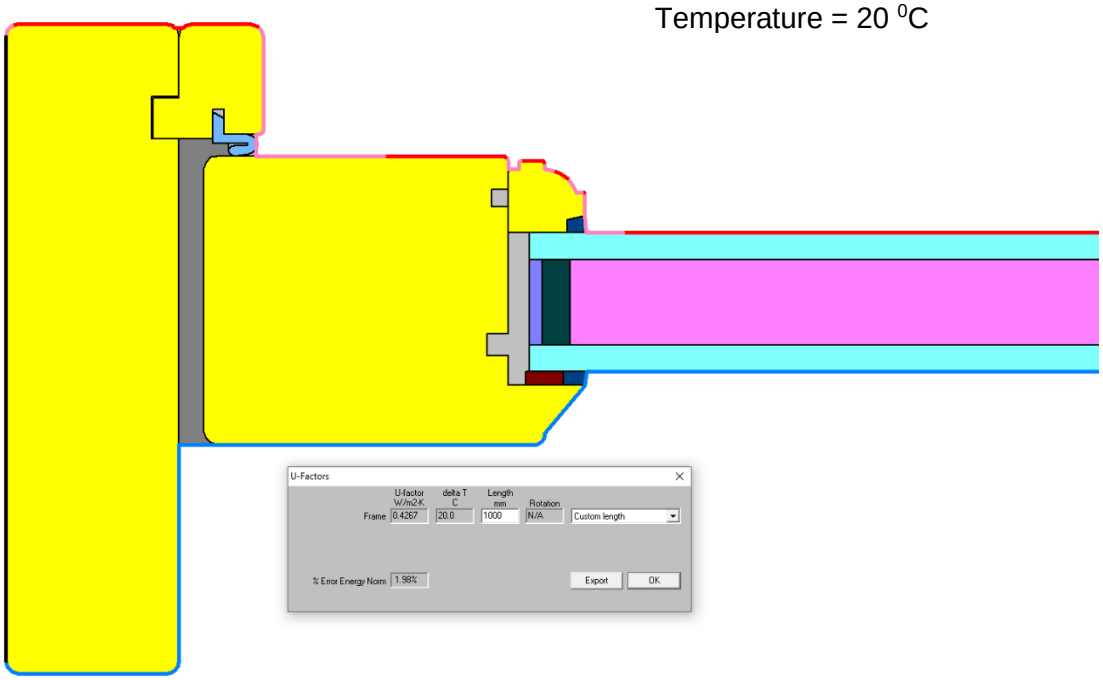
Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C



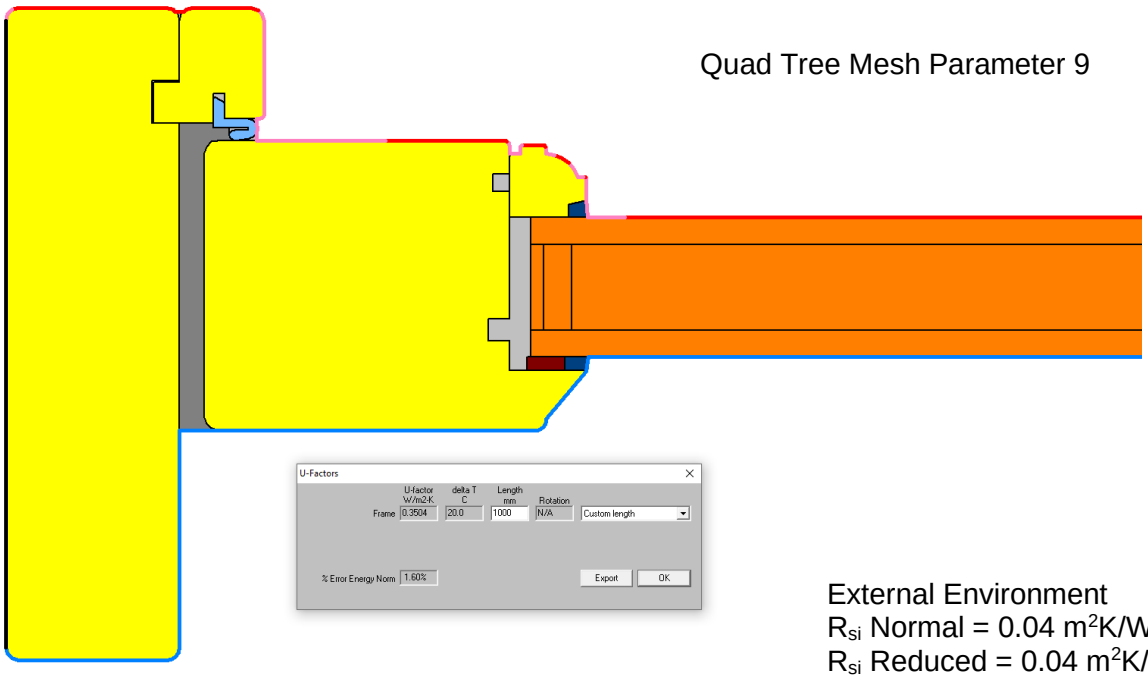
Quad Tree Mesh Parameter 9

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



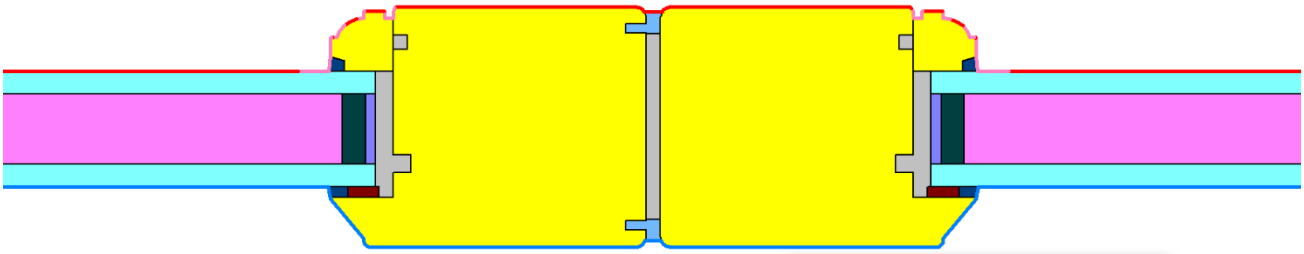
Quad Tree Mesh Parameter 9

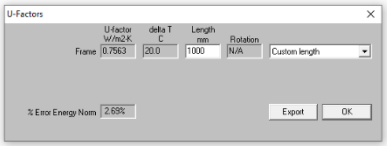


External Environment
R_{si} Normal = 0.04 m^2K/W
R_{si} Reduced = 0.04 m^2K/W
Temperature = 0 ^0C

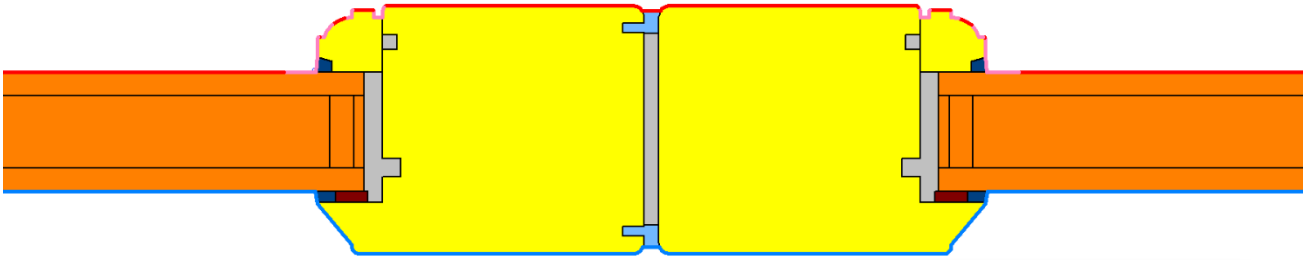
Figure 5. Simulation of meeting stile profile.

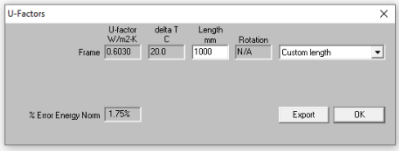
Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C





Quad Tree Mesh Parameter 9





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

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
	Aluminium	160.0	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
	W/(m²·K)	(m²·K)/W	W/(mK)	
1	1.065	0.75659	0.0264	15
2	1.065	0.75659	0.0264	15

G-Value Data

Calumen

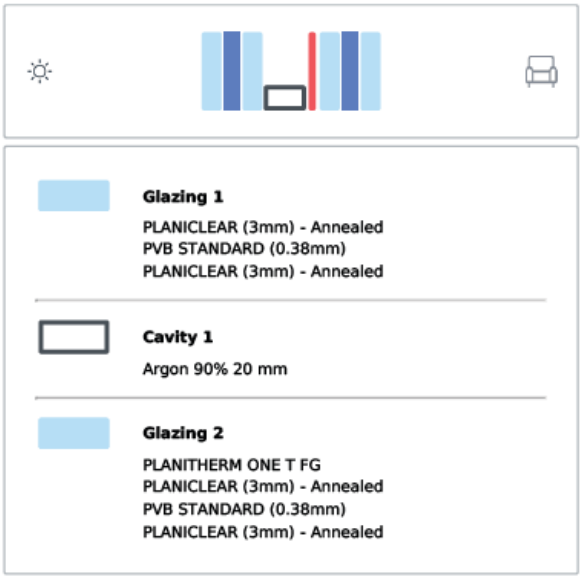
SAINT-GOBAIN

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

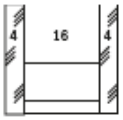
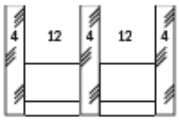
based on determination of the equivalent thermal conductivity of spacers by measurement

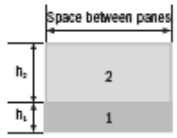
swisspacer SAINT-GOBAIN

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