Calculation of Thermal Transmittance

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

Thermal Performance of Windows, Doors & Shutters

CONFIDENTIAL

Report reference:	U25-008-6A
Prepared for:	Bereco Ltd Unit 5 Aspen Court Centurion Business Park Rotherham, S60 1FB
Project:	Flush Entrance Door
Issued by:	Sue Peatey
Issue date:	27 March 2025

20057

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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 U-value of the doorset was calculated using two different mid-rails, the first measured 107mm and the second 154mm.

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	S Peatey
Report Checked By:	Richard Bate Technical Director	Richard Bate

3 Results

3.1 U-Value

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

U25-008-6A-A – doorset with 107mm mid-rail	**1.3 W/m²K**
U25-008-6A-B – doorset with 154mm mid-rail	**1.3 W/m²K**

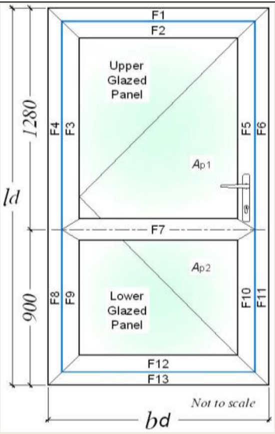
3.2 Frame thermal transmittance and linear thermal transmittance (in accordance with BS EN ISO 10077-1: 2017)

Frame Profile	Frame Thermal Transmittance (U_f)	Linear Thermal Transmittance (ψ)
Threshold	2.2 W/m^{2}K	0.046 W/m.K
Head	1.3 W/m^{2}K	0.046 W/m.K
Hinge Jamb	1.3 W/m^{2}K	0.046 W/m.K
Lock Jamb	1.3 W/m^{2}K	0.046 W/m.K
107mm mid-rail	1.4 W/m^{2}K	0.092 W/m.K
154mm mid-rail	1.4 W/m^{2}K	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^{2}K

4. U-value calculations



Sample Style: **Door Type 3**

Fully glazed residential door with mid rail

Report Number:	U25-008-6A	Issue No 1.0:	*15/01/2025*
Report Date:	27 February 2025		
Project Details:	Traditional Flush Entrance Door - Open In (107 mid rail)		

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Frame offset: **No**

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_w	2725	mm
Total door width **0DP**	b_w	1537.5	mm

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

Upper Panel dim's and properties:		
Thickness of upper panel, $d_{g/p1}$	**32.8**	mm
Panel type:	**Glazing panel**	
Thermal Transmittance of panel - 3DP		
$U_{g/p1}$	**1.065**	W/(m²·K)
Lower Panel dim's and properties:		
Thickness of lower panel, $d_{g/p2}$	**32.8**	mm
Panel type:	**Glazing panel**	
Thermal Transmittance of panel - 3DP		
$U_{g/p2}$	**1.065**	W/(m²·K)

Thermal transmittance of door from hot box testing		
U_d - 2dp		W/(m²·K)

Frame dimensions (All frame dimensions to 0dp)	Frame heights, bf (mm) Internal	Frame heights, bf (mm) Combo
F1 fixed top rail	**36**	148
F2 moving top rail	**112**	
F3 top hinge (LH) jamb (moving sash)	**112**	148
F4 top hinge (LH) jamb (fixed frame)	**36**	
F5 top close (RH jamb (moving sash)	**112**	148
F6 top close (RH) jamb (fixed frame)	**36**	
F7 mid rail	**107**	107
F8 bottom hinge (LH) jamb (fixed frame)	**36**	148
F9 bottom hinge (LH) jamb (moving sash)	**112**	
F10 bottom close (RH) jamb (moving sash)	**112**	148
F11 bottom close (RH) jamb (fixed frame)	**36**	
F12 bottom moving rail	**178**	236
F13 bottom fixed rail	**58**	

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_g (mm)
F1+F2 top rail	L_f^{2D}	**0.3668**	**190**	L_ψ^{2D}	**0.4435**	190
F3+F4 top hinge (LH) jamb		**0.3668**	190		**0.4435**	190
F5+F6 top close (RH) jamb		**0.3677**	190		**0.4444**	190
F7 mid rail		**0.4922**	190 / **190**		**0.6456**	190 / 190
F8+F9 bottom hinge (LH) jamb		**0.3668**	190		**0.4435**	190
F10+F11 bottom close (RH) jamb		**0.3677**	190		**0.4444**	190
F12+F13 bottom rail		**0.7010**	190		**0.7776**	190

Door Dimensions:

Panel	Length, l (m)	Width, b (m)	Area, A (m²)
Glazing panel	1.6235	1.2415	2.0156
Glazing panel	0.6105	1.2415	0.7579
Total of glazing + panel			2.7735
Frame	**m**	**m**	**m²**
F1	1.5375	0.0360	0.0541
F2	1.4655	0.1120	0.1516
F3	1.7890	0.1120	0.1911
F4	1.8250	0.0360	0.0651
F5	1.7890	0.1120	0.1911
F6	1.8250	0.0360	0.0651
F7	1.4655	0.1070	0.1448
F8	0.9000	0.0360	0.0314
F9	0.8420	0.1120	0.0813
F10	0.8420	0.1120	0.0813
F11	0.9000	0.0360	0.0314
F12	1.4655	0.1780	0.2409
F13	1.5375	0.0580	0.0871
Total Frame			1.4162
Total Door, A_d			4.1897
Percentage upper panel area			48.11%
Percentage lower panel area			18.09%

Frame: Section	Frame width, b_f (m)	Frame U-value, U_f (W/(m²·K))	Frame ares (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 top rail	0.1480	1.3188	0.2056	0.2712	0.0460	1.2415	0.0571
F3+F4 top hinge jamb	0.1480	1.3188	0.2562	0.3378	0.0460	1.6235	0.0746
F5+F6 top close jamb	0.1480	1.3249	0.2562	0.3394	0.0460	1.6235	0.0746
F7 mid rail	0.1070	1.3923	0.1448	0.2016	0.0919	1.2415	0.1141
F8+F9 btm. hinge jamb	0.1480	1.3188	0.1127	0.1486	0.0460	0.6105	0.0281
F10+F11 btm. Cls. jamb	0.1480	1.3249	0.1127	0.1493	0.0460	0.6105	0.0281
F12+F13 bottom rail	0.2360	2.2432	0.3280	0.7358	0.0459	1.2415	0.0569
		Totals	1.4162	2.1838		Total	0.4335

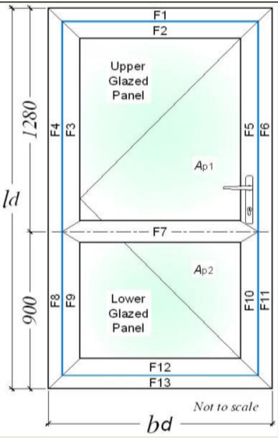
		Panel thickness,	$d_{p1} = d_{g1} =$ 0.0328		$d_{p2} = d_{g2} =$	0.0328	m
$\lambda_p =$	0.035	W/(m·K)	$R_{se} =$ 0.04	m²·K/W	$R_{se} =$	0.13	m²·K/W
$R_{p1} =$	0.9371	m²·K/W	$R_{tot1} =$ 1.1071	m²·K/W	$U_{p1} =$	0.9032	W/(m²·K)
$R_{p2} =$	0.9371	m²·K/W	$R_{tot2} =$ 1.1071	m²·K/W	$U_{p2} =$	0.9032	W/(m²·K)

U_{door}			
	No bars; or attached bars	**1.33**	W/(m²·K)
	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**

BFRC Certified Simulator No

Simulator Name: **Sue Peatey** **S166**



Sample Style:
Door Type 3

Fully glazed residential door with mid rail

Report Number:	U25-008-6B
Issue No 1.0:	*15/01/2025*
Report Date:	27 February 2025
Project Details:	Traditional Flush Entrance Door - Open In (154 mid rail)

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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 door height ***0DP***	l_w	2725	mm
Total door width ***0DP***	b_w	1537.5	mm

Frame offset: **No**

Frame dimensions (All frame dimensions to 0dp)	Frame heights, bf (mm) Internal	Frame heights, bf (mm) Combo
F1 fixed top rail	**36**	148
F2 moving top rail	**112**	
F3 top hinge (LH) jamb (moving sash)	**112**	148
F4 top hinge (LH) jamb (fixed frame)	**36**	
F5 top close (RH jamb (moving sash)	**112**	148
F6 top close (RH) jamb (fixed frame)	**36**	
F7 mid rail	**154**	154
F8 bottom hinge (LH) jamb (fixed frame)	**36**	148
F9 bottom hinge (LH) jamb (moving sash)	**112**	
F10 bottom close (RH) jamb (moving sash)	**112**	148
F11 bottom close (RH) jamb (fixed frame)	**36**	
F12 bottom moving rail	**178**	236
F13 bottom fixed rail	**58**	

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

Upper Panel dim's and properties:		
Thickness of upper panel, $d_{g/p1}$	**32.8**	mm
Panel type:	**Glazing panel**	
Thermal Transmittance of panel - 3DP		
$U_{g/p1}$	**1.065**	W/(m²·K)
Lower Panel dim's and properties:		
Thickness of lower panel, $d_{g/p2}$	**32.8**	mm
Panel type:	**Glazing panel**	
Thermal Transmittance of panel - 3DP		
$U_{g/p2}$	**1.065**	W/(m²·K)

Thermal transmittance of door from hot box testing

U_d - *2dp*		W/(m²·K)

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_g (mm)
F1+F2 top rail	L_f^{2D}	**0.3668**	**190**	L_ψ^{2D}	**0.4435**	190
F3+F4 top hinge (LH) jamb		**0.3668**	190		**0.4435**	190
F5+F6 top close (RH) jamb		**0.3677**	190		**0.4444**	190
F7 mid rail		**0.5611**	190 / **190**		**0.7144**	190 / 190
F8+F9 bottom hinge (LH) jamb		**0.3668**	190		**0.4435**	190
F10+F11 bottom close (RH) jamb		**0.3677**	190		**0.4444**	190
F12+F13 bottom rail		**0.7010**	190		**0.7776**	190

Door Dimensions:

Panel	Length, l (m)	Width, b (m)	Area, A (m²)
Glazing panel	1.6000	1.2415	1.9864
Glazing panel	0.5870	1.2415	0.7288
Total of glazing + panel			2.7152
Frame	**m**	**m**	**m²**
F1	1.5375	0.0360	0.0541
F2	1.4655	0.1120	0.1516
F3	1.7890	0.1120	0.1898
F4	1.8250	0.0360	0.0651
F5	1.7890	0.1120	0.1898
F6	1.8250	0.0360	0.0651
F7	1.4655	0.1540	0.2084
F8	0.9000	0.0360	0.0314
F9	0.8420	0.1120	0.0800
F10	0.8420	0.1120	0.0800
F11	0.9000	0.0360	0.0314
F12	1.4655	0.1780	0.2409
F13	1.5375	0.0580	0.0871
Total Frame			1.4745
Total Door, A_d			4.1897
Percentage upper panel area			47.41%
Percentage lower panel area			17.39%

Frame:

Section	Frame width, b_f (m)	Frame U-value, U_f (W/(m²·K))	Frame ares (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 top rail	0.1480	1.3188	0.2056	0.2712	0.0460	1.2415	0.0571
F3+F4 top hinge jamb	0.1480	1.3188	0.2548	0.3361	0.0460	1.6000	0.0735
F5+F6 top close jamb	0.1480	1.3249	0.2548	0.3376	0.0460	1.6000	0.0735
F7 mid rail	0.1540	1.4148	0.2084	0.2949	0.0918	1.2415	0.1140
F8+F9 btm. hinge jamb	0.1480	1.3188	0.1114	0.1469	0.0460	0.5870	0.0270
F10+F11 btm. Cls. jamb	0.1480	1.3249	0.1114	0.1476	0.0460	0.5870	0.0270
F12+F13 bottom rail	0.2360	2.2432	0.3280	0.7358	0.0459	1.2415	0.0569
		Totals	1.4745	2.2701		Total	0.4290

Panel thickness, $d_{p1} = d_{g1} =$ 0.0328 $d_{p2} = d_{g2} =$ 0.0328 m

$\lambda_p =$	0.035	W/(m·K)	$R_{se} =$	0.04	m²·K /W	$R_{se} =$	0.13 m²·K/W
$R_{p1} =$	0.9371	m²·K /W	$R_{tot1} =$	1.1071	m²·K/ W	$U_{p1} =$	0.9032 W/(m²·K)
$R_{p2} =$	0.9371	m²·K /W	$R_{tot2} =$	1.1071	m²·K/ W	$U_{p2} =$	0.9032 W/(m²·K)

U_{door}	No bars; or attached bars	**1.33**	W/(m²·K)
	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**

BFRC

BFRC Certified Simulator No

Simulator Name: **Sue Peatey**   **S166**

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

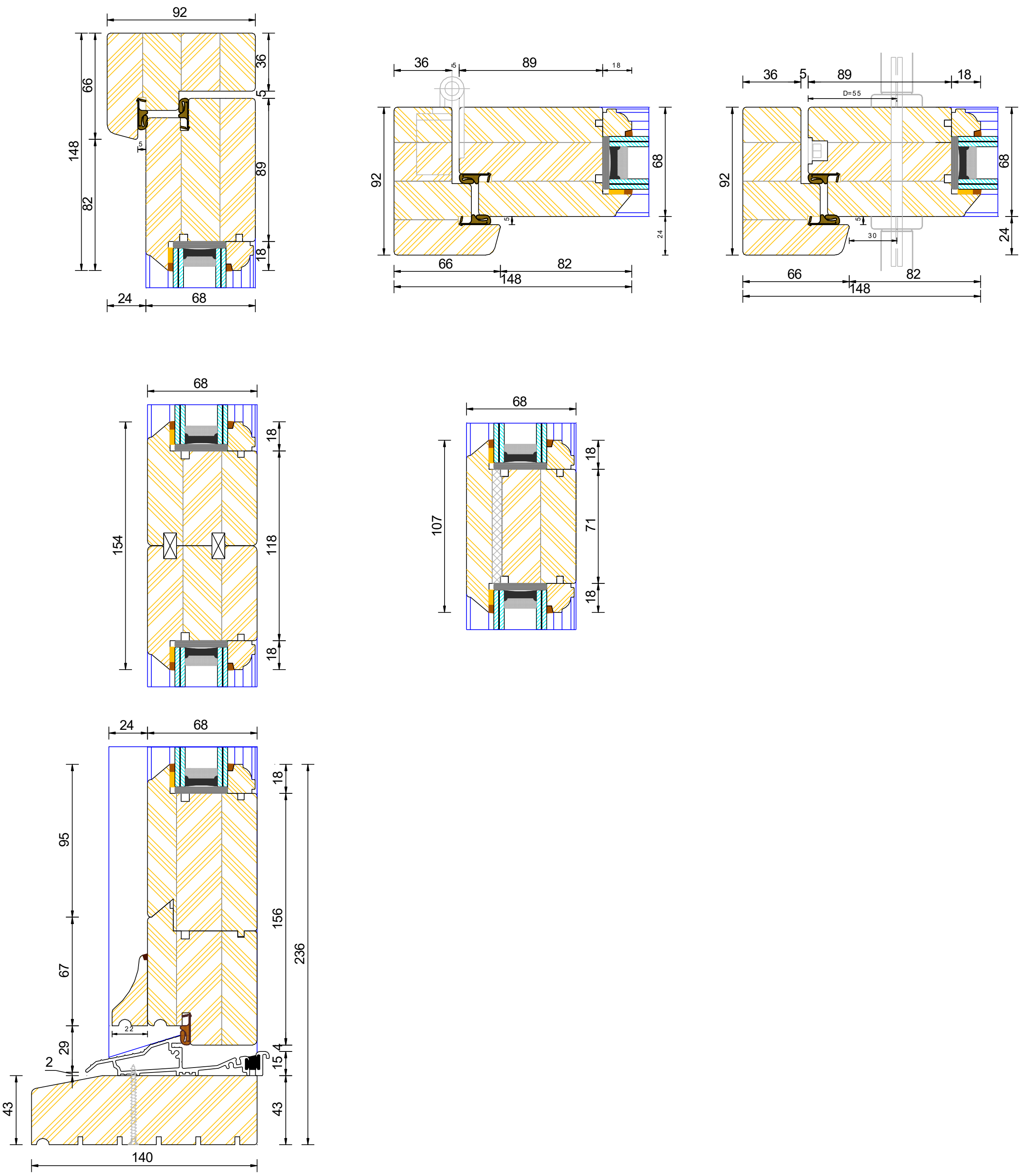
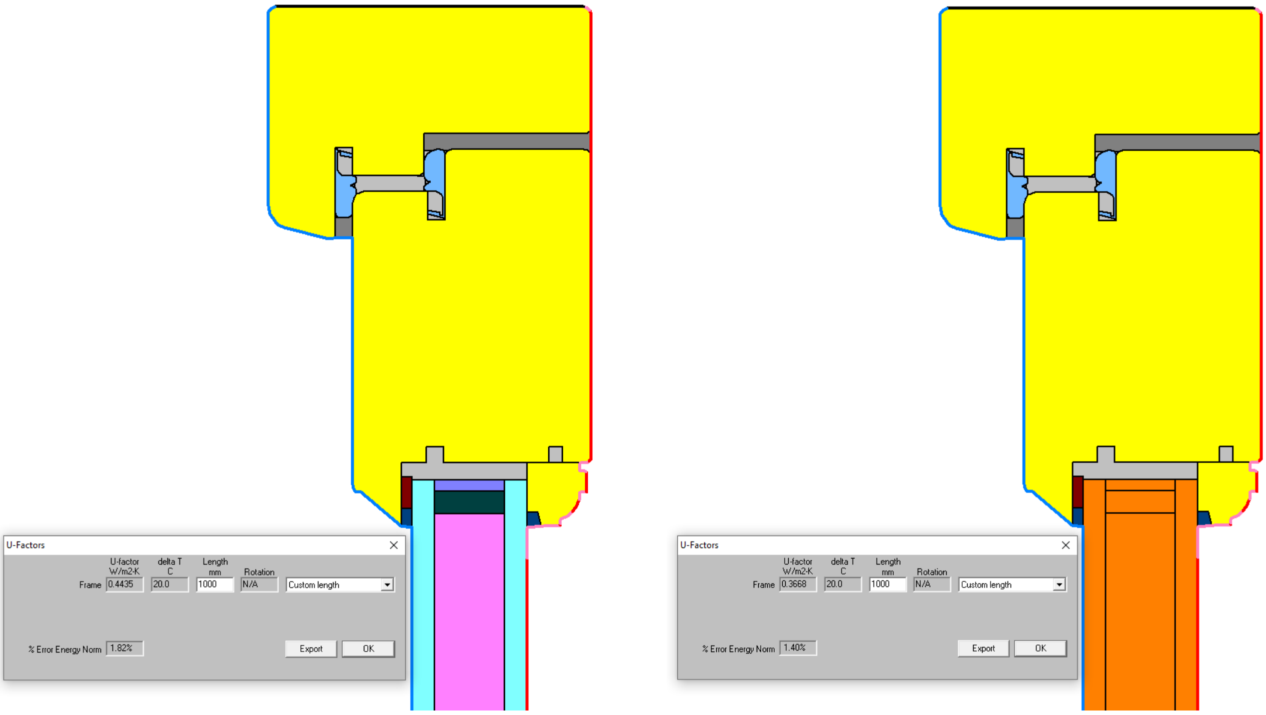


Figure 2. Simulation of head and hinge jamb profile

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

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

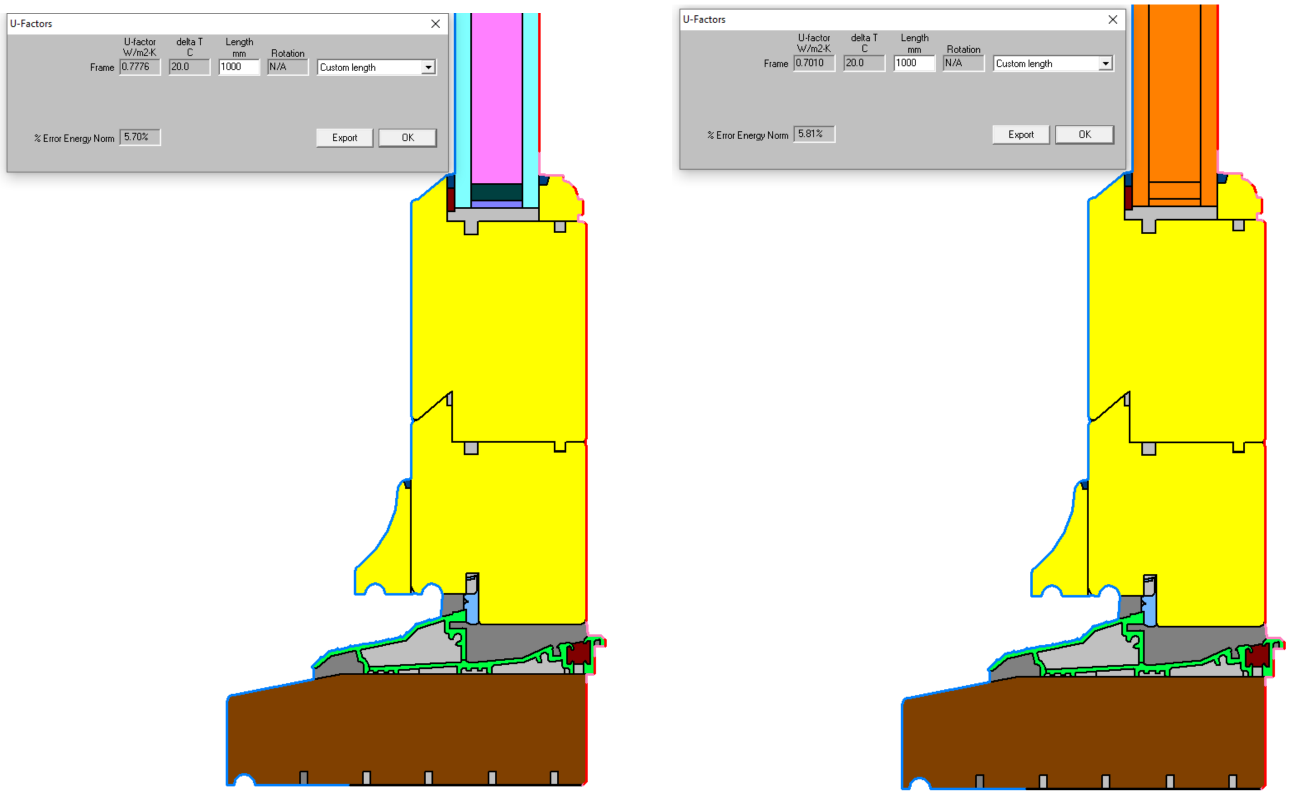


Quad Tree Mesh Parameter 9

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

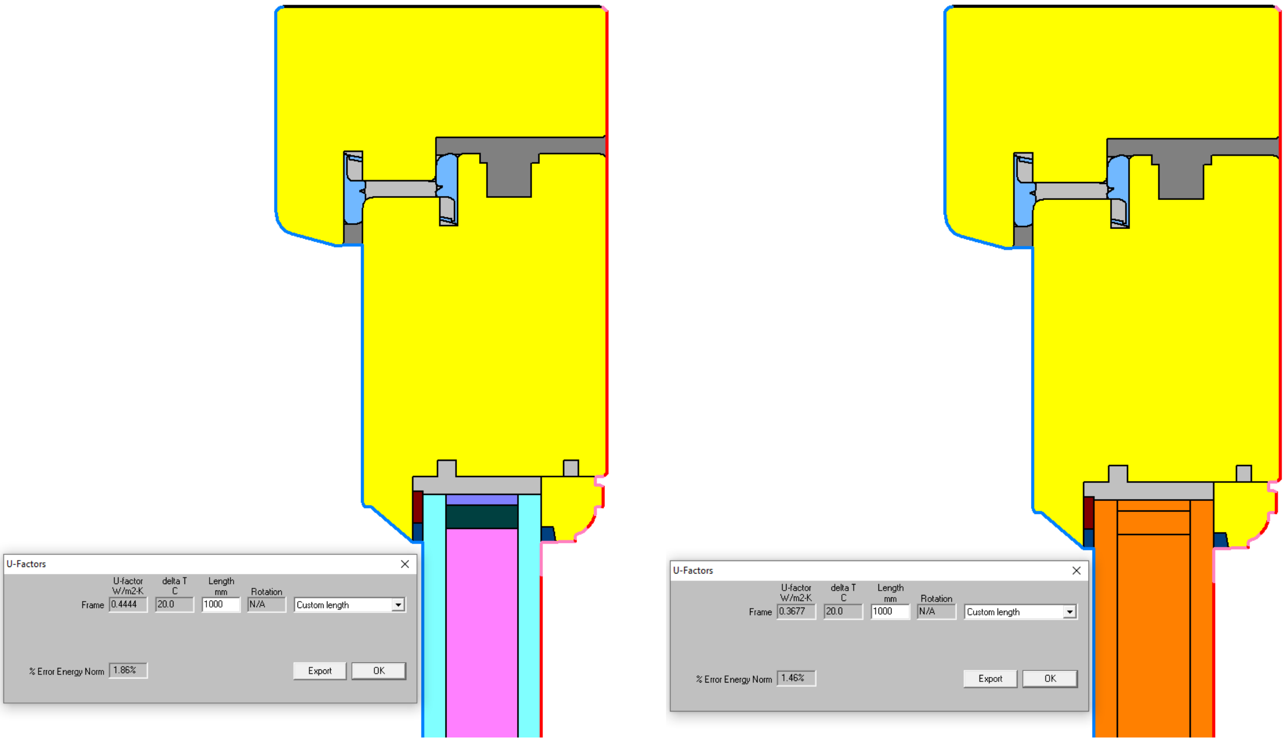


Quad Tree Mesh Parameter 9

Figure 4. Simulation of lock jamb profile.

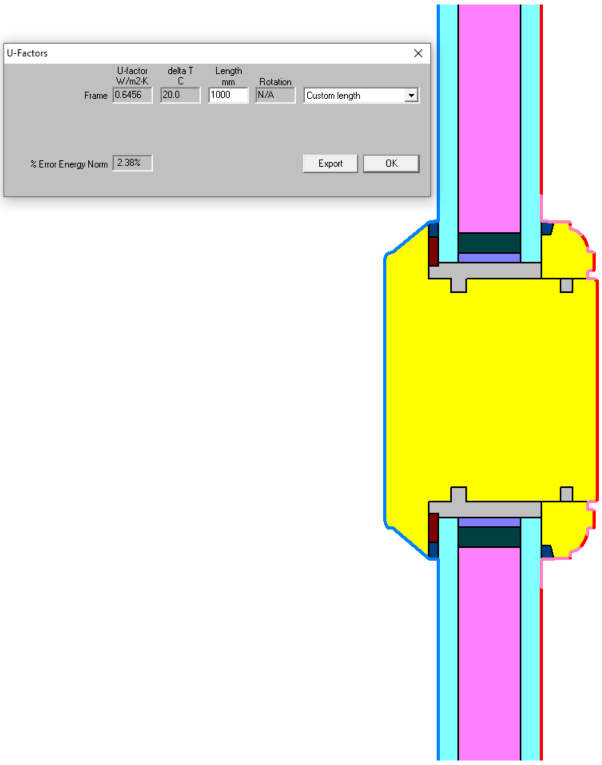
Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C

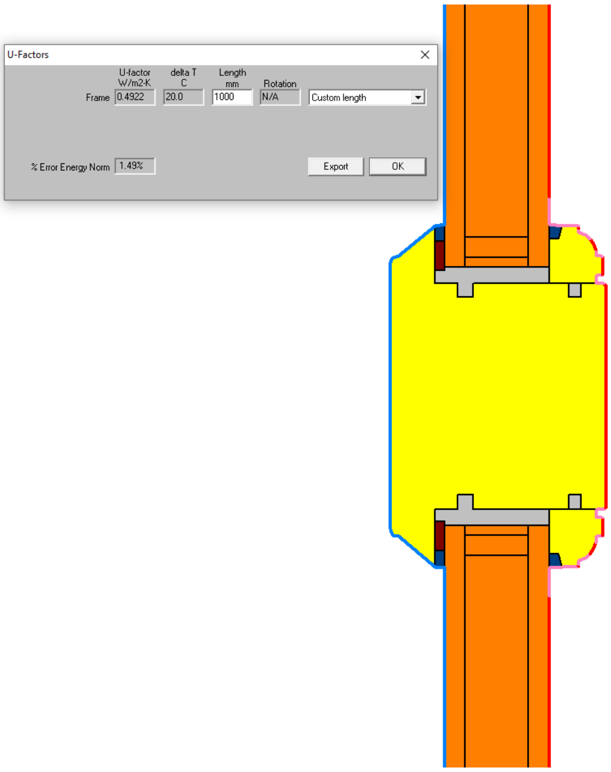
External Environment
R_{si} Normal = 0.04 m^2K/W
R_{si} Reduced = 0.04 m^2K/W
Temperature = 0 ^0C



Quad Tree Mesh Parameter 9

Figure 5. Simulation of mid-rail (107mm) profile.



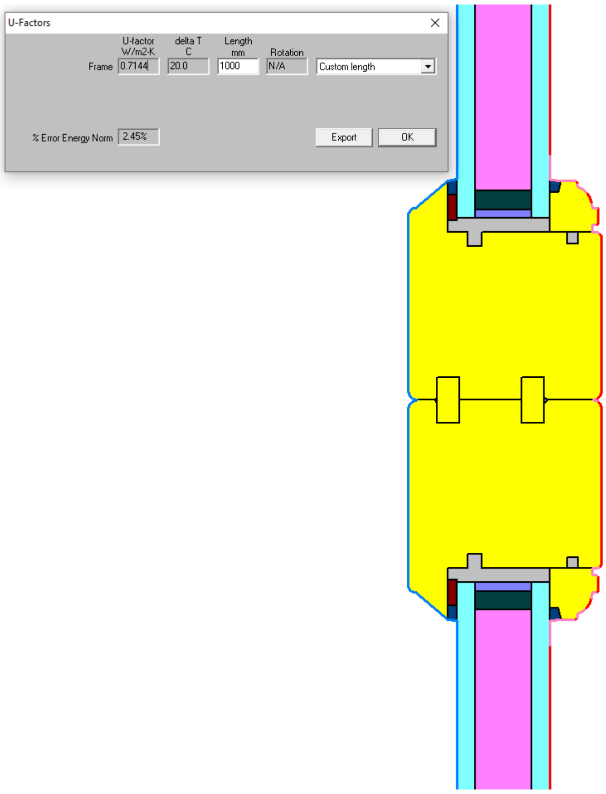


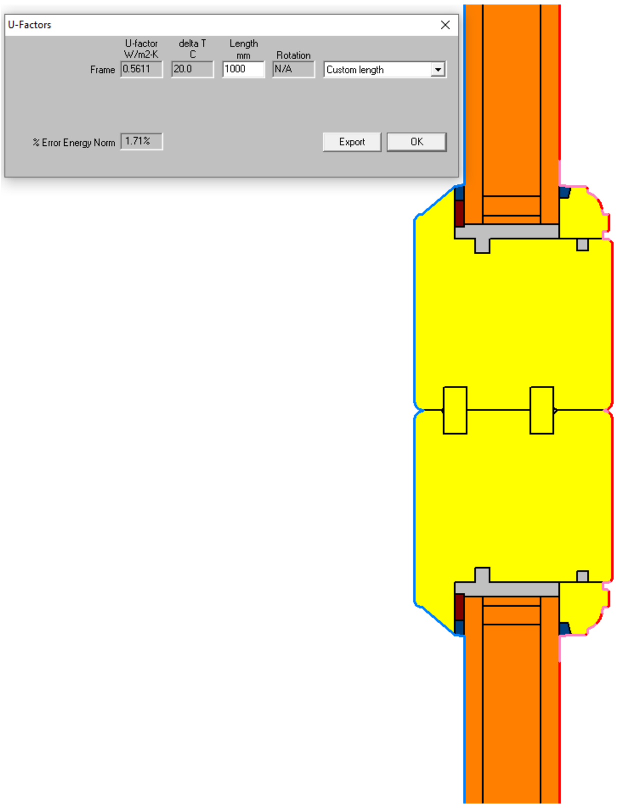
External Environment
R_{si} Normal = 0.04 m^{2}K/W
R_{si} Reduced = 0.04 m^{2}K/W
Temperature = 0 ^{0}C

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

Quad Tree Mesh Parameter 9

Figure 6. Simulation of mid-rail (154mm) 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

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 15)
	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

Outside

Pane 1 | 90% | Pane 2

Calculate

	Pane 1	Gas		Pane 2
		Argon		
Thickness (mm)	6.4	20		6.4
Normal emissivity		0.89	0.01	
$\sum d_j \cdot r_j =$ 0.0128		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 $W/(m^2 \cdot K)$	$\sum 1/h_s$ $(m^2 \cdot K)/W$	λeff W/(mK)	ΔT
1	1.065	0.75659	0.0264	15
2	1.065	0.75659	0.0264	15

G-Value Data

Calumen

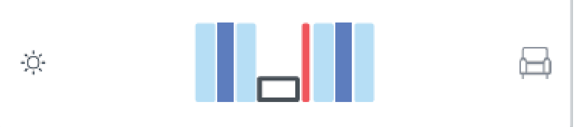
SAINT-GOBAIN

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

Conductivity of Spacer

August 2014 – No. W24 – Revision index 7-01/2025 – valid until June 30th, 2025

'WARM EDGE' WORKING PARTY

BF

RAL GÜTEZEICHEN MEHRSCHEIBEN ISOLIERGLAS

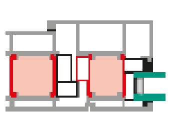
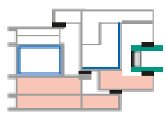
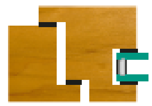
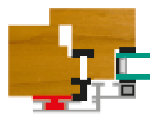
Data sheet Psi values for windows

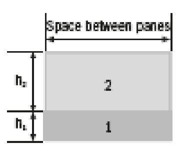
based on determination of the equivalent thermal conductivity of spacers by measurement

swisspacer SAINT-GOBAIN

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

Profile description	Product name		Spacer height in mm	Material	Thickness d in mm
			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	4 16 4 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	4 12 4 12 4 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