BFRC, 40 Rushworth Street, London, SE1 0RB
enquiries@bfrc.org
+44 (0) 20 7403 9200

Proven Performance.

Report in Accordance with BFRC Guidelines and Regulations

Energy Rating Performance of Windows & Doors

CONFIDENTIAL

Report reference:	3-014-2
Prepared for:	London Box Sash Windows 9 Tramsheds Coomber Way Croydon CR0 4TQ
Product Description:	Box Sash Vertical Sliding Window
Date:	31 August 2023
Prepared by:	Sue Peatey BFRC Technical Officer Approved Simulator S166

This report is not a UK Approved Body or UKAS accredited report and would not be suitable for use in a Declaration of Performance or in support of UKCA Marking. This report is only valid in conjunction with a BFRC licence application.

The results in this report relate only to the products calculated from 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. British Fenestration Rating Council Ltd and its representatives accept no liability for misuse of this report.

1 Introduction

This document details the energy rating performance of the window configuration as detailed below.

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 Summary of Results

BFRC Rating	A	
Energy Rating Index	+5	kWh(m²·yr)
Thermal transmittance (U_{window})	1.4	W/(m²·K)
Solar Factor (g_{window})	0.47	
Window Air Leakage Heat Loss (L_{factor})	0.01	W/(m²·K)

3 Authorisation

Report Issued By:	Sue Peatey Technical Officer	

4 Technical Specification

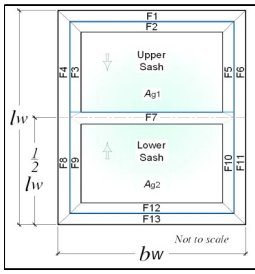
System & Manufacturer	London Box Sash Windows – Box Sash
Window Type	Vertical Sliding Sash Window

Frame		**Reference**	**Size (mm) h x w**
Outer Frame	Head	Accoya and MDF (Tricoya)	77 x 155
	Sill	Accoya	75 x 155
	Jambs	Accoya and MDF (Tricoya)	95 x 154
Sash	Head	Accoya	55 x 52
	Sill	Accoya	97 x 52
	Jambs	Accoya	55 x 52
Bead	Glazing bead	Accoya	16 x 6.5
	Parting bead	Accoya	25 x 8

Weather Seals / Gaskets	Reference	Material
Frame Rebate	SP5920 Deventer seal	EPDM
Sash	SP5920 Deventer seal	EPDM
Glazing Rebate	Glazing tape	EPDM
Glazing Bead	Glazing tape	EPDM

Glazing Unit	Description
Overall Size	24mm
Outer Pane	4mm St Gobain, Diamant
Cavity	16mm 90% Argon
Inner Pane	4mm St Gobain, Planitherm Total+
Spacer Bar	St Gobain, Swisspacer Ultimate
Secondary Sealant	Polysulfide / Polyurethane

5 BFRC Spreadsheet



Sample Style:

Vertical Sliding Sash

Blue line illustrates opening light length (air leakage)

Report Number:	3-014-2
Report Date:	08/08/2023
Project Details:	Box sash VSS

Report Issue No.15.3: *04/01/2016*

THIS SPREADSHEET IS THE PROPERTY OF THE BFRC AND CAN ONLY BE USED IN CONJUNCTION WITH A BFRC LICENCE APPLICATION

Input Values:
Yellow input, green intermediary, blue finals — X' DP is no.of decimal place 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, d_{p1}	**4.0**	mm
Glazing fill thickness 1/2, d_{gf1}	**16.0**	mm
Gas fill (1/2)	**Argon 90%**	
Thickness of pane 2, d_{p2}	**4.0**	mm
Complete next 3 cells for TG IGU		
Glazing fill thickness 2/2, d_{gf2}		mm
Gas fill (2/3)		
Thickness of pane 3, d_{p3}		mm
Glazing Trans. - ***3DP*** U_g	**1.195**	W/(m²·K)
g-value - ***2DP*** $g_\perp$	**0.73**	

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

Window Dimensions:

Section	Length, l (m)	Width, b (m)	Area, A: No gasket (m²)	Area, A: With gasket (m²)
Upper glazing	0.6005	0.9560	0.5741	0.5741
Lower glazing	0.5705	0.9560	0.5454	0.5454
Total of glazing			1.1195	1.1195
Frame	m	m	m²	m²
F1	1.2300	0.0770	0.0874	0.0874
F2	1.0400	0.0440	0.0439	0.0439
F3	0.6630	0.0420	0.0265	0.0265
F4	0.7400	0.0950	0.0666	0.0666
F5	0.6630	0.0420	0.0265	0.0265
F6	0.7400	0.0950	0.0666	0.0666
F7	1.0400	0.0370	0.0369	0.0369
F8	0.7400	0.0950	0.0667	0.0667
F9	0.6650	0.0420	0.0259	0.0259
F10	0.6650	0.0420	0.0259	0.0259
F11	0.7400	0.0950	0.0667	0.0667
F12	1.0400	0.0760	0.0758	0.0758
F13	1.2300	0.0750	0.0851	0.0851
Total Frame			0.7009	0.7009
Total Window, Aw			1.8204	1.8204
Percentage upper glass area			31.54%	31.54%
Percentage lower glass area			29.96%	29.96%
Percentage glass area (total)			61.50%	61.50%

Frame dimensions (All frame values to 0dp, gaskets to 1DP)

	Frame height, b_f (mm) Internal	External	Gasket protrusion (mm)	With gasket (mm)	Total
F1 fixed top rail	**77**	78	n/a	77.0	121.0
F2 moving top rail	**44**	**43**	**0.0**	44.0	
F3 top (LH) jamb (moving sash)	**42**	**42**	**0.0**	42.0	137.0
F4 top (LH) jamb (fixed frame)	**95**	95	n/a	95.0	
F5 top (RH) jamb (moving sash)	42	42	0.0	42.0	137.0
F6 top (RH) jamb (fixed frame)	95	95	n/a	95.0	
F7 mid rail (upper)	**37**		**0.0**	37.0	37.0
F7 mid rail (lower)			**0.0**		
F8 bottom (LH) jamb (fixed frame)	95	95	n/a	95.0	137.0
F9 bottom (LH) jamb (moving sash)	**42**	42	**0.0**	42.0	
F10 bottom (RH) jamb (moving sash)	42	42	0.0	42.0	137.0
F11 bottom (RH) jamb (fixed frame)	95	95	n/a	95.0	
F12 bottom moving rail	**76**		**0.0**	76.0	151.0
F13 bottom fixed rail	**75**		n/a	75.0	
Total gasket area			0	m²	

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_p (mm)	$L_\psi{}^{2D}$ W/(m·K)	b_g (mm)
F1+F2 top rail	**0.4262**	**190**	**0.4662**	190
F3+F4 top (LH) jamb	**0.3928**	190	**0.4322**	190
F5+F6 top (RH) jamb	0.3928	190	0.4322	190
F7 mid rail	**0.5669**	380	**0.6516**	380
F8+F9 bottom (LH) jamb	**0.3914**	190	**0.4314**	190
F10+F11 bottom (RH) jamb	0.3914	190	0.4314	190
F12+F13 bottom rail	**0.4369**	190	**0.4770**	190

Frame:

Section	Frame width, b_f (m)	Frame U-value, U_f W/(m²·K)	Frame areas, 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	0.1210	1.6873	0.1313	0.2216	0.0350	0.9560	0.0334
F3+F4 top left jamb	0.1370	1.2464	0.0932	0.1161	0.0344	0.6005	0.0206
F5+F6 top right jamb	0.1370	1.2464	0.0932	0.1161	0.0344	0.6005	0.0206
F7 mid rail	0.0370	3.3196	0.0369	0.1226	0.0747	0.9560	0.0714
F8+F9 btm left jamb	0.1370	1.2362	0.0927	0.1146	0.0350	0.5705	0.0200
F10+F11 btm right jamb	0.1370	1.2362	0.0927	0.1146	0.0350	0.5705	0.0200
F12+F13 bottom rail	0.1510	1.4229	0.1610	0.2291	0.0351	0.9560	0.0335
Totals		0.7009	1.0346		Total		0.2196

Solar Factor, *g*-value:

glazing area A_g (m²)	1.3063
F_w	0.9
g_w	0.47

Other parameters needed for calculation, taken from simulations:

λ_p =	0.035 W/(m·K)	R_{se} =	0.04 m²·K/W	$d_p = d_g$ =	0.024 m
R_p =	0.6857 m²·K/W	R_{tot} =	0.8557 m²·K/W	R_{se} =	0.13 m²·K/W
				U_p =	1.1686 W/(m²·K)

U_{window} W/(m²·K)

No bars; or attached bars	**1.42**
Single cross bar in IGU	**1.5**
Multiple cross bar in IGU	**1.6**
Glazing bar (Georgian bar)	**1.8**

Air Leakage loss:

Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - ***2DP***			**0.10**	m³/(m·h)
Opening light length, $l_{opening}$	6.2220	m	Total air leakage	0.622 m³/h
L_{50}	0.34	m³/(m²·h)	Heat loss = 0.0165 L_{50}	0.01 W/(m²·K)

Energy Window
Energy Index

5

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}) =	**5.14**
Climate zone is:	**UK**

Thermal transmittance, W/(m²·K)	U_{window}	**1.4**
Solar factor	g_{window}	**0.47**
Window air leakage heat loss, W/(m²·K)	L_{factor}	**0.01**

BFRC Certified Simulator No **S166**

Simulator Name: **Sue Peatey**

BFRC
Proven Performance.

6 BS EN 673 Spreadsheet

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

Number of spaces
1

Help

Spaces 1

Glazing orientation		
	Vertical	
Resistivity panes	1	m·K/W

Outside

	Pane 1	90%	Pane 2
Calculate		Gas	
		Argon	
Thickness (mm)	4.0	16	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
	$W/(m^2 \cdot K)$	$(m^2 \cdot K)/W$	W/(mK)	
1	1.195	0.65864	0.0243	15
2	1.195	0.65864	0.0243	15

7 Conductivity of Spacer

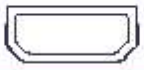
April 2013 – No. W19 – Revision index 5-06/2023 – valid until June 30th, 2025 'WARM EDGE' WORKING PARTY

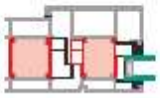
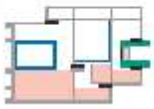
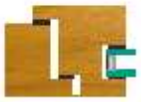
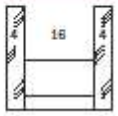
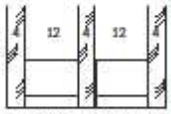
Data sheet Psi values for windows

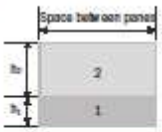
based on determination of the equivalent thermal conductivity of spacers by measurement

SWISSPACER

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

Profile description	Product name	Spacer height h in mm	Material	Thickness d in mm
	ULTIMATE SWISSPACER 	6.5 Spacer category C	Metallized multilayer polyester film "High Tech Gas Barrier Foil"/ SAN-GF	~ 0.05 1.0

Representative glass constructions	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

Two Dia model Characteristic values	Space between panes in mm	$\lambda_{eq,2D}$ 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-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

8 G-Value Data

Calumen

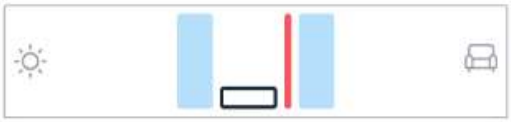
SAINT-GOBAIN

4 DIAMANT (16 Argon 90) 4

PLANITHERM TOTAL+ FG #3

Computed by: **Sue Peatey** Computed on: **07/08/2023** Location: **United Kingdom**

Glazing type



Glazing 1
DIAMANT (4mm) - Annealed
Cavity 1
Argon 90% 16 mm
Glazing 2
PLANITHERM TOTAL+ FG
PLANICLEAR (4mm) - Annealed

Simulated performance datas

Luminous Factors	**CIE (15-2004)**
Light Transmittance (TL)	80%
Outdoor Reflectance (RLe)	13%
Indoor Reflectance (RLi)	13%
Energy Factors	**EN410 (2011-04)**
Transmittance (TE)	63%
Outdoor Reflectance (Ree)	23%
Indoor Reflectance (Rei)	21%
Absorptance A1 (AE1)	3%
Absorptance A2 (AE2)	11%
Solar Factors	**EN410 (2011-04)**
Solar Factor (g)	0.73
Shading Coefficient (SC)	0.83
Thermal Transmission (Ug)	**EN673-2011**
Ug	1.2 W/(m2.K)
Angle relative to the vertical	0°
Acoustics	**EN 12758**
Acoustic values according to EN 12758 and from notified body	
Rw	31 (-1; -4) dB
STC (ASTM E413)	N/A
OITC (ASTM E1332)	N/A
Color Rendering	**CIE (15-2004)**
Transmission (Ra)	99.1
Reflection (Ra)	90.4
Safety Class	**EN 12600**
Pendulum Body Resistance	NPD
Anti-Burglary	**EN 356**
Burglar Resistance	NPD
Manufacturing Sizes	
Nominal Thickness	24.0 mm
Weight	20 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 (kg CO_2 eq./m²) European average	34

Verified Results EN 410 EN 673

Calumen® calculates the photometric characteristics and thermal transmission of glass using calculation algorithms which comply with the following standards: the European standards EN 410 and EN 673, the international standard ISO9050, the Japanese standard JIS R 3106/3107 and the Korean standard KS L 2514/2525. The functional output and calculation rules of Calumen® for standards EN 410 and EN 673 have been validated by TÜV Rheinland (report 8921215349). The technical performances obtained according to these standards are provided for information only and are subject to amendment.
Only the values entered in the performance declaration available on the CE marking site of Saint-Gobain Glass are official.
The sound absorption indices are measured under laboratory conditions according to the standards EN ISO 10140 and EN 12758. The calculated indices are provided for information only. The accuracy for the index lies within a range of +/-2dB. The glass thickness calculations comply with the 2012 version of the DTU39-P4 description. The USER is responsible for ensuring that the correct calculation hypotheses are entered and the DTU39 is applied appropriately for the project concerned.

9 Copy of Air Leakage Test Evidence

6. Test Results

6.1 Lab Conditions

The conditions measured inside the laboratory were as follows:

Temperature (°C)	Humidity (%RH)	Atmospheric Pressure (kPa)
21.1	47.4	100.1

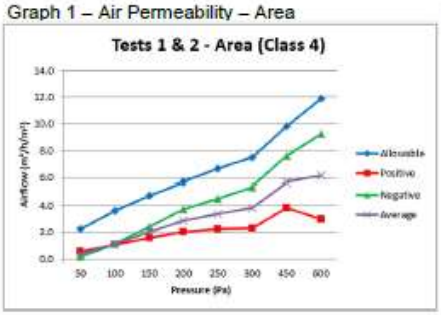
6.2 Air Permeability

Calculated area of test sample 1.54 m²
Measured length of opening joints 6.00 m

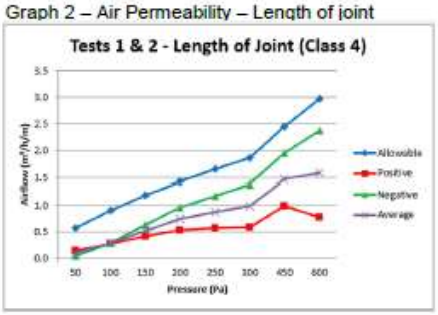
6.2.1 Initial Air Permeability Tests 1 & 2

Pressure Differential Pa	Air Permeability Rate Infiltration & Exfiltration Tests m³/hr/m² - Area			Air Permeability Rate Infiltration & Exfiltration Tests m³/hr/m - Length of Joint		
	Test No. 1	Test No. 2	Average	Test No. 1	Test No. 2	Average
50	0.57	0.19	0.38	0.15	0.05	0.10
100	1.09	1.15	1.12	0.28	0.30	0.29
150	1.60	2.43	2.01	0.41	0.62	0.52
200	2.04	3.70	2.87	0.53	0.95	0.74
250	2.23	4.53	3.38	0.57	1.17	0.87
300	2.30	5.36	3.83	0.59	1.38	0.98
450	3.83	7.60	5.72	0.98	1.95	1.47
600	3.00	9.26	6.13	0.77	2.38	1.58

Graph 1 – Air Permeability – Area



Graph 2 – Air Permeability – Length of joint



UKAS TESTING 5772

BFRC Proven Performance.

10 Thermal Conductivity Values Test Evidence - Accoya

Evidence of Performance
Thermal conductivity

Test Report
Nr. 10-000788-PR01
(PB-K23-06-en-01)

ift ROSENHEIM

Client	Titan Wood B.V. PO Box 2147 Westervoortsedijk 73 6802 Arnhem Netherlands
Product / Construction	Modified wood - product
Designation	ACCOYA® HOLZ
Material	Pinus radiata, modified by acetylation
Thickness	30 mm
Density	514.4 kg/m³ (average) 495 - 541 kg/m³ (range)
Conditioning	23 °C / 50 % rh up to constant mass (0.1 % / 24 h)
Special features	--

Thermal conductivity (declared value)

$\lambda_D = 0.120$ W/(m · K)*

*determined at mean temperature of 10 °C

ift Rosenheim
07. November 2011

Dr. Joachim Hessinger, Dipl.-Phys.
Head of Testing Department
Building Physics

Konrad Huber, Dipl.-Ing. (FH)
Assistant Head of Testing Department
Building Physics

Basis

EN 12664: 2001
Building materials - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Dry and moist products of medium and low thermal resistance

EN ISO 10456: 2008
Building materials and products - Hygrothermal properties - Tabulated design values and procedures for determining declared and design thermal values

Instructions for use

This test report serves to demonstrate the declared value of the equivalent thermal conductivity λ_D. The declared value can be used within the calculation acc. to prEN ISO 10077-2: 2011.

The declared value acc. to EN ISO 10456 doesn't represent the design value acc. to DIN V 4108-4. The determination of the design value has to take into account the national regulations.

Validity

The data and results given relate solely to the tested and described specimen.

Testing for thermal conductivity λ does not allow any statement to be made on any further characteristics relevant to performance and quality of the present construction.

Notes on publication

The ift Guidance Sheet "Conditions and Guidance for the Use of ift Test Documents" applies.

The cover sheet can be used as abstract.

Contents

The report compromises a total of 15 pages

Vs-PrüNr-1494-de / 06-08 / 384

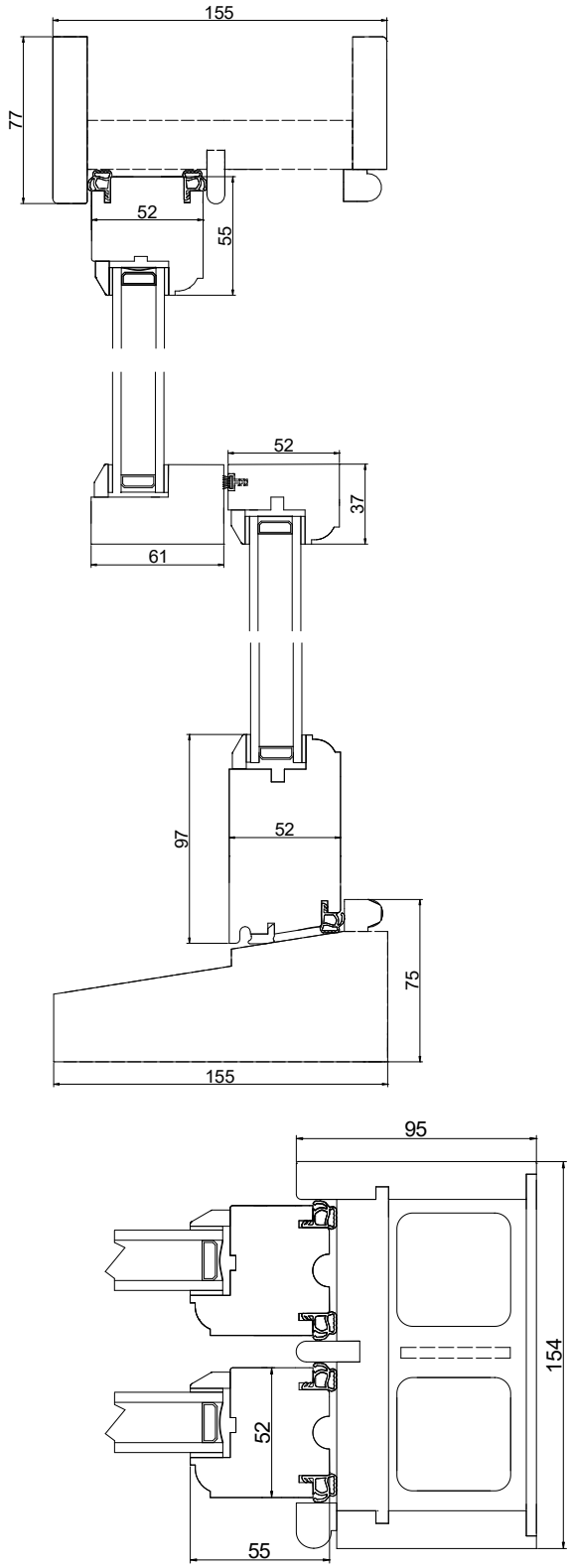
ift Rosenheim GmbH
Geschäftsführer:
Dipl.-Ing. (FH) Ulrich Sieberath
Dr. Jochen Peichl

Theodor-Gietl-Str. 7 - 9
D-83026 Rosenheim
Tel.: +49 (0)8031/261-0
Fax: +49 (0)8031/261-290
www.ift-rosenheim.de

Sitz: 83026 Rosenheim
AG Traunstein, HRB 14783
Sparkasse Rosenheim
Kto. 3822
BLZ 711 500 00

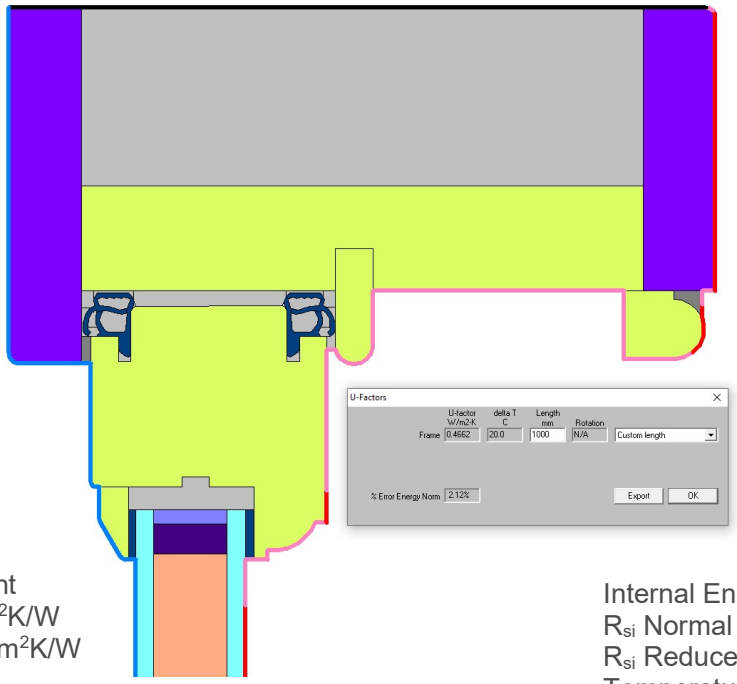
Notified Body Nr.: 0757
Anerkannte PÜZ-Stelle: BAY 18

Appendix 1 – Technical Drawings



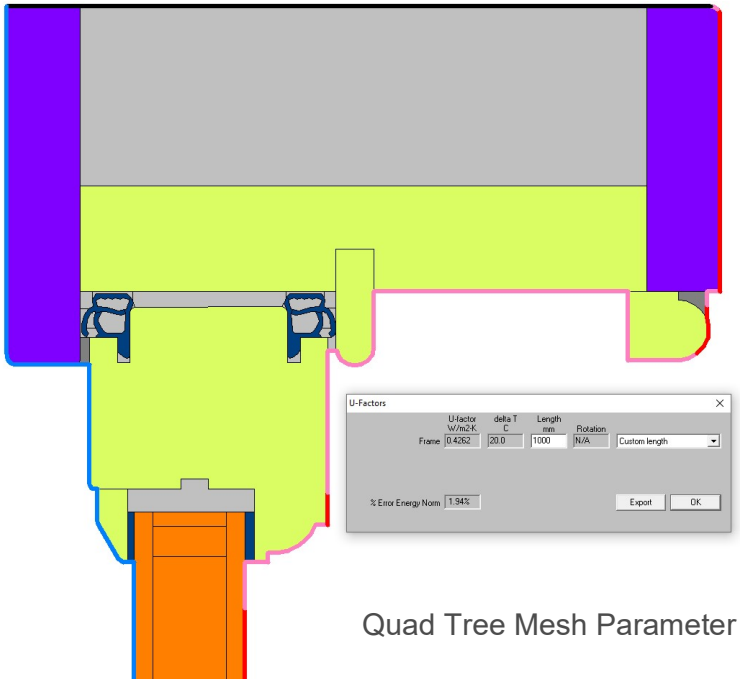
Appendix 2 – Simulations

1. Head profile



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

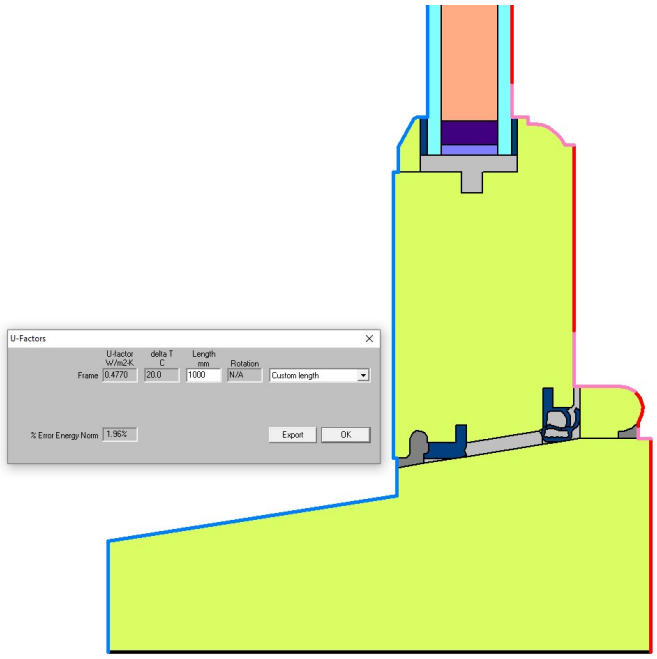
Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C



Quad Tree Mesh Parameter 9

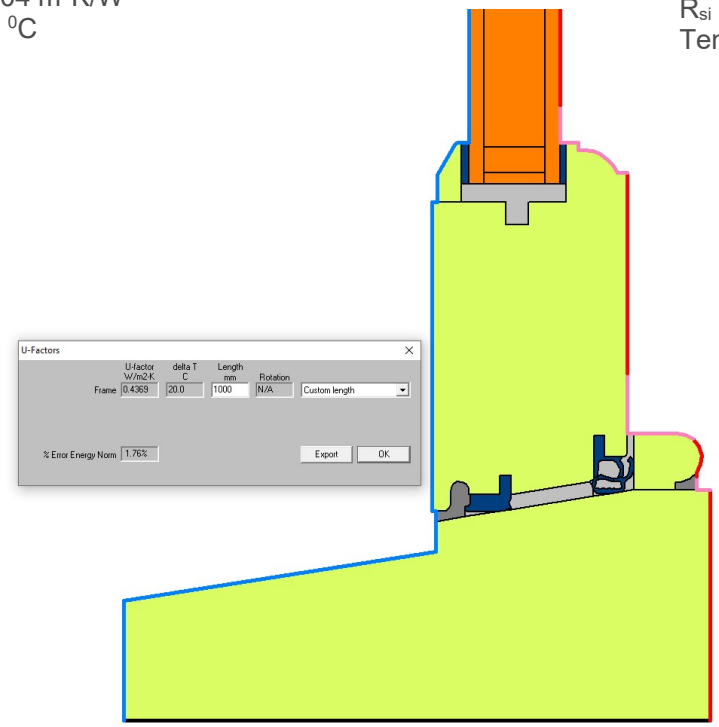
2. Sill profile.

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

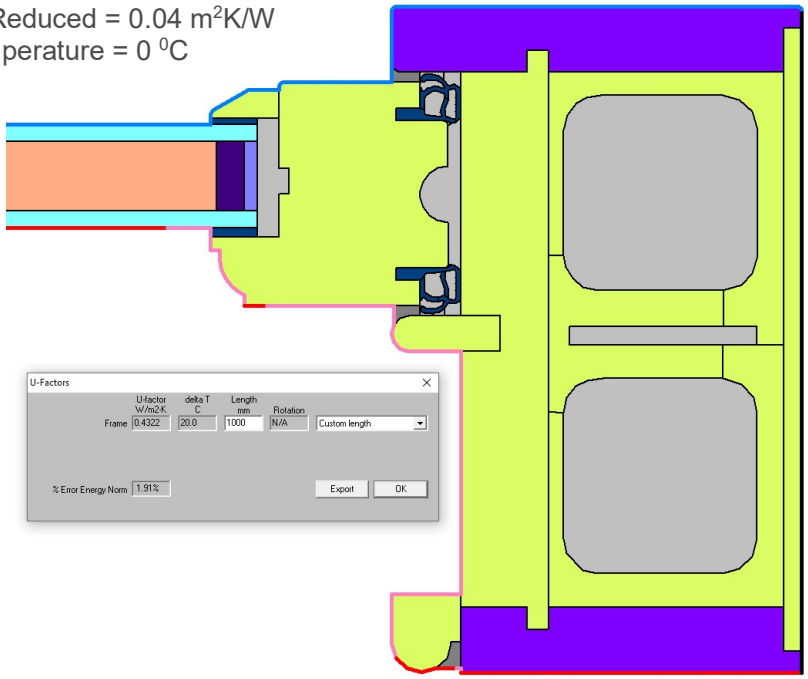
Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C

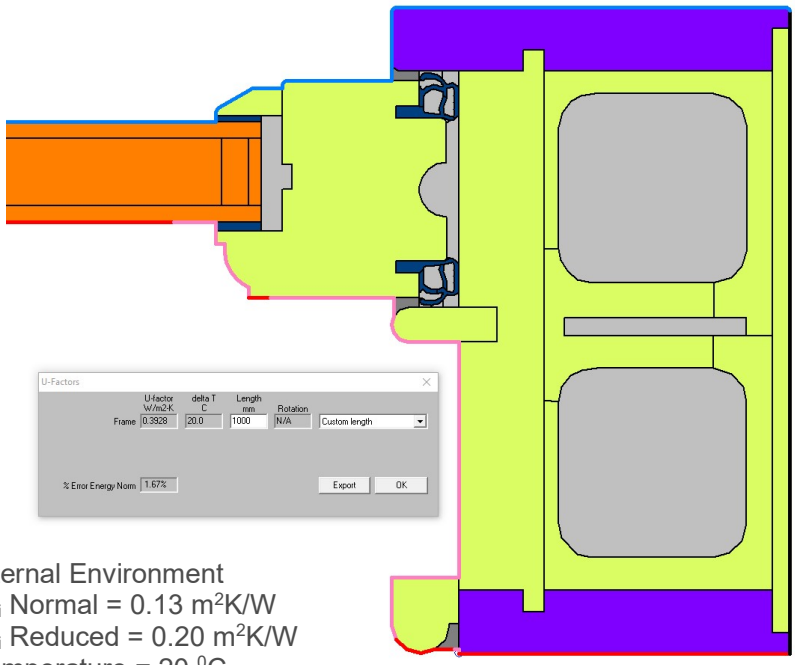


3. Upper Jamb profile.

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



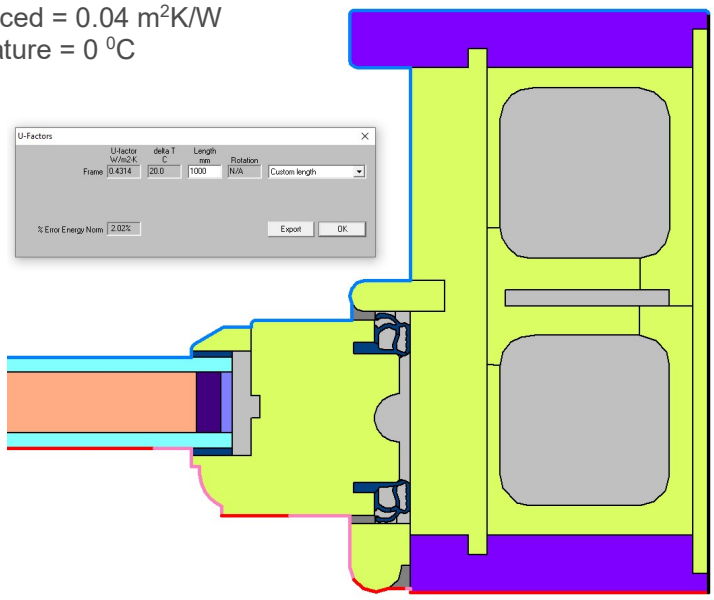


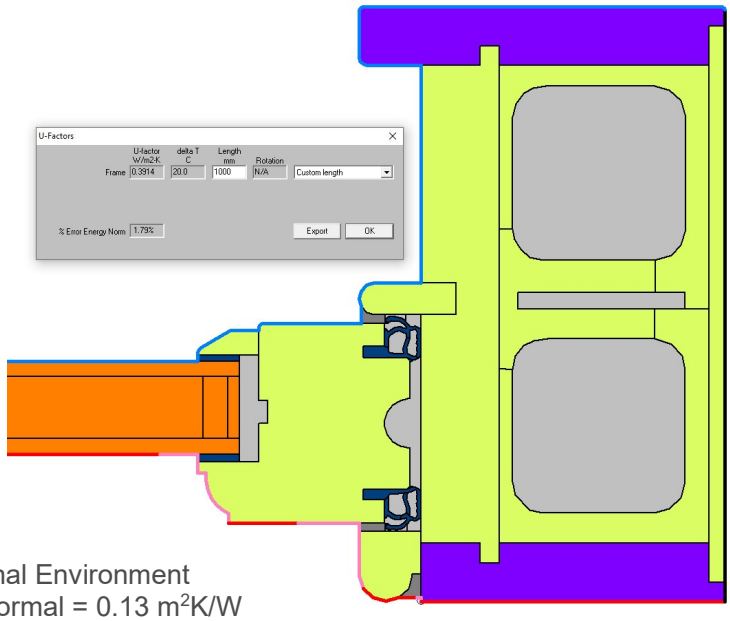
Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C

4. Lower Jamb profile.

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

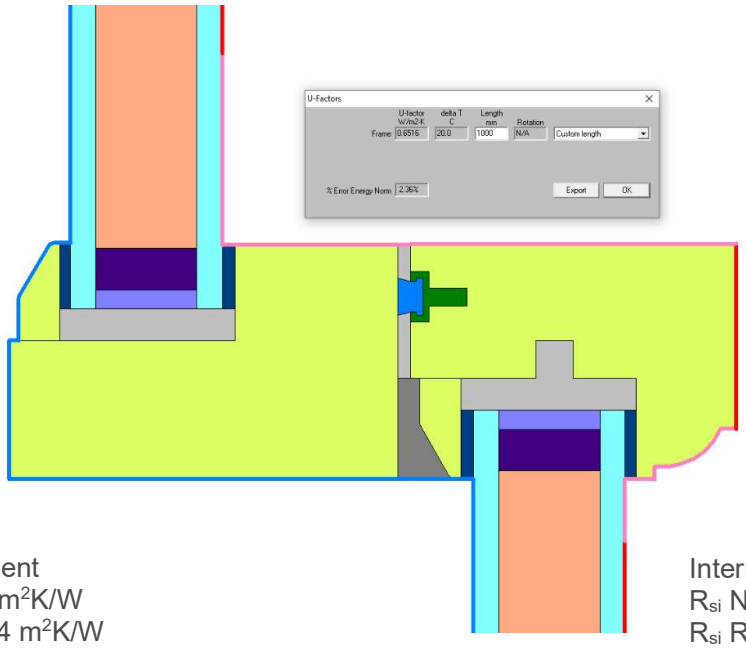




Internal Environment
R_{si} Normal = 0.13 m^2K/W
R_{si} Reduced = 0.20 m^2K/W
Temperature = 20 ^0C

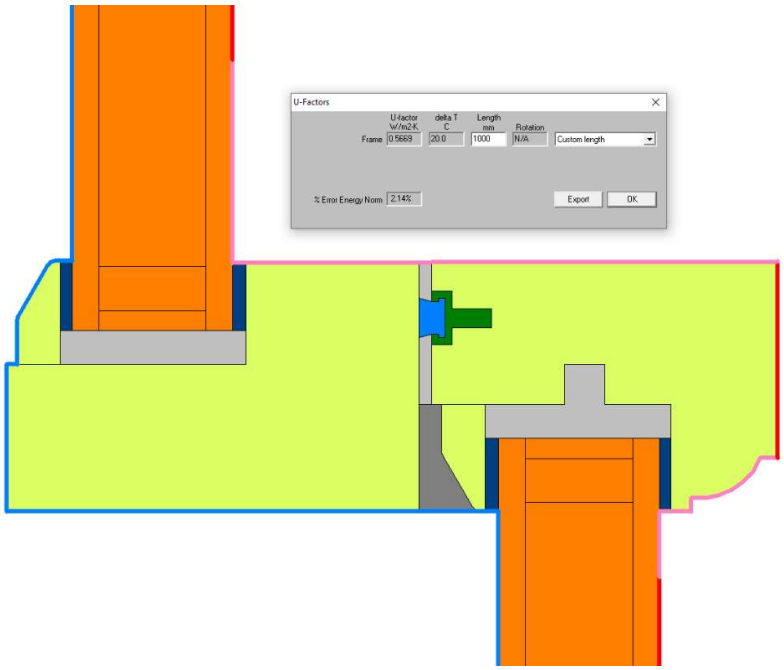
5. Meeting rail profile.

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

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



Key to Materials

	Material	Thermal Conductivity W/(m.K)	Source
	Accoya	0.12 (declared value)	IFT report 10-000788-PR01
	MDF (max density 800kg/m³)	0.18	BS EN 10456
	EPDM	0.25	Annex D of BS 10077-2
	Soda Lime Glass	1.0	Annex D of BS 10077-2
	Swisspacer Ultimate	0.14	BF Datasheet W19
	Polysulfide / Polyurethane	0.40	Annex D of BS 10077-2
	Mohair	0.14	Annex D of BS 10077-2