

Report in Accordance with BFRC Guidelines and Regulations

Product description: “The Sash Window Workshop Accoya Spiral Sash Window”

CONFIDENTIAL

Client:	The Sash Window Workshop Ltd Unit 4 Kiln Lane Bracknell Berkshire RG12 1NA
Project:	Accoya Spiral Sash
Project reference:	CU14332-8
Prepared By:	Richard Bate Technical Director
Issue date:	27 April 2015

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Approved Simulator 001

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1 Introduction

The U-value calculations of The Sash Window Workshop Accoya spiral sash window detailed below were commissioned by Peter Smith of The Sash Window Workshop.

2 Validation of Program

The Therm 5.2 analysis software has been validated against proofs in Annex D (D1 to D10) of BS EN ISO 10077-2:2012.

3 Analysis Method

The frame profile results detailed below are provided by computer simulation using LBL software program THERM 5.2 and BFRC guidelines and regulations.

4 Summary of Results

A summary of results are detailed in the following sections. The details supplied for the analysis as well as all information required to verify the analysis can be found in the attached CD.

4.1 Frame thermal transmittance (following the principles of BS EN ISO 10077-2)

SWW Accoya Spiral Sash Frame Profile	Frame Thermal Transmittance (U_f)
Head	1.5 W/(m ² ·K)
Upper Jamb	1.5 W/(m ² ·K)
Mid Rail	3.9 W/(m ² ·K)
Lower Jamb	1.5 W/(m ² ·K)
Cill	1.5 W/(m ² ·K)

4.2 Linear thermal transmittance (following the principles of BS EN ISO 10077-2)

SWW Accoya Spiral Sash Frame Profile	Linear Thermal Transmittance (ψ)
Head	0.042W/(m·K)
Upper Jamb	0.042 W/(m·K)
Mid Rail	0.093 W/(m·K)
Lower Jamb	0.042 W/(m·K)
Cill	0.042 W/(m·K)

4.3 Centre pane U-Value of glazing calculated in accordance with BS EN 673.

Glazing Unit	Centre Pane U-value (U_g)
4-10-4 Low-E 0.05 uncorrected emissivity (St Gobain Planitherm Total+), 90% krypton 10% air filled, low iron outer pane (St Gobain Diamant) glazing unit with Edgetech Superspacer Premium spacer bar with 5mm hot melt butyl secondary seal.	1.1 W/(m ² ·K)

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4.4 The thermal performance of the windows (Uw) in accordance with BFRC guidelines and regulations:

SWW Accoya Spiral Sash Frame Profile	Window U-Value
Timber frame system with 4-10-4 Low-E 0.05 uncorrected emissivity (St Gobain Planitherm Total+), 90% krypton 10% air filled, low iron outer pane (St Gobain Diamant) glazing unit with Edgetech Superspacer Premium spacer bar with 5mm hot melt butyl secondary seal.	1.4 W/(m ² ·K)

4.5 The Effective L₅₀ in accordance with BFRC guidelines and regulations:

SWW Accoya Spiral Sash Frame Profile	Effective L ₅₀
Air permeability at 50 pa	0.00 W/(m ² ·K)

4.6 Total solar energy transmittance (g) in accordance with EN 410

SWW Accoya Spiral Sash Frame Profile	g _{window}
Timber frame system with 4-10-4 Low-E 0.05 uncorrected emissivity (St Gobain Planitherm Total+), 90% krypton 10% air filled, low iron outer pane (St Gobain Diamant) glazing unit with Edgetech Superspacer Premium spacer bar with 5mm hot melt butyl secondary seal.	0.48


5.0 BFRC Rating

5.1 SWW Accoya Spiral Sash window system

SWW Accoya Spiral Sash Frame Profile	Rating
Timber frame system with 4-10-4 Low-E 0.05 uncorrected emissivity (St Gobain Planitherm Total+), 90% krypton 10% air filled, low iron outer pane (St Gobain Diamant) glazing unit with Edgetech Superspacer Premium spacer bar with 5mm hot melt butyl secondary seal.	+6 (Rating Scale A)

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6.0 Authorisation

	Prepared by:
Signature:	
Name:	Richard Bate
Title:	Technical Director

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Technical Specification

Profiles		Ref. No.	Material Type/Manufacturer's Name & Density (Timber only)	Dimensions (Height & Width)
Outer Frame	Head & jambs	N/A	Accoya - Sash Window Workshop	50mm x 150mm
	Cill	N/A	Accoya – Sash Window Workshop	65mm x 150mm
Sash	Head & jambs	N/A	Accoya – Sash Window Workshop	55mm x 48mm
	Cill	N/A	Accoya – Sash Window Workshop	102mm x 46mm
Mid Rail	Upper Sash	N/A	Accoya – Sash Window Workshop	35mm x 59.5mm
	Lower Sash	N/A	Accoya – Sash Window Workshop	35mm x 48mm
Staff Bead		N/A	Accoya – Sash Window Workshop	15mm x 20mm
Parting Bead		N/A	Accoya – Sash Window Workshop	24mm x 8.5mm
Glazing Bead		N/A	Accoya – Sash Window Workshop	15mm x 6mm

Weather Seals		Ref. No.	Material Type/ Manufacturer's Name
Glazing Bead		N/A	Silicone sealant
Glazing Rebate		N/A	Silicone sealant
Perimeter seal	Outer frame	WS29	Schlegel Q-Lon seal
	Parting bead	WS29	Schlegel Q-Lon seal
	Staff bead	WS28	Schlegel Q-Lon seal
Meeting edge		WS28	Schlegel Q-Lon seal
Lower sash bottom rail		WS28	Schlegel Q-Lon seal

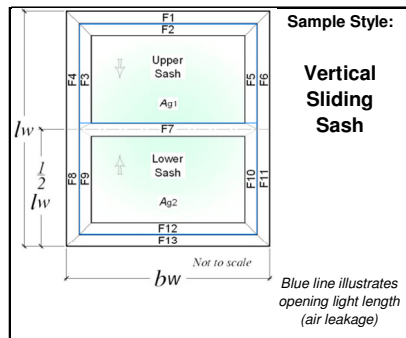
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Glazing Component	Specification
Overall sealed unit: 1. Thickness (mm)	1. 18mm
Outer pane 1. Thickness (mm) 2. Manufacturer 3. Description	1. 4mm 2. St Gobain 3. Diamant
Inner pane: 1. Thickness 2. Manufacturer 3. Description	1. 4mm 2. St Gobain 3. Planitherm Total+
Spacer bar: 1. Manufacturer 2. Description	1. Edgetech 2. Superspacer Premium
Cavity 1. Distance (mm) 2. Gas %	1. 10mm 2. Krypton 90% Air 10%
Edge seal 1. Manufacturer 2. Description	1. N/A 2. 5.3mm Hot Melt Butyl

Additional Notes
<p>Air leakage data is taken from Build Check Ltd Test report ref. W10176-2 dated 30 June 2010 (data at 50Pa pressure = 0.02 m³/h/m).</p> <p>Solar heat gain figures are calculated from g-values supplied by the product manufacturer from EN 410 calculations for the glass units used in this simulation. The value used is 0.75.</p>

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BFRC Spreadsheet



Report Number: **U14332-7** Report Issue No.15.1 (11/03/13)
Report Date: **31/03/2015**

Project Details: **Accoya box sash - Total+, Diamant, Superspacer Premium, Krypton**

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

Parameter	Symbol	Units
Total window height ODP	I_w	1480 mm
Total window width ODP	b_w	1230 mm

Frame offset: **No**

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

Glazing dimensions and properties:

Thickness of pane 1, d_{p1}	4.0	mm
Glazing fill thickness 1/2, d_{g1}	10.0	mm
Gas fill (1/2)	Krypton 90%	
Thickness of pane 2, d_{p2}	4.0	mm
Complete next 3 cells for TG IGU		
Glazing fill thickness 2/2, d_{g2}		mm
Gas fill (2/3)		
Thickness of pane 3, d_{p3}		mm
Glazing Trans. - 3DP	U_g	1.120 W/(m ² ·K)
g-value - 2DP	g_{\perp}	0.75

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

Window Dimensions:

Section	Length, l		Width, b		Area, A	
	m	m	No gasket m ²	With gasket m ²		
Upper glazing	0.5655	0.9160	0.5180	0.5127		
Lower glazing	0.5575	0.9160	0.5107	0.5061		
Total of glazing			1.0287	1.0188		
Frame	m	m	m ²	m ²		
F1	1.2300	0.1150	0.1282	0.1282		
F2	1.0000	0.0420	0.0402	0.0419		
F3	0.6250	0.0420	0.0250	0.0260		
F4	0.7400	0.1150	0.0785	0.0785		
F5	0.6250	0.0420	0.0250	0.0260		
F6	0.7400	0.1150	0.0785	0.0785		
F7	1.0000	0.0350	0.0335	0.0368		
F8	0.7400	0.1150	0.0805	0.0805		
F9	0.6600	0.0420	0.0256	0.0266		
F10	0.6600	0.0420	0.0256	0.0266		
F11	0.7400	0.1150	0.0805	0.0805		
F12	1.0000	0.0850	0.0814	0.0823		
F13	1.2300	0.0800	0.0892	0.0892		
Total Frame			0.7917	0.8016		
Total Window, A_w			1.8204	1.8204		
Percentage upper glass area			28.46%	28.16%		
Percentage lower glass area			28.05%	27.80%		
Percentage glass area (total)			56.51%	55.96%		

Solar Factor, g-value:

glazing area A_g (m ²)	1.2832
F_w	0.9
g_w	0.48

U_{window} W/(m²·K)

No bars; or attached bars	1.47
Single cross bar in IGU	1.6
Multiple cross bar in IGU	1.7
Glazing bar (Georgian bar)	1.9

BFRC Rating kWh/(m ² ·yr)	Label index	EWER Rating Scale	Window Rating
≥10	4	A+	A
0 to <10		A	
-10 to <0		B	
-20 to <-10		C	
-30 to <-20		D	
-50 to <-30		E	
-70 to <-50	F		

Frame dimensions (All frame values to ODP, gaskets to 1DP)	Frame height, b_f (mm)		Gasket protrusion (mm)	With gasket (mm)	Total
	Internal	External			
F1 fixed top rail	115	115	n/a	115.0	158.8
F2 moving top rail	42	42	1.8	43.8	
F3 top (LH) jamb (moving sash)	42	42	1.8	43.8	158.8
F4 top (LH) jamb (fixed frame)	115	115	n/a	115.0	
F5 top (RH) jamb (moving sash)	42	42	1.8	43.8	158.8
F6 top (RH) jamb (fixed frame)	115	115	n/a	115.0	
F7 mid rail (upper)	35		1.8	38.6	38.6
(lower)			1.8		
F8 bottom (LH) jamb (fixed frame)	115	115	n/a	115.0	158.8
F9 bottom (LH) jamb (moving sash)	42	42	1.8	43.8	
F10 bottom (RH) jamb (moving sash)	42	42	1.8	43.8	158.8
F11 bottom (RH) jamb (fixed frame)	115	115	n/a	115.0	
F12 bottom moving rail	85		1.0	86.0	166.0
F13 bottom fixed rail	80		n/a	80.0	
Total gasket area			0.00988216	m ²	

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

Frame conductance:

Section	All L values to 4DP . All b values to ODP		L_{ψ}^{2D}	b_g (mm)
	$W/(m^2 \cdot K)$	b_g (mm)		
F1+F2 top rail	0.5491	190	0.6582	190
F3+F4 top (LH) jamb	0.4990	190		0.4754
F5+F6 top (RH) jamb	0.4990	190		0.4754 190
F7 mid rail	0.6956	380		380
F8+F9 bottom (LH) jamb	0.5006	190		0.4774 190
F10+F11 bottom (RH) jamb	0.5006	190		0.4774 190
F12+F13 bottom rail	0.5284	190		0.5060 190

Frame:

Section	Frame width, b_f (m)	Frame U-value, U_f (W/(m ² ·K))	Frame area, A_f (m ²)	Frame heat flow, HU (W/K)	Linear trans, ψ (W/(m·K))	Linear length, l_{ψ} (m)	Junction heat flow, H_{ψ} (W/K)
F1+F2 top rail	0.1570	1.7289	0.1685	0.2913	0.0416	0.9160	0.0381
F3+F4 top left jamb	0.1570	1.4098	0.1035	0.1459	0.0413	0.5655	0.0233
F5+F6 top right jamb	0.1570	1.4098	0.1035	0.1459	0.0413	0.5655	0.0233
F7 mid rail	0.0350	4.0079	0.0335	0.1344	0.0923	0.9160	0.0846
F8+F9 btm left jamb	0.1570	1.4200	0.1061	0.1506	0.0417	0.5575	0.0232
F10+F11 btm right jamb	0.1570	1.4200	0.1061	0.1506	0.0417	0.5575	0.0232
F12+F13 bottom rail	0.1650	1.5196	0.1706	0.2593	0.0425	0.9160	0.0389
Totals		0.7917	1.2780			Total	0.2547

Air Leakage loss:

Air leakage at 50 Pa per hour & per unit length of opening light (BS 6375-1) - **2DP**

Opening light length, $l_{opening}$	6.2100 m	Total air leakage	0.124 m ³ /h
L_{50}	0.07 m ³ /(m ² ·h)	Heat loss = 0.0165 L_{50}	0.00 W/(m ² ·K)

Other parameters needed for calculation, taken from simulations:

$\lambda_p = 0.035$ W/(m·K)	$R_{sp} = 0.04$ m ² ·K/W	$d_p = d_g = 0.018$ m
$R_p = 0.5143$ m ² ·K/W	$R_{rot} = 0.6843$ m ² ·K/W	$R_{sg} = 0.13$ m ² ·K/W
		$U_p = 1.4614$ W/(m ² ·K)

BFRC Rating =

218.6g_{window} - 68.5 x (U_{window} + Effective L₅₀) = 4.23

Climate zone is: UK

Thermal transmittance, W/(m ² ·K)	U_{window}	1.5
Solar factor	g_{window}	0.48
Window air leakage heat loss, W/(m ² ·K)	L_{factor}	0.00



Simulator Name: **Richard Bate** BFRC Certified Simulator **001**

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BS EN 673 Spreadsheet

Version 11 23/10/2012. Calculations according to BS EN 673:2011

Number of spaces	Help																					
1																						
Spaces 1																						
Glazing orientation	Vertical																					
Resistivity panes	1	m·K/W																				
Outside																						
<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 5px;">Emissivities</div> <div style="border: 1px solid black; padding: 5px;">Calculate</div> </div>																						
<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td rowspan="2" style="writing-mode: vertical-rl; transform: rotate(180deg);">P a n e 1</td> <td style="text-align: center;">90%</td> <td rowspan="2" style="writing-mode: vertical-rl; transform: rotate(180deg);">P a n e 2</td> </tr> <tr> <td style="text-align: center;">Gas Krypton</td> </tr> <tr> <td>Thickness (mm)</td> <td>4.0</td> <td>10</td> <td>4.0</td> </tr> <tr> <td>Normal emissivity</td> <td>0.89</td> <td>0.05</td> <td></td> </tr> <tr> <td>$\sum d_j r_j =$</td> <td colspan="3">0.008</td> </tr> <tr> <td></td> <td colspan="3" style="text-align: center;">Uncoated</td> </tr> </table>			P a n e 1	90%	P a n e 2	Gas Krypton	Thickness (mm)	4.0	10	4.0	Normal emissivity	0.89	0.05		$\sum d_j r_j =$	0.008				Uncoated		
P a n e 1	90%	P a n e 2																				
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Normal emissivity	0.89	0.05																				
$\sum d_j r_j =$	0.008																					
	Uncoated																					

For uncoated surfaces input 0.89 for normal emissivity, which corresponds to a corrected emissivity of 0.83.

Iteration number	U value	$\sum 1/h_s$	λ_{eff}	ΔT
	W/(m ² ·K)	(m ² ·K)/W		
1	1.120	0.71474	0.0140	15
2	1.120	0.71474	0.0140	15

Thermal Conductivity Values Used

Material/Conductivity W/(m.K)	Reference
PVCu / 0.17	(Annex A BS EN ISO 10077-2)
Accoya / 0.12	(IFT Rosenheim report 10-000788-PR01)
Silicone / 0.35	(Annex A BS EN ISO 10077-2)
Soda Lime Glass / 1.0	(Annex A BS EN ISO 10077-2)
Hot Melt Butyl / 0.24	(Annex A BS EN ISO 10077-2)
Superspacer Premium / 0.15	(BF Website)
Elastomeric Foam / 0.05	(Annex A BS EN ISO 10077-2)

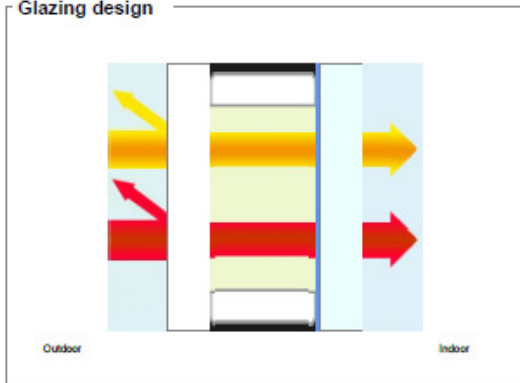
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G Value Source

Calumen® II 1.3.1
26 March 2015
Data base : SGG UK



Glazing design



	First glazing	Second glazing
Gas		Krypton 92% 10.00mm
Coating		PLANITHERM TOTAL+
First glass	DIAMANT 4.00mm	PLANICLEAR 4.00mm
Coating		
Layer		
Coating		
Second glass		
Coating		

Manufacturing sizes

Nominal thickness : 18.0 mm
Weight : 20.0 kg/m²

Luminous factors (EN410-2011) : (D65 2°)

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 : 1.1 W/(m².K)



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CALLUMEN® II is a simulation software to calculate key performance of glass such as light transmission, solar factor or thermal insulation coefficient. Computed values are indicative and subject to change. They can not be used to guarantee performance of the products.

These values are calculated according to EN410-2011 and EN673-2011 standards. Tolerances are defined according to EN 1096-4 or ISO9050-2003 standards. Nevertheless, user must check the feasibility of the associated products, in particular in terms of thickness and colour. Furthermore, it is his responsibility to check that the resulting combination of glazing meets regulatory requirements at national, local or regional level.

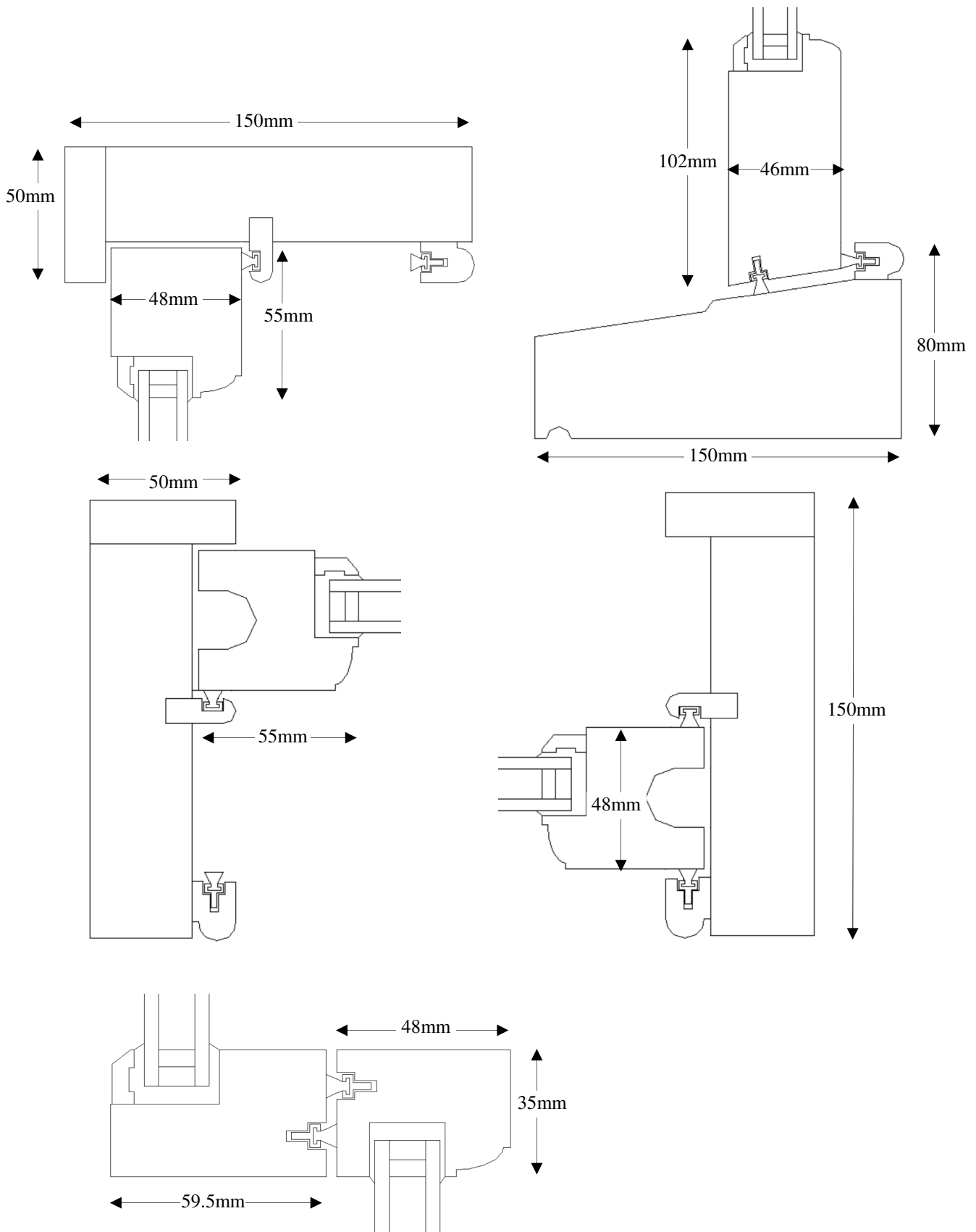
Calculation rules and functional output of Calumen II have been validated by TÜV Rheinland Quality Report 11923R-11-33705



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Appendix

Profile Drawings



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